

SMPTE STANDARD

Dual Link 1.5 Gb/s Digital Interface for 1920 × 1080 and 2048 × 1080 Picture Formats



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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE ST 372 was prepared by Technology Committee 32NF.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

1 Scope

This standard specifies the mapping of the source image data defined in Table 1 onto a dual-link 1.5 Gb/s HD-SDI (Link A and Link B) in conformance with SMPTE ST 292-1. The total data rate of the dual link connection is 2.970 Gb/s or 2.970/1.001 Gb/s. This dual link also specifies carriage of the embedded audio, ancillary data and the payload ID of the stream in conformance with SMPTE ST 291, SMPTE ST 299-1 and SMPTE ST 352.

The image source digital representations are defined in SMPTE ST 274, SMPTE ST 428-9, SMPTE ST 428-19 and SMPTE ST 2048-2.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

3 Normative References

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 12-2:2008) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 12M-2-2008). Documents with the same root number (e.g. 12-2) and publication year (e.g. 2008) are functionally identical.

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 recommended practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE ST 12-2:2008, Television —Transmission of Time Code in the Ancillary Data Space

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

SMPTE ST 291:2010, Ancillary Data Packet and Space Formatting

SMPTE ST 292-1:2011, 1.5 Gb/s Signal/Data Serial Interface

SMPTE ST 299-1:2010, 24-Bit Digital Audio Format for SMPTE ST 292-1 Bit-Serial Interface

SMPTE ST 352:2011, Payload Identification Codes for Serial Digital Interfaces

SMPTE ST 428-9:2008, D-Cinema Distribution Master — Image Pixel Structure Level 3 — Serial Digital Interface Signal Formatting

SMPTE ST 428-19:2010, D-Cinema Distribution Master — Additional Frame Rates Level AFR2 and Level AFR4 — Serial Digital Interface Signal Formatting

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

4 General

This dual link standard is intended to extend SMPTE ST 292-1 applications to include R'G'B', X'Y'Z' and R'_{FS}G'_{FS}B'_{FS} (hereafter R'G'B' indicates either R'G'B' or R'_{FS}G'_{FS}B'_{FS}) and 10-bit and 12-bit source signals, as well as to provide for the carriage of an optional Alpha channel. See Table 1. In addition, support for frame rates greater than 30 Frames per second are documented.

4.1 When 60P,59.94P,50P,48P,47.95P/4:2:2/10-bit signals are present, data in the 4:2:2 (Y'C_BC_R) format shall be divided line sequentially into two data streams,

4.2 When 4:4:4 (R'G'B'+A)/10-bit signals are present, Link A shall carry all the G' samples plus B' and R' even-numbered samples. Link B shall carry the B' and R' odd-numbered samples, and, if present, the samples of the alpha channel.

4.3 When 4:4:4 (R'G'B') or X'Y'Z' 12-bit signals are present, Link A shall carry the most significant 10 bits of all the G' or Y' samples plus the most significant 10 bits of B' or Z' and R' or X' even-numbered samples. Link B shall carry the most significant 10 bits of the B' or Z' and R' or X' odd-numbered samples, plus the least significant 2 bits of the R'G'B' or X'Y'Z' samples which are mapped to the alpha channel.

4.4 When 4:4:4 (Y'C_BC_R), 4:4:4 (Y'C_BC_RA)/10-bit or 4:4:4 (Y'C_BC_R)/12-bit signals are present, the data structure of Link A and Link B shall be identical to that used for R'G'B', R'G'B'+A/10-bit or R'G'B'/12-bit respectively.

4.5 When 4:2:2:4 (Y'C_BC_RA) 12-bit signals are present, Link A shall carry the most significant 10 bits of all the Y' samples plus the most significant 10 bits of C_B and C_R even-numbered samples. Link B shall carry the least significant 2 bits of the Y', C_B and C_R even-numbered samples, plus the least significant 2 bits of the Y' (only) odd-numbered samples plus the alpha channel.

4.6 Link A and Link B shall carry SAV, EAV as defined in SMPTE ST 274, Line Number data (LN) and CRC as defined in SMPTE ST 292-1.

5 Source Image Formats

The source image formats used in this standard shall be as defined in Table 1.

Table 1 – Source signal formats

Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/Pixel Depth	Frame Rates	Document Section Number
ST 274	1920 × 1080	4:2:2 (Y'C _B C _R)/10-bit	60, 60/1.001 and 50 Progressive	§ 5.1
		4:4:4 (R'G'B'), 4:4:4:4 (R'G'B' +A [see note])/10-bit	30, 30/1.001, 25, 24 and 24/1.001 Progressive, PsF	§ 5.2
		4:4:4 (R'G'B')/12-bit		§ 5.3
		4:4:4 (Y'C _B C _R), 4:4:4:4 (Y'C _B C _R +A [see note]) /10-bit		§ 5.4
		4:4:4 (Y'C _B C _R)/12-bit	60, 60/1.001 and 50 Fields Interlaced	§ 5.4
		4:2:2 (Y'C _B C _R)/12-bit, 4:2:2:4 (Y'C _B C _R A)/12-bit		§ 5.5
ST 2048-2 ¹	2048 × 1080	4:2:2 (Y'C _B C _R)/10-bit	60, 60/1.001, 50, 48 and 48/1.001 Progressive	§ 5.1
		4:4:4 (R'G'B'), 4:4:4:4 (R'G'B' +A [see note])/10-bit	30, 30/1.001, 25, 24 and 24/1.001 Progressive, PsF	§ 5.2
		4:4:4 (R'G'B')/12-bit		§ 5.3
		4:4:4 (Y'C _B C _R), 4:4:4:4 (Y'C _B C _R +A [see note]) /10-bit		§ 5.4
		4:4:4 (Y'C _B C _R)/12-bit		§ 5.4
		4:2:2 (Y'C _B C _R)/12-bit, 4:2:2:4 (Y'C _B C _R A)/12-bit		§ 5.5
ST 428-9	2048 × 1080	4:4:4 (X'Y'Z')/12-bit	24 Progressive, PsF	§ 5.3
ST 428-19	2048 × 1080	4:4:4 (X'Y'Z')/12-bit	25 and 30 Progressive, PsF	§ 5.3

Note: Definition of the A channel is application-dependent. In the cases when the A channel is used for non-picture data, the payload is constrained to 8-bit words maximum

5.1 4:2:2 (Y'C_BC_R)/10-bit Signals at 60, 60/1.001, 50, 48 and 48/1.001 Progressive Frame Rates

5.1.1 Data Stream Mapping

Mapping of the data created by the 4:2:2 picture sampling structure shall be as shown in Figures 1 and 2. Each line of the source picture raster shall be alternately mapped between Link A and Link B.

1 R'G'B' indicates either R'G'B' or R'_{FS}G'_{FS}B'_{FS}.

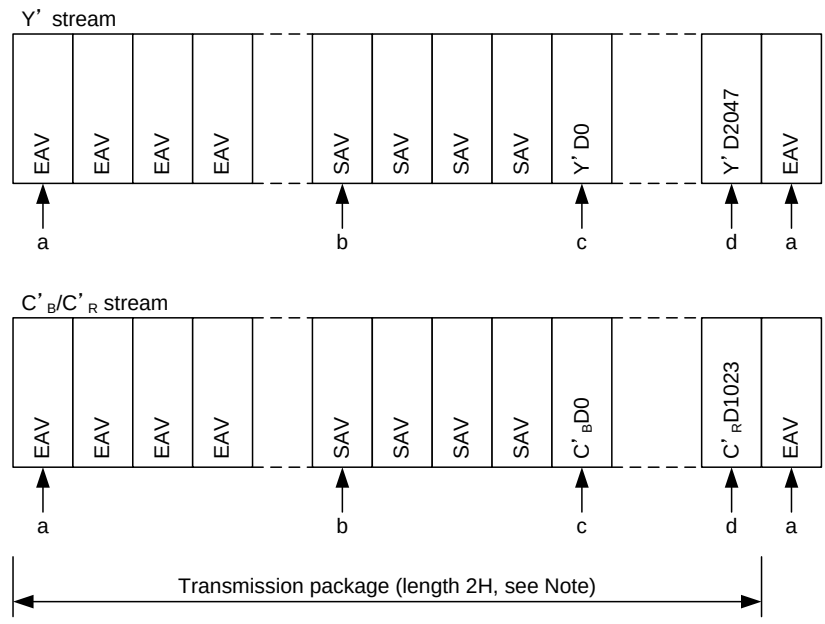
5.1.2 Timing Reference Signals and Line Numbers

The F (field/frame), V (vertical), H (horizontal), P3, P2, P1, P0 (parity) bits and the line numbers of Link A and Link B shall be as shown in Figures 1 and 2 and shall be as defined in SMPTE ST 274 and SMPTE ST 292-1.

5.1.2.1 The Line Number data carried in Link A and Link B shall be the digital interface Line Number defined in SMPTE ST 292-1 and shall not be the picture source line numbers. The relation between the digital interface line number and the picture source line number shall be as shown in Figure 2.

5.1.2.2 Buffering having a minimum duration of one horizontal line shall be required by this process at each interface, making a minimum transmission delay of two horizontal lines.

5.1.2.3 Figure 1 defines luma and color-difference signals multiplexing within a transmission package.



Note: H denotes one line period of the original 60, 60/1.001, 50 progressive signals as specified by SMPTE ST 274 or 60, 60/1.001, 50, 48, 48/1.001 progressive signals as specified by SMPTE ST 2048-2.

Reference SMPTE Standard	Frame Rate	Total words per transmission package	Total words of active image data per transmission package	Word number			
				a	b	c	d
ST 274	60 or 60/1.001	2200	1920	1920	2196	0	1919
ST 2048-2	60 or 60/1.001	2200	2048	2048	2196	0	2047
ST 274	50	2640	1920	1920	2636	0	1919
ST 2048-2	50	2640	2048	2048	2636	0	2047
ST 2048-2	48 or 48/1.001	2750	2048	2048	2746	0	2047

Figure 1 – Multiplexed horizontal data stream

		Original Picture Source Line Number		Digital Interface Line Number
		Link A	Link B	
Digital Field Blanking (V=1)		2	3	1
Digital Field #1 (F=0) (total lines: 563 x 2)		40	41	20
	Digital Active Field (V=0)	42	43	21
		1120	1121	560
Digital Field Blanking (V=1)		1122	1123	561
		1124	1125	562
		1	2	563
		3	4	564
Digital Field #2 (F=1) (total lines: 562 x 2)		41	42	583
	Digital Active Field (V=0)	43	44	584
		1121	1122	1123
Digital Field Blanking (V=1)		1123	1124	1124
		1125	1	1125

Figure 2 – 1080P— Link A/B line interleaving and line numbering

5.1.2.4 Line 42 of the source active picture and line 1122 of the source vertical blanking interval, when transported in Digital Field #2 of Link B shall be mapped on to the interface line 583 and line 1123 respectively. Interface line 583 of Link B carries active video data however V bit shall be set to 1, and interface line 1123 of Link B does not carry active video data however the V bit shall be set to 0.

5.1.2.5 Link B Interface line number 583, samples number 0-1919 shall not be used to carry ancillary data packets.

Note: Some early implementations do not adhere to this requirement.