Standards and Recommended Practices

Proposed SMPTE Standards

Published here for information are three Proposed SMPTE Standards:

SMPTE 347M, Television—540 Mb/s Serial Digital Interface—Source Image Format Mapping

SMPTE 349M, Television—Transport of Alternate Source Image Formats through SMPTE 292M

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

SMPTE 347M is available from Society Headquarters for $34.00; SMPTE 349M for $28.00, and SMPTE 352M for $26.00.

Approved SMPTE Standards

Two SMPTE Standards were recently approved by the Society:

SMPTE 355M-2001, Television—Format for Non-PCM Audio and Data in AES3—KLV Data Type

SMPTE 358M-2001, Television—Four-Circuit Fiber Optic Connector

Available from Headquarters, SMPTE 355M is $24.00 and SMPTE 358M is $22.00.

—Carlos V. Girod, Jr., P.E.,
Director of Engineering

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PROPOSED SMPTE STANDARD

for Television — 540 Mb/s Serial Digital Interface — Source Image Format Mapping

1 Scope

This standard species the mapping of various source image formats onto the 540 Mb/s serial digital interface. These formats include single link 4:4:4:4 component digital signals (525i/59.94 and 625i/50) as well as progressive scan 4:2:2 component digital signals (525p/59.94 and 625p/50). Additional source image formats may be added in future revisions of this standard.

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:

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

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

3 Source image format parameters

3.1 Source image format parameters are defined in table 1.

3.2 G, B, R, Y, C_B, C_R, and A components shall be prohibited from having the eight most significant bits all zeros or all ones. Any 10-bit G, B, R, Y, C_B, C_R, or A with values 000_h-003_h shall be remapped to 004_h and values $3FC_h$-$3FF_h$ shall be remapped to $3FB_h$.

Table 1 – Source image format parameters

	Nomenclature	Total lines per frame	Frame rate	Fields per frame	Active lines per frame	Samples per total line (each component)	Samples per active line (each component)	Reference standard
1	Single link 4:4:4:4 525i/59.94	525	30/1.001	2	483	858	720	SMPTE RP 174
2	Single link 4:4:4:4 625i/50	625	25	2	576	864	720	ITU-R BT.799
3	Single link 4:2:2P 525p/59.94	525	60/1.001	1	483	858	720	SMPTE 293M
4	Single link 4:2:2P 625p/50	625	50	1	576	864	720	ITU-R BT.1358
5	Dual link 4:2:2P 525p/59.94	525	60/1.001	1	483	858	720	SMPTE 294M
6	Dual link 4:2:2P 625p/50	625	50	1	576	864	720	ITU-R BT.1362

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4 54-MHz parallel data stream

G, B, R, and A or Y, C_B, C_R, and A components shall be mulitplexed into 54-MHz parallel data streams as shown in figures 1 (for system 1), 3 (for system 2), 5 (for system 3), 7 (for system 4), 9 (for system 5), and 11 (for system 6).

5 Timing references signals

5.1 EAV and SAV timing references shall be inserted into the parallel data streams on a line-by-line basis as shown in figures 1 (for system 1), 3 (for system 2), 5 (for system 3), 7 (for system 4), 9 (for system 5), and 11 (for system 6).

5.2 EAV sequences shall comprise four consecutive 10-bit code words: $3FF_h$, 000_h, 000_h, and XYZ.

5.3 XYZ words shall be encoded as defined in clauses 5.3.1 through 5.3.6.

5.3.1 XYZ words for system 1 (single link 4:4:4:4 – 525i/59.94)

Words 2883 and 3431 of the 54-MHz parallel data stream (refer to figure 1) shall be encoded as shown in tables 2 and 3. Refer to figure 2 for spatial representation of H, V, and F bits.

Table 2 – XYZ words for system 1 (single link 4:4:4:4 – 525i/59.94)

Bit	Words 2883 and 3431	Description
9	1	Fixed
8	F	F=0 during field 1 F=1 during field 2
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	S	S=0 for GBR signals S=1 for Y, C_b, C_r signals
4	P4	See table 3
3	P3	See table 3
2	P2	See table 3
1	P1	See table 3
0	P0	See table 3

Table 3 – Protection state bits for system 1 (single link 4:4:4:4 – 525i/59.94)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	S	P4	P3	P2	P1	P0
	1	0	0	0	0	0	0	0	0	0
	1	0	0	0	1	0	1	1	1	0
	1	0	0	1	0	1	0	1	1	0
	1	0	0	1	1	1	1	0	0	0
	1	0	1	0	0	1	1	1	0	0
	1	0	1	0	1	1	0	0	1	0
	1	0	1	1	0	0	1	0	1	0
	1	0	1	1	1	0	0	1	0	0
	1	1	0	0	0	1	1	0	1	0
	1	1	0	0	1	1	0	1	0	0
	1	1	0	1	0	0	1	1	0	0
	1	1	0	1	1	0	0	0	1	0
	1	1	1	0	0	0	0	1	1	0
	1	1	1	0	1	0	1	0	0	0
	1	1	1	1	0	1	0	0	0	0
	1	1	1	1	1	1	1	1	1	0

5.3.2 XYZ words for system 2 (single link 4:4:4:4 – 625i/50)

Words 2883 and 3455 of the 54-MHz parallel data stream (refer to figure 3) shall be encoded as shown in tables 4 and 5. Refer to figure 4 for spatial representation of H, V, and F bits.

Table 4 – XYZ words for system 2 (single link 4:4:4:4 – 625i/50)

Bit	Words 2883 and 3455	Description
9	1	Fixed
8	F	F=0 during field 1 F=1 during field 2
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	S	S=0 for GBR signals S=1 for Y, C_b, C_r signals
4	P4	See table 5
3	P3	See table 5
2	P2	See table 5
1	P1	See table 5
0	P0	See table 5

Table 5 – Protection state bits for system 2 (single link 4:4:4:4 – 625i/50)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	S	P4	P3	P2	P1	P0
	1	0	0	0	0	0	0	0	0	0
	1	0	0	0	1	0	1	1	1	0
	1	0	0	1	0	1	0	1	1	0
	1	0	0	1	1	1	1	0	0	0
	1	0	1	0	0	1	1	1	0	0
	1	0	1	0	1	1	0	0	1	0
	1	0	1	1	0	0	1	0	1	0
	1	0	1	1	1	0	0	1	0	0
	1	1	0	0	0	1	1	0	1	0
	1	1	0	0	1	1	0	1	0	0
	1	1	0	1	0	0	1	1	0	0
	1	1	0	1	1	0	0	0	1	0
	1	1	1	0	0	0	0	1	1	0
	1	1	1	0	1	0	1	0	0	0
	1	1	1	1	0	1	0	0	0	0
	1	1	1	1	1	1	1	1	1	0

5.3.3 XYZ words for system 3 (single link 4:2:2P – 525p/59.94)

Words 1443 and 1715 of the 54-MHz parallel data stream (refer to figure 5) shall be encoded as shown in tables 6 and 7. Refer to figure 6 for spatial representation of H, V, and F bits.

Table 6 – XYZ words for system 3 (single link 4:2:2P – 525p/59.94)

Bit	Words 1443 and 1715	Description
9	1	Fixed
8	F=0	F=0 always
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	P3	See table 7
4	P2	See table 7
3	P1	See table 7
2	P0	See table 7
1	0	Fixed
0	0	Fixed

Table 7 – Protection state bits for system 3 (single link 4:2:2P – 525p/59.94)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	P3	P2	P1	P0		
	1	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	1	0	1	0	0
	1	0	1	0	1	0	1	1	0	0
	1	0	1	1	0	1	1	0	0	0

5.3.4 XYZ words for system 4 (single link 4:2:2P – 625p/50)

Words 1443 and 1727 of the 54-MHz parallel data stream (refer to figure 7) shall be encoded as shown in tables 8 and 9. Refer to figure 8 for spatial representation of H, V, and F bits.

Table 8 – XYZ words for system 4 (single link 4:2:2P – 625p/50)

Bit	Words 1443 and 1727	Description
9	1	Fixed
8	F=0	F=0 always
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	P3	See table 9
4	P2	See table 9
3	P1	See table 9
2	P0	See table 9
1	0	Fixed
0	0	Fixed

Table 9 – Protection state bits for system 4 (single link 4:2:2P – 625p/50)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	P3	P2	P1	P0		
	1	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	1	0	1	0	0
	1	0	1	0	1	0	1	1	0	0
	1	0	1	1	0	1	1	0	0	0

5.3.5 XYZ words for system 5 (dual link 4:2:2P – 525p/59.94)

Words 2883 and 3431 of the 54-MHz parallel data stream (refer to figure 9) shall be encoded as shown in tables 10 and 11. Refer to figure 10 for spatial representation of H, V, and F bits.

Table 10 – XYZ words for system 5 (dual link 4:2:2P – 525p/59.94)

Bit	Words 2883 and 3431	Description
9	1	Fixed
8	F	F=0 during field 1 F=1 during field 2
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	P3	See table 11
4	P2	See table 11
3	P1	See table 11
2	P0	See table 11
1	0	Fixed
0	0	Fixed

Table 11 – Protection state bits for system 5 (dual link 4:2:2P – 525p/59.94)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	P3	P2	P1	P0		
	1	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	1	0	1	0	0
	1	0	1	0	1	0	1	1	0	0
	1	0	1	1	0	1	1	0	0	0
	1	1	0	0	0	1	1	1	0	0
	1	1	0	1	1	0	1	0	0	0
	1	1	1	0	1	1	0	0	0	0
	1	1	1	1	0	0	0	1	0	0

5.3.6 XYZ words for system 6 (Dual link 4:2:2P – 625p/50)

Words 2883 and 3455 of the 54-MHz parallel data stream (refer to figure 11) shall be encoded as shown in tables 12 and 13. Refer to figure 12 for spatial representation of H, V, and F bits.

Table 12 – XYZ words for system 6 (dual link 4:2:2P – 625p/50)

Bit	Words 2883 and 3455	Description
9	1	Fixed
8	F	F=0 during field 1 F=1 during field 2
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	P3	See table 13
4	P2	See table 13
3	P1	See table 13
2	P0	See table 13
1	0	Fixed
0	0	Fixed

Table 13 – Protection state bits for system 6 (dual link 4:2:2P – 625p/50)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	P3	P2	P1	P0		
	1	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	1	0	1	0	0
	1	0	1	0	1	0	1	1	0	0
	1	0	1	1	0	1	1	0	0	0
	1	1	0	0	0	1	1	1	0	0
	1	1	0	1	1	0	1	0	0	0
	1	1	1	0	1	1	0	0	0	0
	1	1	1	1	0	0	0	1	0	0

6 Ancillary data

6.1 Ancillary data may be inserted in horizontal and vertical blanking intervals.

6.2 The ancillary data header shall consist of the three words 000_h, $3FF_h$, $3FF_h$ with formatting of the ancillary data packet defined in SMPTE 291M. Data values 000_h to 003_h and $3FC_h$ to $3FF_h$ are excluded from user ancillary data.

6.3 Ancillary data space is reserved for error detection and handling data formatted in accordance with SMPTE RP 165.

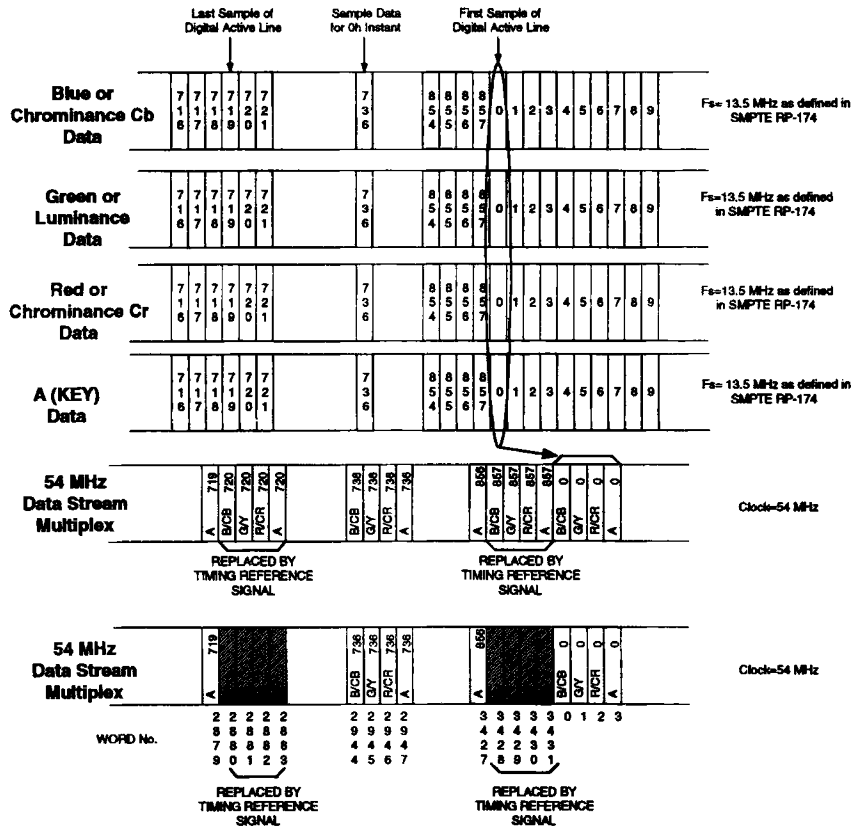

Figure 1 – Generation of 54-MHz parallel data stream for system 1 (single-link 4:4:4:4 — 525I/59.94)

SMPTE 347M

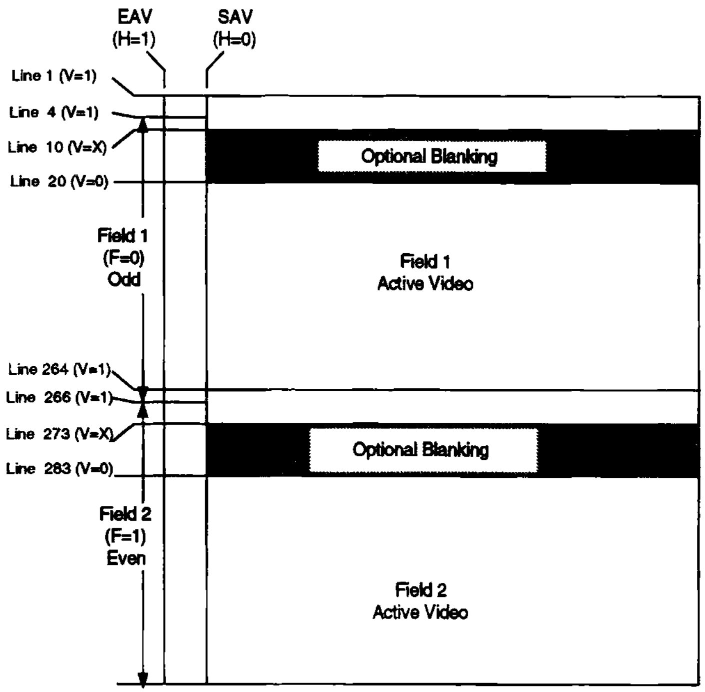

Figure 2 – Spatial representation of timing reference signals during video frame for system 1 (single-link 4:4:4:4 – 525I/59.94)

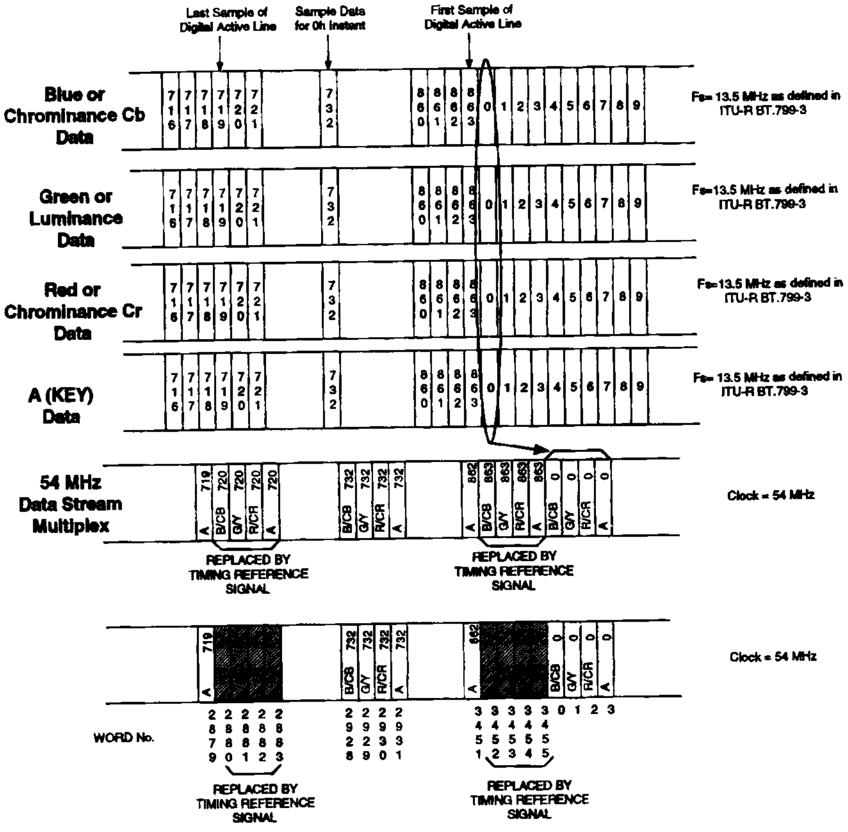

Figure 3 – Generation of 54-MHz parallel data stream for system 2 (single-link 4:4:4:4 – 625i/50)

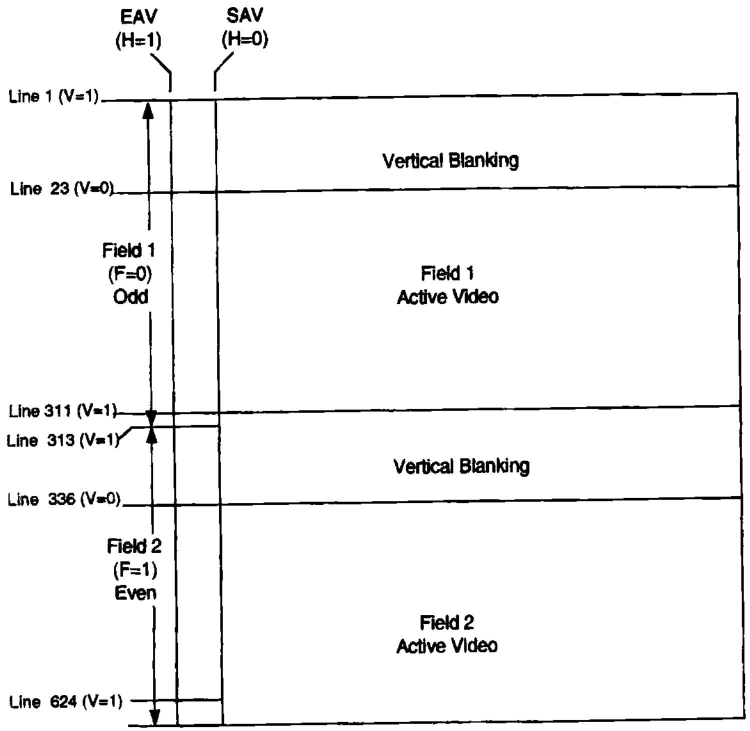

Figure 4 – Spatial representation of timing reference signals during video frame for system 2 (single-link 4:4:4:4 – 625i/50)

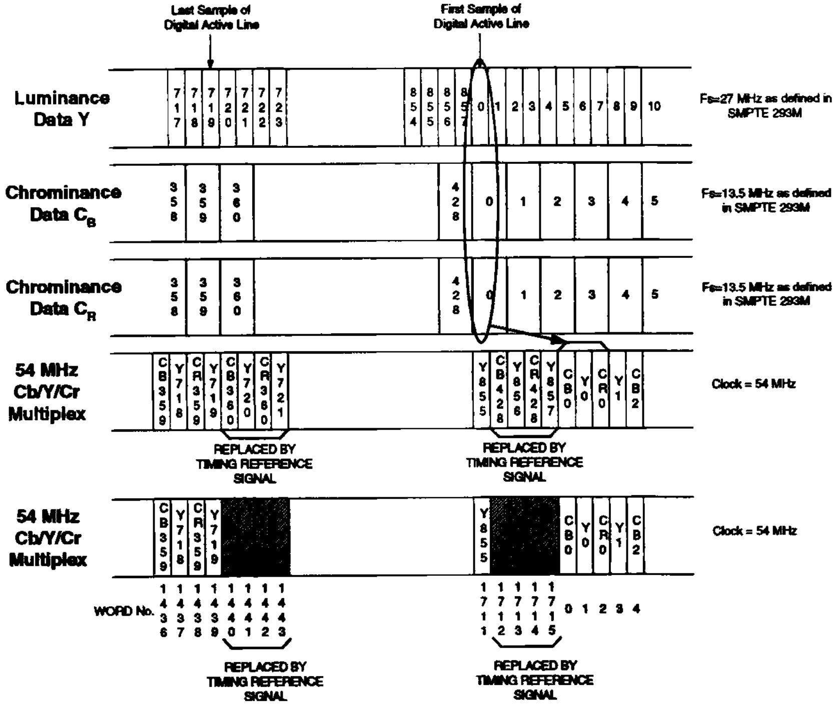

Figure 5 – Generation of 54-MHz parallel data stream for system 3 (single-link 4:2:2p – 525p/59.94)

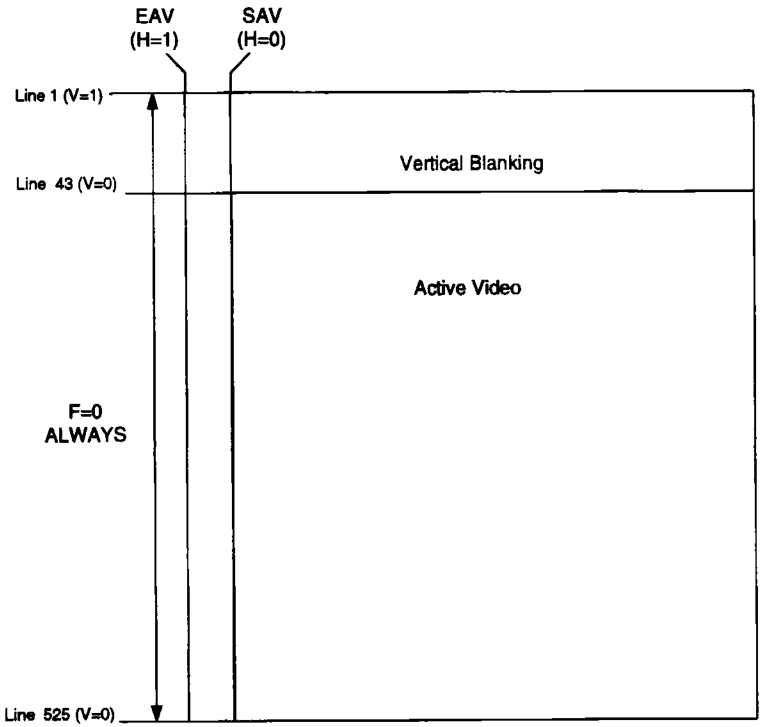

Figure 6 – Spatial representation of timing reference signals during video frame for system 3 (single-link 4:2:2p – 525p/59.94)

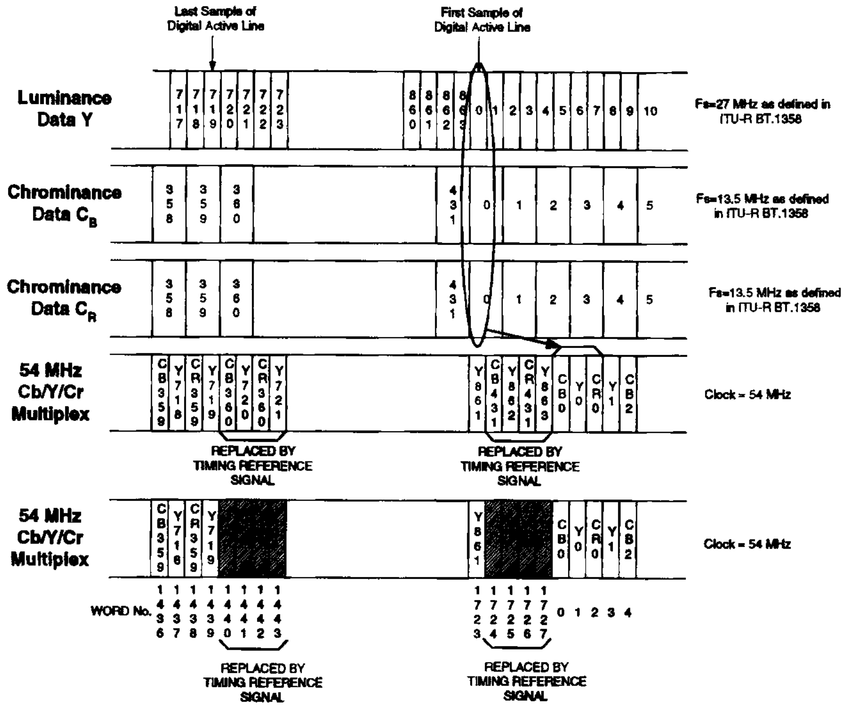

Figure 7 – Generation of 54-MHz parallel data stream for system 4 (single-link 4:2:2p – 626p/50)

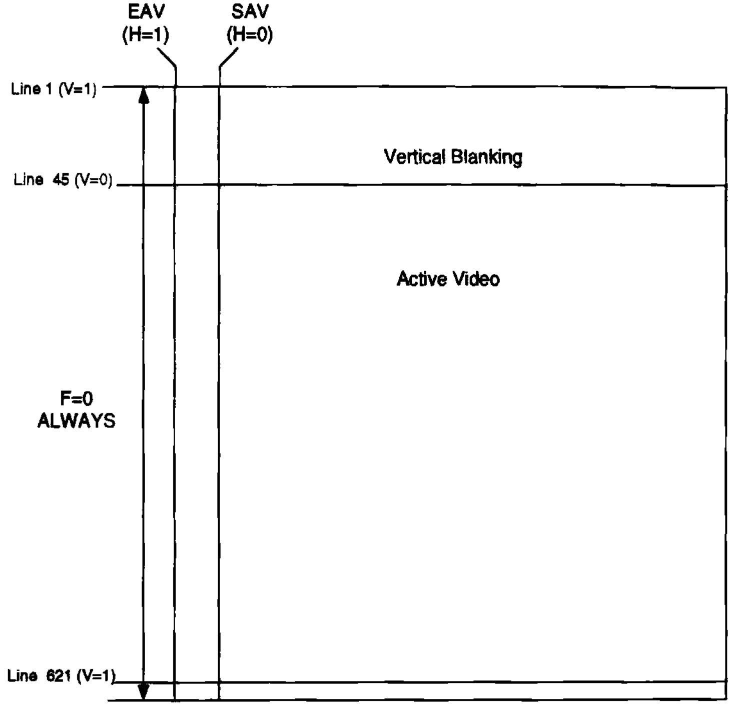

Figure 8 – Spatial representation of timing reference signals during video frame for system 4 (single-link 4:2:2p – 625p/50)

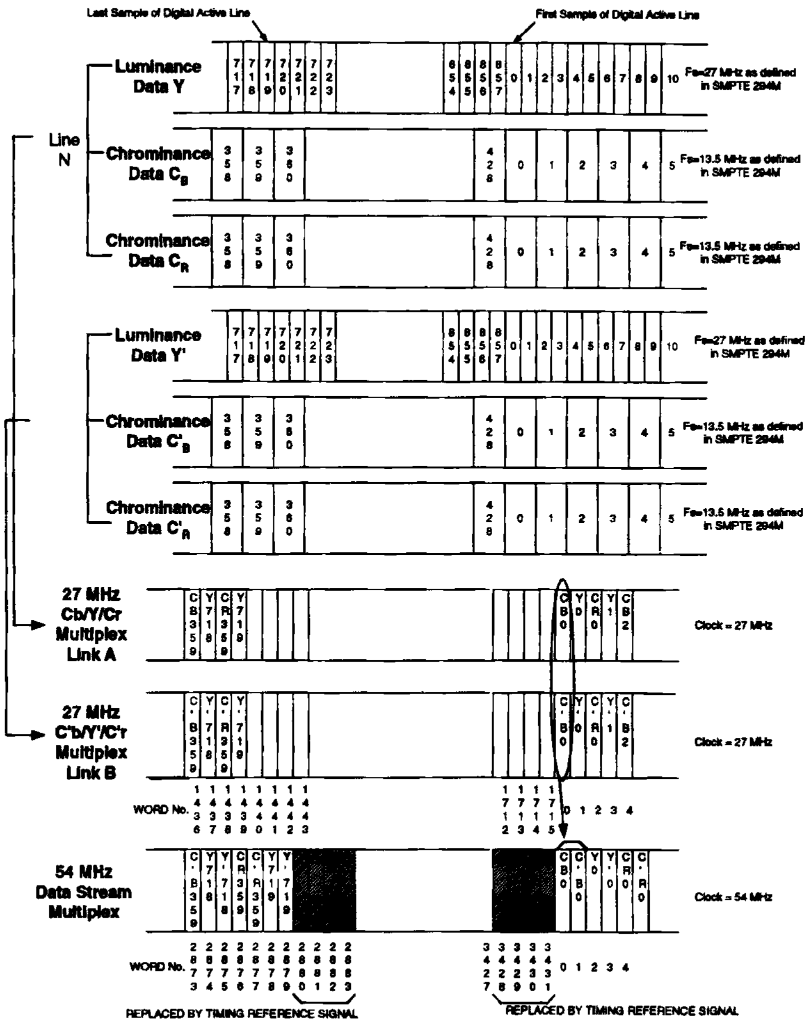

Figure 9 – Generation of 54-MHz parallel data stream for system 5 (dual-link 4:2:2p – 525p/59.94)

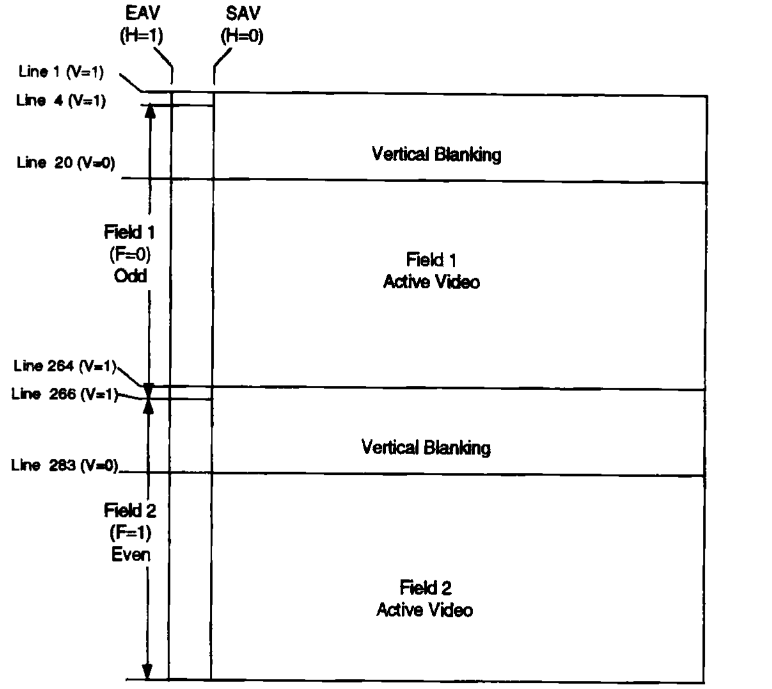

Figure 10 – Spatial representation of timing reference signals during video frame for system (single-link 4:2:2p – 525p/59.94)

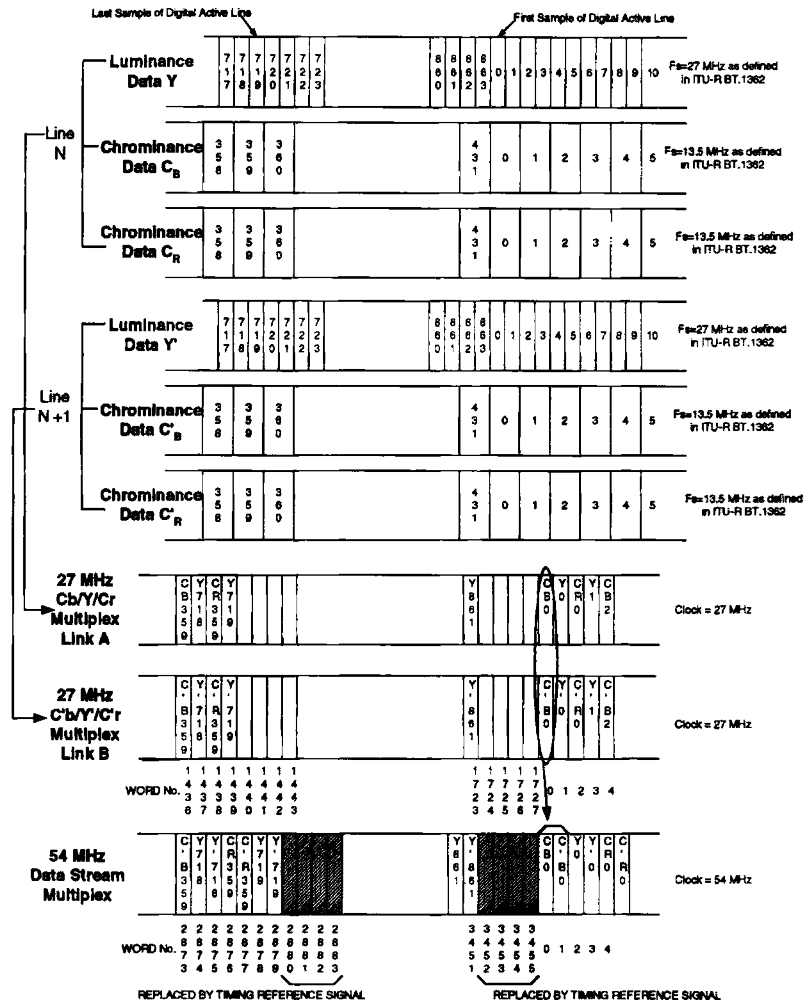

Figure 11 – Generation of 54-MHz parallel data stream for system 6 (dual-link 4:2:2p – 625p/50)

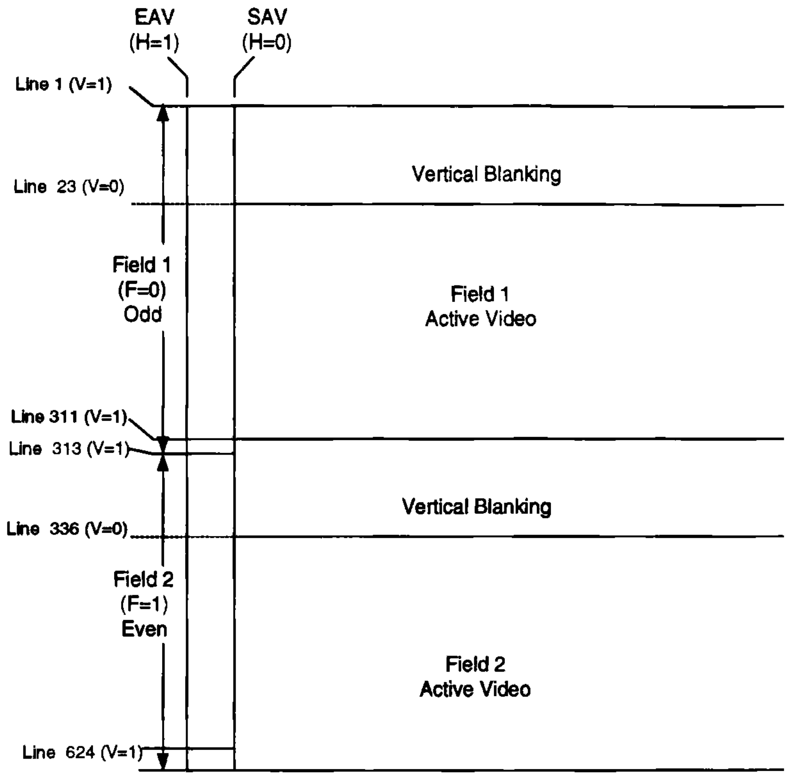

Figure 12 – Spatial representation of timing reference signals during video frame for system 6 (dual link 4:2:2p – 625p/50)

7 Format identifier

7.1 A format identifier shall be inserted into the relevant 54-MHz parallel data stream in accordance with SMPTE 352M.

7.2 As defined by SMPTE 352M, the format identifier shall have the structure in table 14.

7.3 The four SDI payload label words for systems 1, 2, 3, 4, 5, and 6 shall be as defined in SMPTE 352M.

Table 14 – Format identifier structure

Name	Acronym	Value
Ancillary data flag (10-bit word)	ADF	000_h, $3FF_h$, $3FF_h$
Data identification	DID	41_h
Secondary data identification	SID	01_h
Data count	DC	04_h
SDI payload label	4 words	See 7.3
Checksum	CS	—

Annex A (informative)
Bibliography

ANSI/SMPTE 293M-1996, Television — 720 × 483 Active Line at 59.94-Hz Progressive Scan Production — Digital Representation

ANSI/SMPTE 294M-1997, Television — 720 × 483 Active Line at 59.94-Hz Progressive Scan Production — Bit-Serial Interfaces

SMPTE 344M-2000, Television — 540 Mb/s Serial Digital Interface

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

SMPTE RP 174-1993, Bit-Parallel Digital Interface for 4:4:4:4 Component Video Signal (Single Link)

ITU-R BT.799-3 (02/98), Interfaces for Digital Component Video Signals in 525-Line and 625-Line Television Systems Operating at the 4:4:4 Level of Recommendation ITU-R BT.601 (Part A)

ITU-R BT.1358 (02/98), Studio Parameters of 625 and 525 Line Progressive Scan Television Systems

ITU-R BT.1362 (02/98), Interfaces for Digital Component Video Signals in 525- and 625-Line Progressive Scan Television Systems

PROPOSED SMPTE STANDARD

SMPTE 349M

for Television — Transport of Alternate Source Image Formats through SMPTE 292M

1 Scope

This standard specifies the transport of component 525-line interlaced, 525-line progressive, 625-line interlaced, and 625-line progressive scan source formats through SMPTE 292M, the bit-serial digital interface for high-definition television systems.

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 293M-1996, Television — 720 × 483 Active Line at 59.94-Hz Progressive Scan Production — Digital Representation

ANSI/SMPTE 294M-1997, Television — 720 × 483 Active Line at 59.94-Hz Progressive Scan Production — Bit-Serial Interfaces

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

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

SMPTE 344M-2000, Television — 540-Mb/s Serial Digital Interface

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

SMPTE RP 174-1993, Bit-Parallel Digital Interface for 4:4:4:4 Component Video Signal (Single Link)

ITU-R BT.601-5 (10/95), Studio Encoding Parameters of Digital Television for Standard 4:3 and Wide-Screen 16:9 Aspect Ratios

ITU-R BT.656-4 (02/98), Interfaces for Digital Component Video Signals in 525-Line and 625-Line Television Systems Operating at the 4:2:2 Level of Recommendation ITU-R BT.601 (Part A)

ITU-R BT.799-3 (02/98), Interfaces for Digital Component Video Signals in 525-Line and 625-Line Television Systems Operating at the 4:4:4 Level of Recommendation ITU-R BT.601 (Part A)

ITU-R BT.1358 (02/98), Studio Parameters of 625 and 525 Line Progressive Scan Television Systems

ITU-R BT.1362 (02/98), Interfaces for Digital Component Video Signals in 525- and 625-Line Progressive Scan Television Systems

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3 Introduction

High-definition television equipment and systems capable of a variety of image formats use the 1.485 Gb/s or 1.485/1.001 Gb/s serial digital interface. This high-definition equipment and these systems will, in many cases, be capable of processing other scanning formats, such as 525-line interlaced/progressive and 625-line interlaced/progressive.

To allow the use of a single digital interface for these formats, in addition to the originally intended 1125-line interlaced/progressive and 750-line progressive scan formats, this standard defines the transport of alternate formats through an SMPTE 292M serial digital interface.

This specification is based on adjusting the number of lines to match those of the source formats while keeping a common clock rate. Each source format is mapped onto the interface format, as specified in clause 5.

4 Source formats

Frame and line structure, parallel and multiplexed word rate, and reference standards for the alternate source formats to be transmitted through a 1.485 Gb/s serial digital interface are shown in the top half of table 1. The meanings of the case and type values in table 1 are described in the next clause. Word count values in the table are for either the Y, C_b/C_r source format or the R, G, B, A source format.

5 Interface format

5.1 Serial data formatting

The serial data format, channel coding, coaxial cable interface, and optical fiber interface shall be as specified in SMPTE 292M.

5.2 Interface format parameters

The frame and line structure, parallel and serial word rate, and case and type of the interface format shall be as shown in the bottom half of table 1 and figure 1. Word count values in the table are for either the Y or C channel of the interface format.

5.3 Case value

The case value of table 1 shall be used to define the number of lines per frame and whether the available data area is a standard (S) or extended (E) length. The length value defines the horizontal line parameters including total line length, data area length, and H-ANC length. The specification of the availabledata area is dependent on the interface line number rate and the values are defined in table 1.

5.4 Type value

The type value of table 1 shall be used to define the method of source format data packing onto the interface. Source format data may be either interlaced (I) or progressive (P) and mapped onto the interface as defined later in this standard.

5.5 Interface word rate

The interface parallel word rate shall be exactly 74.25 Mwords/s.

NOTE – The interface parallel word rate is exactly 74.25 Mwords/s even for 525-line 29.97 frame rate source formats.

5.6 Interface frame rate

In the case of 525-line source formats, the frame rate of the interface format shall be 30/1.001 Hz 2:1 interlaced. In the case of 625-line source formats, the frame rate of the interface format shall be 25 Hz 2:1 interlaced.

5.7 Lines per frame

The total lines per frame of the interface format shall be the same as the total lines per frame of the source format.

5.8 Words per line

In the case of 525-line interlaced and progressive source formats, the total words per line of the interface format shall be 4719. In the case of 625-line interlaced source formats, the total words per line of the interface format shall be 4752.

NOTE – These numbers are derived from the following equation:

$$74.25 \text{ Mwords} = 525 \times 4719 \times 30/1.001 = 625 \times 4752 \times 25$$

Table 1 – Parameters of source and interface format

	Source format						
No.	Total lines per frame	Total words per line	Frame rate (Hz)	Fields per frame	Parallel and multiplexed word rate	Signal type	Reference standards
1	525	858	30/M	2	27 Mb/s	4:2:2i	SMPTE 125M/SMPTE 259M
2		1144	30/M	2	36 Mb/s	4:2:2i	SMPTE 267M/SMPTE 259M
3		858	30/M	2	54 Mb/s	4:4:4:4i	SMPTE RP 174/SMPTE 344M
4		858	60/M	1	27 Mb/s x2	4:2:2p	SMPTE 293M/SMPTE 294M
5		858	60/M	1	54 Mb/s	4:2:2p	SMPTE 293M/SMPTE 344M
6		858	60/M	1	36 Mb/s	4:2:0p	SMPTE 293M/SMPTE 294M
7	625	864	25	2	27 Mb/s	4:2:2i	ITU-R BT.601/ITU-R BT.656
8		1152	25	2	36 Mb/s	4:2:2i	ITU-R BT.601/ITU-R BT.656
9		864	25	2	54 Mb/s	4:4:4:4i	ITU-R BT.799/SMPTE 344M
10		864	50	1	27 Mb/s x2	4:2:2p	ITU-R BT.1358/ITU-R BT.1362
11		864	50	1	54 Mb/s	4:2:2p	ITU-R BT.1358/SMPTE 344M
12		864	50	1	36 Mb/s	4:2:0p	ITU-R BT.1358/ITU-R BT.1362

	Interface format									
No.	Total lines per frame	Total words per line	Frame rate (Hz)	Fields per frame	Parallel and multiplexed word rate	Words per data area	Words per H-ANC	Case	Length	Type
1	525	4719	30/M	2	74.25 Mb/s	4100	607	A	S	I
2						4100	607	A	S	I
						4580	127	B	E	I
3						4100	607	A	S	I
4						4100	607	A	S	I
5						4100	607	A	S	P
6						4580	127	B	E	I
7	625	4752	25			4100	640	C	S	I
8						4100	640	C	S	I
						4612	128	D	E	I
9						4100	640	C	S	I
10						4100	640	C	S	I
11						4100	640	C	S	P
12						4612	128	D	E	I

NOTE – M = 1.001, S = standard, E = extended.

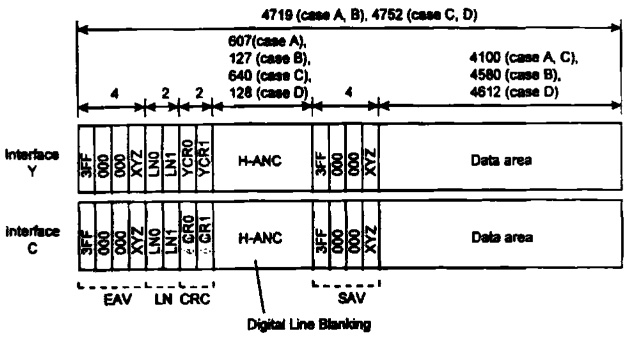


Figure 1 – Interface format

5.9 Line description

The data for each line shall be comprised of the following sequence of component parts: EAV (end of active video), LN (line number), CRC (cyclic redundancy code), H-ANC (digital line blanking), SAV (start of active video), and data area. Each of these component parts is as shown in figure 1, including standard and extended length values defined for the different line rates.

5.10 EAV, SAV, LN and CRC

The EAV and SAV for each of the two parallel data streams (Y channel and C channel) including the F and V bits for cases A and B shall be as specified in ANSI/SMPTE 125M and for cases C and D in ITU-R BT.656. Values of the F and V bits for cases A, B, C, and D shall be as shown in table 2. Line 1 of the source format shall be mapped onto line 1 of the interface format. The LN and CRC for each of the two parallel data streams shall be as specified in SMPTE 292M.

5.11 Ancillary data space

Ancillary data space consists of H-ANC and V-ANC data space and each of two parallel data streams (Y channel and C channel) of the interface format shall be available for ancillary data packets as specified in SMPTE 291M. Ancillary data space where no ancillary data exists shall be set to 040_h for the Y channel and 200_h for the C channel.

Code words 00_h, 01_h, 02_h, 03_h, $3FC_h$, $3FD_h$, $3FE_h$, and $3FF_h$ shall be prohibited from ancillary data words.

Table 2 – F and V bits of EAV and SAV

Case		A, B (525-lines)	C, D (625-lines)
F bit	F = 0 during field 1	Lines 4 to 265	Lines 1 to 312
	F = 1 during field 2	Lines 266 to 3	Lines 313 to 625
V bit	V = 0 elsewhere	Lines 20 to 263 Lines 283 to 525	Lines 23 to 310 Lines 336 to 623
	V = 1 during field blanking	Lines 1 to 19 Lines 264 to 282	Lines 624 to 22 Lines 311 to 335

5.11.1 H-Ancillary data space

The H-ANC space shall be in the digital line blanking area as shown in figure 1.

5.11.2 V-Ancillary data space

The V-ANC space shall be in the data area where the V bits of EAV and SAV are 1 as shown in table 2.

5.12 Format identification H-ANC packet

The format identification shall be provided by a 4-byte label encapsulated in an H-ANC data packet according to SMPTE 352M.

6 Mapping data formats

The active video of the source format shall be mapped onto the data area of the interface format. The C and Y channels shall have the same mapping mode.

This clause describes the normal mapping mode. An alternative whole-line mapping mode is defined in annex A. The normal mapping mode shall be supported by all equipment designed to this standard whereas whole-line mapping is provided as an option and may not be supported by all equipment.

6.1 Mapping mode

The mapping mode bit shall be set to 0 as specified in SMPTE 352M.

6.2 Data area

The data area consists of two portions of data and an antipathological (AP) sequence of four words as shown in figure 2. The active video data of the source format shall be mapped on this area.

6.2.1 Data size

The total size of the two portions of the data in both the interface-C and interface-Y is 4096 words for the standard length mode (cases A and C), 4576 words for 525 lines in the extended length mode (case B), and 4608 words for 625 lines in the extended length mode (case D) as shown in figure 2. The two portions of the data consist of four channels: Ch1 and Ch2 in the interface-C and Ch3 and Ch4 in the interface-Y. Each channel has 2048 words for the standard length mode (cases A and C), 2288 words for 525 lines in the extended length mode (case B), and 2304 words for 625 lines in the extended length mode (case D).

6.2.2 Source format and the channel

Each component of the source formats, Y, C_b/C_r, R, G, B, and A in table 1 are firstly word-multiplexed either as a pair of (Y, C_b/C_r), a pair of (R, G) or a pair of (B, A), then mapped onto the channels of the data of the interface format either as a type I or type P. The mapped order shall be Ch1, Ch2, Ch3, and Ch4. Source formats 1, 2, 6, 7, 8, and 12 in table 1 shall be mapped onto Ch1. Source formats 3, 4, 5, 9, 10, and 11 shall be mapped onto Ch1 and Ch2. Mixed source formats on one interface (interface C or interface Y) are not permissible. Ch3 and Ch4 are optional. When the source format does not exist, the default value of each word of the associated channels shall be set to 040_h.

NOTE – Link A of source formats 4 and 10 shall be mapped onto Ch1 of the interface format.

6.2.3 Types I and P

Source formats are mapped onto the source data channels of the interface format as either type I or type P as shown in figures 2a and 2b. Column 11 of table 1 identifies whether a source format is mapped as type I or type P.

Type I: Word-multiplexed pairs of the source format shall be diversely mapped onto Ch1 (and Ch2 if necessary) of the interface format as shown in figure 2a. All the source formats except 5 and 11 shall be mapped as this type.

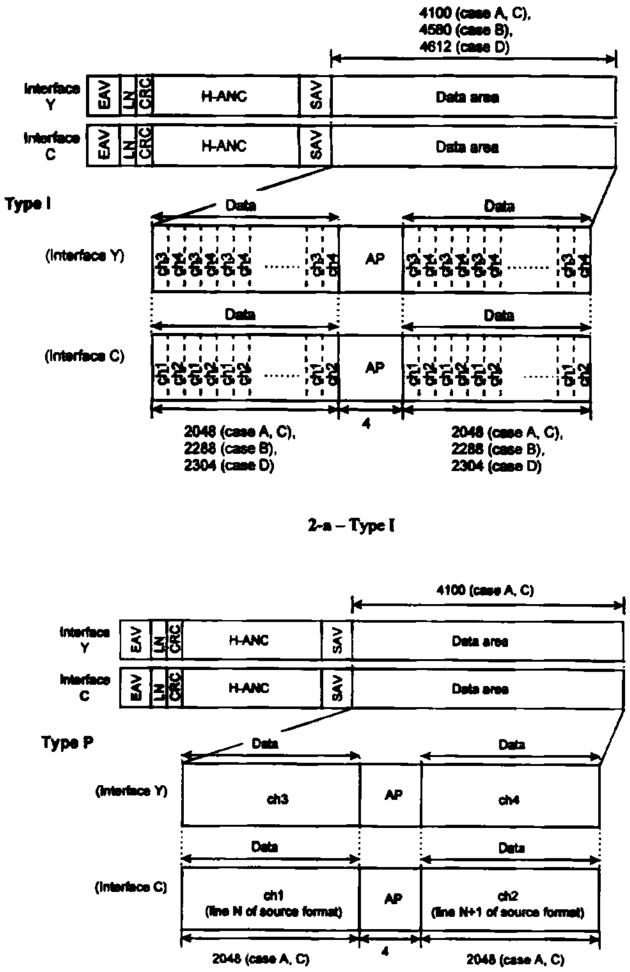
Type P: Word-multiplexed pairs of each odd line of the source format shall be consecutively mapped onto Ch1 of the interface format, and those of each even line onto Ch2 as shown in figure 2b.

6.2.4 AP

The AP (antipathological) signal shall consist of four words each set to 040h. The AP sequence provides the capability to prevent pathological sequences in one source channel from affecting another source channel. The AP signal shall not be put on the V-ANC area.

6.2.5 Channel structure

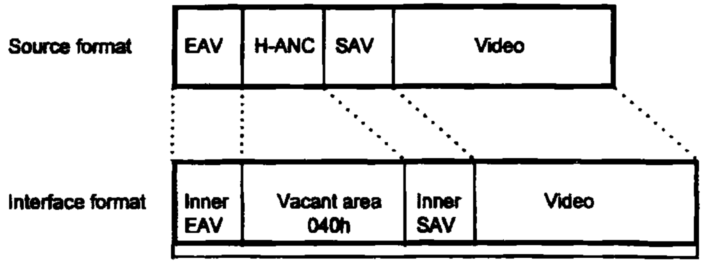
The source format on each channel consists of an inner EAV, vacant area, inner SAV, and video as shown in figure 3 and table 3.



2-a – Type I

2-b – Type P

Figure 2 – Types I and P



Channel

Figure 3 – Source format mapping onto the channel (normal mapping)

Table 3 – Mapping onto the channel

	Source format				Interface format						
						Mapping on the channel					
No.	Total word pairs per line	EAV SAV	Word pairs per H-ANC	Word pairs per video	H-ANC	Channel size	Inner EAV Inner SAV	Vacant area	Video	Number of channels	Case
1	1716		268	1440	607	2048		600	1440	1	A
2	2288		360	1920	607	2048		120	1920	1	A
					—	—		—		—	—
3	1716		268	1440	607	2048		600	1440	2	A
4	1716		268	1440	607	2048		600	1440	2	A
5	1716		268	1440	607	2048		600	1440	2	A
6	2288	8	120	2160	127	2288	8	120	2160	1	B
7	1728		280	1440	640	2048		600	1440	1	C
8	2304		376	1920	640	2048		120	1920	1	C
					—	—		—		—	—
9	1728		280	1440	640	2048		600	1440	2	C
10	1728		280	1440	640	2048		600	1440	2	C
11	1728		280	1440	640	2048		600	1440	2	C
12	2304		136	2160	128	2304		136	2160	2	D

6.2.6 Inner EAV and inner SAV

When mapping the word-multiplexed pairs of the source format onto the channel, inner EAV and inner SAV shall be used to define the location of the video and vacant area in the channel as shown in figure 3 and table 3.

The size of inner EAV and inner SAV in each channel shall be four words. Each value of the four words shall be $3FE_h$, 001_h, 001_h, XYZ. The change of the LSB value in the inner EAV and SAV words is to distinguish from the interface EAV and SAV words. When the source format does not exist, each value of the inner EAV and inner SAV shall be set to 040_h.

The first word of the inner EAV shall be located at the first word of the channel. The last word of the inner SAV shall be immediately before the first word of the video. The inner EAV and inner SAV word sequences shall be used as the reference timing for the source format of each channel.

Inner EAV and inner SAV shall not be put on the V-ANC area.

6.2.7 Video

The sizes of the videos in a source format (word-multiplexed pairs per video) and in a channel shall be the same as shown in figure 3 and table 3. The last word of the video of the source format shall be located at the last word of the channel. Code words 00_h, 01_h, 02_h, 03_h, $3FC_h$, $3FD_h$, $3FE_h$, and $3FF_h$ shall be prohibited from video data words.

6.2.8 Vacant area

Sizes of the vacant area for each source format shall be as shown in table 3. The value of the words in the vacant area shall be set to 040_h.

Annex A (normative) Whole-line mapping

Occasionally direct mapping of the H-ANC data packets of the source format into the vacant area is required instead of mapping to the H-ANC area of the interface format. Such a case can happen where 270 Mb/s SDI data are mapped directly onto 1.485 Gb/s SDI with only simple data reallocation. This mapping method, although not recommended as a standard, may be used as an option to normal mapping. Note that all equipment designed to this standard shall operate with the normal mapping mode. Equipment may optionally support whole-line mapping as well as the normal mapping mode.

The similarities and differences between normal mapping and whole-line mapping are shown as follows.

A.1 Format ID

The mapping mode bit shall be set to 1 as specified in SMPTE 352M.

A.2 Data area

The data area consists of two portions of data and an anti-pathological (AP) sequence of 4 words as shown in figure 2. Active video data and embedded ancillary data shall be mapped on this area.

A.2.1 Data size

As specified in 6.2.1.

A.2.2 Source format and the channel

As specified in 6.2.2.

NOTE – 270 Mb/s, 360 Mb/s, or 540 Mb/s SDI sources already have a word-multiplexed structure.

A.2.3 Types I and P

As specified in 6.2.3.

A.2.4 AP

The AP (antipathological) signal shall consist of the 4 words. The word value of each AP word is set to 040_h. The AP sequence provides the capability to prevent pathological sequences in one source channel from affecting another source channel. The AP signal shall be put on the lines where the source format is mapped.

A.2.5 Channel structure

Each channel consists of an inner EAV, inner H-ANC, inner SAV, and video as shown in figure A.1.

A.2.6 Inner EAV and inner SAV

When mapping the word-multiplexed pairs of the source format onto the channel, inner EAV and inner SAV shall be used to define the location of the video and inner H-ANC area in the channel as shown in figure A.1 and table A.1.

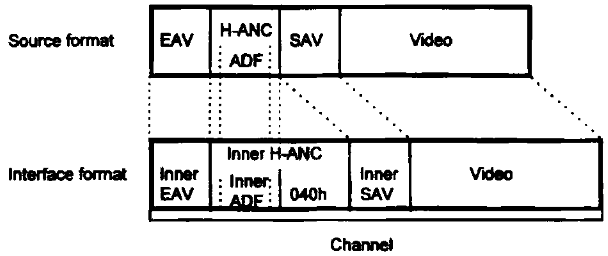


Figure A.1 – Source format mapping onto the channel (whole-line mapping)

Table A.1 – Mapping onto the channel (whole-line mapping)

Source format					Interface format						
No.	Total word pairs per line	EAV SAV	Word pairs per H-ANC	Word pairs per video	H-ANC	Mapping on the channel: Channel size	Inner EAV Inner SAV	Inner H-ANC	Video	Number of channels	Case
1	1716		268	1440	607	2048		600	1440	1	A
2	2288		360	1920	—	—		—	1920	—	—
					127	2288		360		1	B
3	1716		268	1440	607	2048		600	1440	2	A
4	1716		268	1440	607	2048		600	1440	2	A
5	1716	8	268	1440	607	2048	8	600	1440	2	A
6	2288		120	2160	127	2288		120	2160	1	B
7	1728		280	1440	640	2048		600	1440	1	C
8	2304		376	1920	—	—		—	1920	—	—
					128	2304		376		1	D
9	1728		280	1440	640	2048		600	1440	2	C
10	1728		280	1440	640	2048		600	1440	2	C
11	1728		280	1440	640	2048		600	1440	2	C
12	2304		136	2160	128	2304		136	2160	2	D

The sizes of inner EAV and inner SAV in each channel shall be four words. Each value of the four words shall be $3FE_h$, 001_h, 001_h, XYZ. The change of the LSB value in the inner EAV and SAV words is to distinguish from the interface EAV and SAV words. When the source format does not exist, each value of the inner EAV and inner SAV shall be set to 040_h.

The first word of the inner EAV shall be located at the first word of the channel. The last word of the inner SAV shall be immediately before the first word of the video. The inner EAV and inner SAV word sequences shall be used as the reference timing for the source format of each channel. Inner EAV and inner SAV shall be put on the lines where the source format is mapped.

A.2.7 Video

As specified in 6.2.7.

A.2.8 Inner ADF

The size of the inner ADF for each interface format shall be three words. Each value of the three words shall be 001_h, $3FE_h$, $3FE_h$. The change of the LSB in the inner ADF words is to distinguish from the interface ADF words. The position of the inner ADF shall be the same as the ADF of the source channel. The inner ADF shall be used as the reference timing of the inner H-ANC.

A.2.9 Inner H-ANC

Sizes of the inner H-ANC for each source format shall be as shown in table A.1. The value of the inner H-ANC shall be the same as that of the H-ANC of the source format except for the inner ADF The place where no H-ANC exists shall be set to 040_h.

Annex B (informative)
Examples of alternate source image format mapping

Examples of alternate source image format mapping are shown in figures B.1 and B.2.

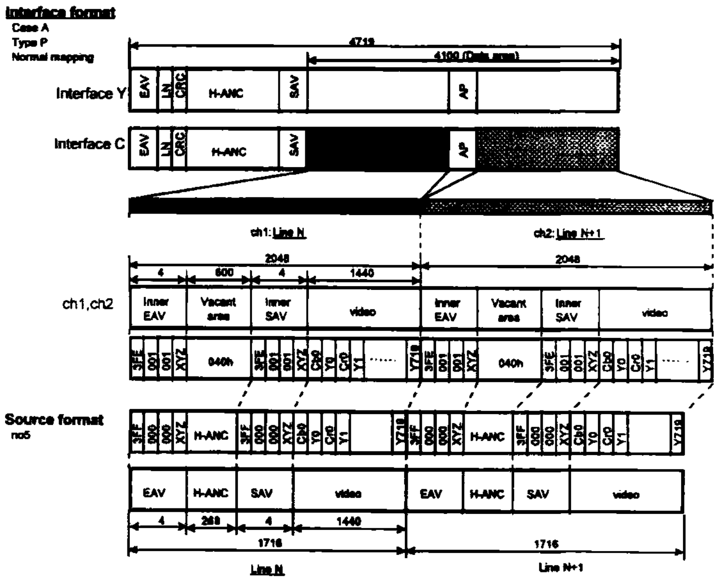


Figure B.1 – Mapping a 525 progressive source into channels 1 and 2 of the interface (normal mapping)

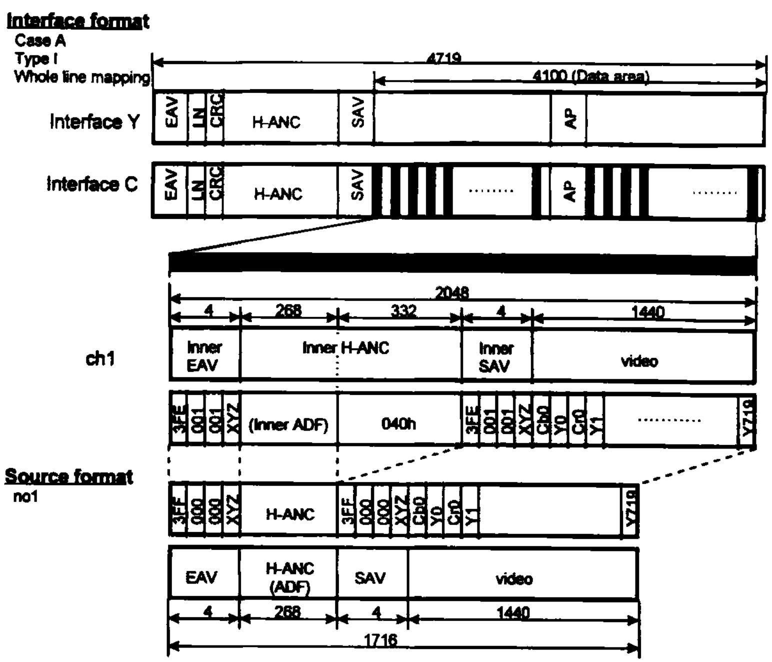


Figure B.2 – Mapping a 525 interlaced source into channel 1 of the interface (whole-line mapping)

Annex C (informative)
Bibliography

ANSI/SMPTE 299M-1997, Television — 24-Bit Digital Audio Format for HDTV Bit-Serial Interface

SMPTE 347M, Television — 540-Mb/s Serial Digital Interface — Source Image Format Mapping

PROPOSED SMPTE STANDARD

SMPTE 352M

for Television —
Video Payload Identification for Digital Television Interfaces

1 Scope

This standard defines the specification of a 4-byte payload identifier which may be added to digital television interfaces for the purpose of identifying the video payload. The payload identifier is intended for application to all existing and future digital television interfaces.

The standard defines how the payload identifier is placed into an ancillary data packet according to SMPTE 291M. It specifies the sample position, line number(s), and repetition rate of the ancillary data packet for different digital television interfaces.

The standard also includes definitions for the interpretation of each byte of the 4-byte payload identifier although the values for many digital television interfaces may have custom requirements. Payload identifier values for existing digital television interfaces are defined and these establish guidelines for the assignment of appropriate payload identifier values to future digital television interfaces.

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

SMPTE 274M-1998, Television — 1920 x 1080 Scanning and Analog and Parallel Digital Interfaces for Multiple Picture Rates

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

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

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

SMPTE 344M-2000, Television — 540 Mb/s Serial Digital Interface

SMPTE 349M, Television — Transport of Alternate Source Image Formats through SMPTE 292M

SMPTE RP 211-2000, Implementation of 24P, 25P and 30P Segmented Frames for 1920 x 1080 Production Format

ITU-R BT.1358 (02/98), Studio Parameters of 625 and 525 Line Progressive Scan Television Systems

ITU-R BT.1362 (02/98), Interfaces for Digital Component Video Signals in 525- and 625-Line Progressive Scan Television Systems

3 Application

The payload identifier may be applied equally to both the parallel and serial forms of digital video interfaces. For convenience, this standard generally refers to the serial (SDI) form. Where this standard refers only to an SDI standard, it shall be assumed to apply equally

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to both the serial standard and the associated parallel standards.

This standard first explains the structure of the proposed 4-byte payload identifier. It then defines how the payload identifier is placed in an ancillary data packet according to SMPTE 291M. The last clause will define the position and timing of the ancillary data packet for various interfaces.

Annex A defines the payload identifier values for the following interfaces:

- SMPTE 259M and ITU-R BT.656 (525/625-line interlaced scanning at 270/360 Mb/s);

- ITU-R BT.1358 and ITU-R BT.1362 (525/625-line progressive scanning, dual-link at 270 Mb/s and single link at 360 Mb/s);

- SMPTE 347M (525/625-line interlaced and progressive scanning modes at 540 Mb/s);

- SMPTE 296M and SMPTE 292M (720-line progressive scanning at 1.485 Gb/s);

- SMPTE 274M, SMPTE RP 211, and SMPTE 292M (1080-line interlaced, progressive, and segmented frame scanning modes at 1.485 Gb/s);

- SMPTE 349M and SMPTE 292M (525/625-line interlaced and progressive scanning modes at 1.485 Gb/s).

NOTE – Segmented frame scanning has the full name progressive segmented frame and uses the acronym PsF in this standard.

Annex B shows the mapping of the payload identifier from the ancillary packet data structure of SMPTE 292M to the K-L-V data structure of SMPTE 336M. The 4-byte payload identifier is an item of metadata which can be registered in the SMPTE metadata dictionary (SMPTE RP 210).

Annex C explains why a payload identifier is needed for digital video interfaces and why the identifier is 4 bytes in length.

4 Payload identifier

The payload identifier shall be used to identify the video payload carried on a digital television bit serial interface.

The payload identifier shall be 4 bytes long where each byte has a separate significance. The first byte of the payload identifier shall have the highest significance and subsequent bytes shall define lower order video payload information. A precise definition of each payload identifier shall be provided for each interface based on the following guidelines:

4.1 Byte 1: Video payload standard

This first byte has the highest significance and shall be used to identify the combination of digital television sampling standard and serial digital interface standard (SDI).

Note that some SDI transports can carry a number of different video payload types at the same bit rate by changing the timing and repetition rates of the timing reference signals. Furthermore, video payloads can now be mapped onto several SDI transports. Thus, the first byte identifies both the video payload itself and the SDI transport onto which the payload is mapped.

The first byte of the payload identifier shall have a nonzero value for all valid video payloads. Thus, the first byte can be used to address up to 255 valid video payload standards.

4.2 Byte 2: Video payload frame rate and line scanning

The second byte shall be used to identify the video payload frame rate and, where necessary, the line scanning format.

For all video payloads on SDI transports, bits b3 to b0 of byte 2 shall be reserved to define the video frame rate in hertz. The 4 bits allow values of 0_h to F_h which shall be as defined in table 1.

Bits b7 and b4 are used as defined by the application. The default value of these bits shall be 0.

4.3 Byte 3: Sampling structures

The third byte shall be used to identify aspects of the sampling structure of the payload.

For all video payloads on SDI transports, bits b3 to b0 of byte 3 shall be reserved to identify the horizontal sampling structure. The 4 bits allow values of 0_h to F_h which shall be as defined in table 2.

Table 1 – Byte 2 frame rate

Value	Frame rate	Value	Frame rate	Value	Frame rate	Value	Frame rate
0_h	Not defined	1_h	Not defined	2h	24/1.001	3_h	24
4_h	Not defined	5_h	25	6h	30/1.001	7_h	30
8_h	Not defined	9_h	50	Ah	60/1.001	B_h	60
C_h	Not defined	D_h	75	Eh	72/1.001	F_h	72

Table 2 – Byte 3 sampling structure

Value	Sampling	Value	Sampling	Value	Sampling	Value	Sampling
0_h	4:2:2 I (4:3) (default)	1_h	4:2:2 I (16:9)	2h	4:2:0 P (4:3)	3_h	4:2:2 P (4:3, dual link)
4_h	4:2:2 P (4:3)	5_h	4:2:2 P (16:9)	6h	4:4:4:4 I (4:3, Y/Cb/Cr/key)	7_h	4:4:4:4 I (4:3, R/G/B/key)
8_h	4:2:2 I (4:3, dual channel)	9_h	4:2:2 I (16:9, dual channel	Ah	4:2:0 P (4:3, dual channel)	B_h	Not defined
C_h	Not defined	D_h	Not defined	Eh	Not defined	F_h	$4f_{sc}$

Bits b7 and b4 are used as defined by the application. The default value of these bits shall be 0 indicating 4:2:2 sampling with a nominal 4:3 sampling aspect ratio.

NOTES

1 Dual-link operation refers to those progressively scanned source formats which have been defined to use dual 270 Mb/s SDI links.

2 Dual-channel operation refers to those 525- and 625-line interlaced standards which have been mapped onto SMPTE 292M as a pair of channels (see SMPTE 249M).

4.4 Byte 4: Special options

The last byte is available for any special options as may arise in future implementations and is locally defined in the context of the video payload standard as identified in the first byte.

A null value in byte 4 [00_h] shall be used to indicate either no useful data or the default case.

4.5 Common payload identifier format

The descriptions of each byte are summarized in table 3.

5 Payload identifier specification and carriage

The 4-byte video payload identifier shall be carried in a SMPTE 291M H-ancillary data packet. This ensures a consistent approach to data handling for all digital video interfaces.

5.1 Ancillary data specification

The ancillary data packet used by the video payload identifier shall use the type 2 data identification having a first data identification (DID) word followed by a secondary data identification (SDID) word.

The DID word shall be set to the value 41_h. The SDID word shall be set to the value of 01_h.

Table 4 outlines the ancillary data packet words with values where appropriate. The total size of the ancillary data packet is 11 words.

5.2 Placement of the ancillary data packet

As this packet defines a basic payload type, the preferred horizontal placement of the ancillary data packet is immediately following an EAV word sequence.

Table 3 – Generalized payload identifier definitions for current and future SDI transports

Bits	Byte 1	Byte 2	Byte 3	Byte 4
Bit 7	Video payload and SDI standards	Application specific (Line or frame related)	Application specific (Sampling related)	Special options (depends on the standard defined in byte 1)
Bit 6				
Bit 5				
Bit 4				
Bit 3		Frame rate	Sampling identification	
Bit 2				
Bit 1				
Bit 0				

Table 4 – Ancillary data packet structure for the SDI payload identifier

Name	Acronym	Value
Ancillary data flag (10-bit words)	ADF	000_h, $3FF_h$, $3FF_h$
Data identification	DID	41_h
Secondary data identification	SDID	01_h
Data count	DC	04_h
SDI payload identifier	4 words	–
Checksum	CS	–

The line number of the packet will vary according to the digital video interface to meet existing equipment practice. The details below summarize the line positions for different interfaces.

5.2.1 525 and 625 lines, interlace scanned

For video payloads having 525 or 625 lines with interlaced (I) scanning, ancillary data packets shall be added once per field on the following lines:

525I (field 1): Line 13
525I (field 2): Line 276
625I (field 1): Line 9
625I (field 2): Line 322

NOTE – These line numbers also apply when using SMPTE 349M.

5.2.2 525 and 625 lines, progressively scanned

For video payloads having 525 or 625 lines with progressive (P) scanning, ancillary data packets shall be added once per frame on the following lines:

525P: Line 26 (becomes line 13 on dual-link SDI and 4:2:0P payloads)

625P: Line 18 (becomes line 9 on dual-link SDI and 4:2:0P payloads)

NOTE – These line numbers also apply when using SMPTE 349M.

5.2.3 750 lines, progressively scanned

For video payloads having 750 lines with progressive (P) scanning, ancillary data packets shall be added once per frame on the Y-channel only of the following line:

750P: Line 13

5.2.4 1125 lines, interlaced and segmented frame scanned

For video payloads having 1125 lines with interlaced (I) and progressive segmented-frame (PsF) scanning, ancillary data packets shall be added once per field on the Y-channel only of the following lines:

1125I (field 1): Line 10
1125I (field 2): Line 572

5.2.5 1125 lines, progressively scanned

For video payloads having 1125 lines with progressive (P) scanning, ancillary data packets shall be added once per frame on the Y-channel only of the following line:

1125P: Line 18

Annex A (normative)
Payload identifier definitions for existing interfaces

The definition of the payload identifier uses the first word to identify the relevant standards and there are already several current and emerging standards where the payload identifier could be usefully used. Tables A.1-A.6 identify the current payload and interface combinations and define the values in the payload identifier:

A.1 ITU-R BT.601 payloads on ANSI/SMPTE 259M SDI (525/625-line payloads)

When identifying ITU-R BT.601 video payloads on ANSI/SMPTE 259M SDI, the following limitations shall apply:

– The frame rate shall use only the values 5_h (25-Hz, 625I) and 6_h (30/1.001-Hz, 525I) in accordance with the payload frame rate.

– The sampling identification shall use only the following values:

0_h to identify 4:2:2I, 720 active luminance pixels per line, 270 Mb/s SDI;

1_h to identify 4:2:2I, 960 active luminance pixels per line, 360 Mb/s SDI;

F_h to identify $4f_{sc}$ operation, 143 Mb/s (525I) or 177 Mb/s (625I).

– Bit 4 of byte 3 shall be used only for sampling structures based on payloads with 720 active luminance samples. In these cases, if the bit is 0, then the source image aspect ratio is 4:3, and if the bit is 1, then the source image aspect ratio is 16:9 (i.e., anamorphic).

A.2 ITU-R BT.1358 payloads on ITU-R BT.1362 SDI (525/625-line payloads on 360 Mb/s single-link SDI and 270 Mb/s dual-link SDI)

When identifying the ITU-R BT.1358 525/625P video payload on the ITU-R BT.1362 SDI, the following limitations shall apply:

– The frame rate shall use only the values 9_h (50 Hz) for 625P systems and A_h (60/1.001 Hz) for 525P systems in accordance with ITU-R BT.1358.

– The sampling structure shall use only the values 2_h for single-link 360 Mb/s SDI and 3_h for 270 Mb/s dual-link SDI.

NOTE – The line numbers defined above for the 750-line and 1125-line payloads in the SMPTE 292M-based serial digital interface avoids the lines used by SMPTE 299M for the carriage of the digital audio control data packet.

– In the case of dual-link 270 Mb/s SDI, bits b7 and b6 of byte 3 shall define a count value in the range 0 to 3 where 0 defines single-link operation, 1 defines channel 1 of dual-link operation, and 2 defines channel 2 of dual-link operation. The value of 3 is reserved, but not defined.

– Bit 4 of byte 3 shall be used to define the source image aspect ratio for payloads with 720 active luminance samples per line. If the bit is 0, then the source image aspect ratio is 4:3, and if the bit is 1, then the source image aspect ratio is 16:9 (i.e., anamorphic).

A.3 SMPTE 344M (525/625-line payloads on 540-Mb/s SDI)

Only the following list of frame rates in combination with sampling structures shall be supported:

– Frame rate = 5_h (25 Hz, 625I) and sampling structure = 6_h (4:4:4:4I; Y/C_b/C_r/key);

– Frame rate = 6_h (30/1.001 Hz, 525I) and sampling structure = 6_h (4:4:4:4I; Y/C_b/C_r/key);

– Frame rate = 5_h (25 Hz, 625I) and sampling structure = 7_h (4:4:4:4I; R/G/B/key);

– Frame rate = 6_h (30/1.001Hz, 525I) and sampling structure = 7_h (4:4:4:4I; R/G/B/key);

– Frame rate = 9_h (50 Hz, 625I) and sampling structure = 4_h (4:2:2P, 4:3);

– Frame rate = A_h (60/1.001 Hz, 525I) and sampling structure = 4_h (4:2:2P, 4:3).

Bit 4 of byte 3 shall be used to define the source image aspect ratio for payloads with 720 active luminance samples per line. If the bit is 0, then the source image aspect ratio is 4:3, and if the bit is 1, then the source image aspect ratio is 16:9 (i.e., anamorphic).

A.4 SMPTE 296M (750-line payloads) on SMPTE 292M HD-SDI

The frame rate shall use only the values as defined in SMPTE 296M.

The sampling structure shall be set to 5_h (4:2:2P, 16:9).

A.5 SMPTE 274M and SMPTE RP 211 (1125-line payloads) on SMPTE 292M HD-SDI

When identifying the video payload on SMPTE 274M interfaces, the following limitations shall apply:

– The frame rate shall use only the values as defined in SMPTE 274M;

– Bits b7 and b6 of byte 2 shall define a number to identify the scanning format. The following values shall be used to define the scanning format:

– 0_h = Interlace (I). In this case, the sampling structure shall be set to 1_h (4:2:2I, 16:9);

– 1_h = Segmented frame (PsF). In this case, the sampling structure shall be set to 5_h (4:2:2P, 16:9);

– 3_h = Progressive (P). In this case, the sampling structure shall be set to 5_h (4:2:2P, 16:9);

– The value 2_h is reserved, but not defined.

Table A.1 – Payload identifier definitions forITU-R BT.601 payloads on ANSI/SMPTE 259M SDI

Bits	Byte 1	Byte 2	Byte 3	Byte 4
Bit 7	0	Reserved	Reserved	Reserved
Bit 6	0	Reserved	Reserved	Reserved
Bit 5	0	Reserved	Reserved	Reserved
Bit 4	0	Reserved	4:3/16:9	Reserved
Bit 3	0	Frame rate	Sampling structure	Reserved
Bit 2	0			Reserved
Bit 1	0			Reserved
Bit 0	1			Reserved

Table A.3 – Payload identifier definitions for 525/625 progressive and interlaced payloads on 540 Mb/s SDI

Bits	Byte 1	Byte 2	Byte 3	Byte 4
Bit 7	0	Reserved	Reserved	Reserved
Bit 6	0	Reserved	Reserved	Reserved
Bit 5	0	Reserved	Reserved	Reserved
Bit 4	0	Reserved	4:3/16:9	Reserved
Bit 3	0	Frame rate	Sampling structure	Reserved
Bit 2	0			Reserved
Bit 1	1			Reserved
Bit 0	1			Reserved

A.6 SMPTE 349M (SD video payload mapping into SMPTE 292M)

When identifying SD video payloads mapped onto SMPTE 292M, the following limitations shall apply:

– The frame rate shall be set to the value of the SD interface as defined in table 1 of SMPTE 349M;

– The sampling structure shall be set to the value as defined in table 1 of SMPTE 349M;

– Bit 6 of byte 3 shall be used to identify the mapping mode. Setting bit 6 to 0 shall define normal mapping, and setting bit 6 to 1 shall define whole-line mapping (see SMPTE 349M for details on the mapping modes);

– Bit 4 of byte 3 shall be used only for sampling structures based on payloads with 720 active luminance samples. In these cases, if the bit is 0, then the source image aspect ratio is 4:3, and if the bit is 1, then the source image aspect ratio is 16:9 (i.e., anamorphic).

Table A.2 – Payload identifier definitions for ITU-R BT.1358 payloads on ITU-R BT.1362 SDI

Bits	Byte 1	Byte 2	Byte 3	Byte 4
Bit 7	0	Reserved	Channel number	Reserved
Bit 6	0	Reserved		Reserved
Bit 5	0	Reserved	Reserved	Reserved
Bit 4	0	Reserved	4:3/16:9	Reserved
Bit 3	0	Frame rate	Sampling structure	Reserved
Bit 2	0			Reserved
Bit 1	1			Reserved
Bit 0	0			Reserved

Table A.4 – Payload identifier definitions for 750-line video interfaces on SMPTE 292M

Bits	Byte 1	Byte 2	Byte 3	Byte 4
Bit 7	0	Reserved	Reserved	Reserved
Bit 6	0	Reserved	Reserved	Reserved
Bit 5	0	Reserved	Reserved	Reserved
Bit 4	0	Reserved	Reserved	Reserved
Bit 3	0	Frame rate	Sampling structure	Reserved
Bit 2	1			Reserved
Bit 1	0			Reserved
Bit 0	1			Reserved

Table A.5 – Payload identifier definitions for 1125-line payloads on SMPTE 292M

Bits	Byte 1	Byte 2	Byte 3	Byte 4
Bit 7	0	P, I and PsF identification	Reserved	Reserved
Bit 6	0		Reserved	Reserved
Bit 5	0	Reserved	Reserved	Reserved
Bit 4	0	Reserved	Reserved	Reserved
Bit 3	0	Frame rate	Sampling structure	Reserved
Bit 2	1			Reserved
Bit 1	0			Reserved
Bit 0	0			Reserved

Table A.6 – Payload identifier definitions for mapping SD interfaces into SMPTE 292M HD-SDI

Bits	Byte 1	Byte 2	Byte 3	Byte 4
Bit 7	0	Reserved	Reserved	Reserved
Bit 6	0	Reserved	Mapping mode	Reserved
Bit 5	0	Reserved	Reserved	Reserved
Bit 4	0	Reserved	4:3/16:9	Reserved
Bit 3	0	Frame rate	Sampling structure	Reserved
Bit 2	1			Reserved
Bit 1	1			Reserved
Bit 0	0			Reserved

Annex B (informative)
Mapping the payload identifier from an H-ANC packet to a K-L-V packet according to the data encoding protocol defined in SMPTE 336M

It should be noted that the H-ANC data packet has a key-length-value construct like that of SMPTE 336M. The packet starts with start code; the ADF word sequence, which is a defined start code in digital video interfaces. This is followed by DID and SDID words which define the data type, a data count, and the data itself (the digital video interface payload identifier). The packet is completed with a checksum to detect possible errors. If the ADF and CS words are removed, then the data structure is a key-length-value. Thus, the value of the H-ANC packet (i.e., the digital video interface payload words) can be mapped into the K-L-V protocol of SMPTE 336M (shown in figure B.1 and table B.1) as follows:

In mapping H-ANC packet data into a K-L-V data packet, it is of course possible to consider mapping the whole H-ANC packet as the value, but this is a tunneling process in which there are two layers of overhead, one from the H-ANC packet structure and one from the K-L-V data construct. This adds no value so the concept of heterogeneous operation where the payload is mapped into the local data construct is preferred to that of tunneling.

The 4-byte payload identifier should be added to the SMPTE metadata dictionary (SMPTE RP 210) with the recommended value for the SMPTE universal label (UL) (see table B.2).

NOTE – The 16-byte UL value is shown for guidance only. Users should consult the most recent version of the SMPTE metadata dictionary for the definitive value.

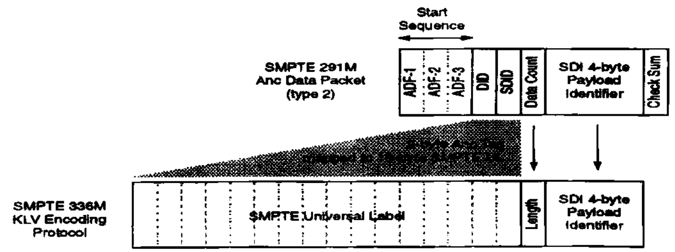

Figure B.1 – Mapping of an H-ANC payload identifier into a K-L-V packet

Table B.1 – Mapping of H-ANC packet data into the K-L-V metadata construct

Data structure	H-ANC packet	K-L-V protocol
Key	DID + SDID	16-byte universal label
Length	DC	Variable length
Value	4-byte SDI payload identifier	4-byte SDI payload identifier

Table B.2 – Recommended value for the SMPTE metadata dictionary universal label

Byte No.	Description	Value (hex)
1	Object identifier	06_h
2	Label size	$0E_h$
3	Designation: ISO	$2B_h$
4	Designation: SMPTE	34_h
5	Registry: Dictionaries	01_h
6	Registry: Metadata dictionaries	01_h
7	Standard: Metadata standard	01_h
8	Version number	01_h
9	Identification and location	01_h
10	Globally unique identification	01_h
11	Stream identification	17_h
12	SDI ANC packet identification	02_h
13	Ancillary data packet DID	41_h
14	Ancillary packet SDID	01_h
15	Zero fill	00_h
16	Zero fill	00_h

Annex C (informative)
Payload identifier

C.1 Need

The first component digital video interface specifications were based on a unique mapping of the sampled pixels onto a synchronous transport mechanism. Thus, the 525 and 625 variants are vertical standards which encompass all levels of the ISO/OSI 7-layer reference model. At the time of developing these standards, the technology was in its infancy and manufacturers had to use the fastest chips available at the time to achieve the 270-Mb/s serial data rate.

Nonetheless, there were already users who wished to use the interfaces in more creative ways; in particular, the use of two digital video interface channels with one channel carrying the baseband 4:2:2 sample structure and the second carrying a linear key channel and the missing chrominance samples to make a so-called 4x4 system. Such developments were used by only a small number of users and, thus, the problem of labeling the twin connections was a matter of physically tagging the cables to ensure that the channels were connected correctly.

A further development was that of the 360-Mb/s SDI which extended the horizontal bandwidth by a third for use with widescreen television based on 960 active luminance samples per line rather than the 720 pixels in 270-Mb/s SDI. This, however, was still manageable and compatibility with 270-Mb/s SDI was relatively easily maintained.

The next major milestone in SDI history was the extension to carry data which, in its various forms, is now known as the transport for data carriage, SDTI. This distinguishes itself from SDI by adding a payload identifier in the H-blanking to identify itself as SDTI and to identify the payload packet structure carried by the transport.

The initial development of HD-SDI (SMPTE 292M) was again an exotic technology at the time having SMPTE data rate which has finally settled at 1.485 Gb/s. It too carried a single payload initially based on a single video sampling structure. However, new developments produced two sample structure variants:

– A first system based on 1080 active lines in an interlaced frame with 1920 horizontal luminance samples; and

– A second system based on 720 active lines in a progressive frame with 1280 horizontal luminance samples.

Both used the HD-SDI interface as a common carrier. Now that HD is considered as a worldwide production format, the list of sampling variants in the 1080-line family has reached 13 and that of the 720-line family has reached eight to accommodate the different frame rates used throughout the world.

A further development is that of 540-Mb/s SDI which is designed to carry a number of payloads including progressive scan 59.94/60-Hz (and potentially 50-Hz) systems.

The latest development is the mapping of SD television scanning rates onto HD-SDI with the aim of using one interface to carry many payloads.

These ongoing developments are possible because the technology now allows such capability and the HD-SDI interface in particular has the capacity to carry almost every television scanning system in use today and the near future.

The problem is that it is now becoming difficult for equipment to recognize the payload type as it is no longer intimately related to the interface. Moving inexorably to the horizontal model of standards, each horizontal layer is becoming detached from the layers immediately above and below.

C.2 Length

The payload identifier has a 4-byte length for a number of reasons:

- One or two bytes do not give sufficient flexibility for possible future (unforeseen) applications;

- A 16-byte SMPTE universal label is a gross excess of capability. Universal labels are conventionally in multiples of 4 bytes up to 64 bytes maximum;

- A 4-byte payload identifier allows both easy parsing and can accommodate all foreseen requirements with adequate room for further expansion for unforeseen requirements in the future.

A digital video interface payload identifier could be used to identify core sampling parameters such as H and V resolutions, luminance and chrominance sampling structures, and more. It would then encompass information which is provided by the SMPTE video index (SMPTE RP 186). Taking this approach to its logical conclusion means that the payload identifier becomes a lengthy metadata set rather than an identifier.

The above approach was rejected as being too complex for relatively simple digital video interface connections and replicates information which would be better placed elsewhere; such as the video index.

The simple approach used in this standard uses the payload identifier to identify the relevant SMPTE standard and any options within that standard. An example would be to use the first byte of the payload identifier to point to SMPTE 274M and then use the remaining parts to identify the table entry in the standard. Since the number of digital video interface standards is limited and the number of tables in each entry is typically restricted to a few entries, this process can be simply defined and easily parsed by decoders.

Annex D (informative)
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