SMPTE ST 372:2017
Revision of SMPTE ST 372:2011

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 291-1, 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 SMPTE ST 2048-2 and Recommendation ITU-R BT.2100.

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

The following engineering documents 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 RP 2077:2013, Full Range Image Mapping

SMPTE ST 12-2:2014, 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 291-1:2011, Ancillary Data Packet and Space Formatting

SMPTE ST 292-1:2012, 1.5 Gb/s Signal/Data Serial Interface

SMPTE ST 299-1:2009, 24-Bit Digital Audio Format for SMPTE ST 292-1 Bit-Serial Interface

SMPTE ST 352:2013, 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

Recommendation ITU-R BT.2100-1 (06/2017), Image parameter values for high dynamic range television for use in production and international programme exchange.

4 General

This dual link standard is intended to extend SMPTE ST 292-1 applications to include IC_TC_P, 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 ($Y'C'_BC'_R$) or (IC_TC_P), format shall be divided line sequentially into two data streams,

4.2 When 4:4:4:4 (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 ($Y'C'_BC'_R$) or (IC_TC_P), 4:4:4:4 ($Y'C'_BC'_RA$) or (IC_TC_PA)/10-bit or 4:4:4 ($Y'C'_BC'_R$) or (IC_TC_P)/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 ($Y'C'_BC'_R$ A) or (IC_TC_PA), 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.

For IC_TC_P image mapping, Y' shall be replaced with I, C'_B shall be replaced with C_T and C'_R shall be replaced with C_P.

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 Standard	Image Format	Signal Format Sampling Structure/Pixel Depth	Frame / Field Rates	Document Section Number
ST 274 Recommendation ITU-R BT.2100	1920 × 1080	4:2:2 ($Y'C'_BC'_R$)/10-bit 4:2:2 (IC_TC_P)/10-bit	60, 60/1.001 and 50 Frames Progressive	§ 5.1
		4:4:4 (R'G'B'), 4:4:4:4 (R'G'B' +A *1)/10-bit	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive or PsF 60, 60/1.001 and 50 Fields Interlaced	§ 5.2
		4:4:4 (R'G'B')/12-bit		§ 5.3
		4:4:4 ($Y'C'_BC'_R$), 4:4:4:4 ($Y'C'_BC'_R$+A *1) /10-bit 4:4:4 (IC_TC_P), 4:4:4:4 (IC_TC_P+A *1)/10-bit		§ 5.4
		4:4:4 ($Y'C'_BC'_R$)/12-bit 4:4:4 (IC_TC_P)/12-bit		§ 5.4
		4:2:2 ($Y'C'_BC'_R$)/12-bit, 4:2:2:4 ($Y'C'_BC'_R$A)/12-bit		§ 5.5
ST 2048-2 *2	2048 × 1080	4:2:2 ($Y'C'_BC'_R$)/10-bit	60, 60/1.001, 50, 48 and 48/1.001 Frames Progressive	§ 5.1
		4:4:4 (R'G'B'), 4:4:4:4 (R'G'B' +A *1)/10-bit	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive or PsF	§ 5.2
		4:4:4 (R'G'B')/12-bit		§ 5.3
		4:4:4 ($Y'C'_BC'_R$), 4:4:4:4 ($Y'C'_BC'_R$+A *1) /10-bit		§ 5.4
		4:4:4 ($Y'C'_BC'_R$)/12-bit		§ 5.4
		4:2:2 ($Y'C'_BC'_R$)/12-bit, 4:2:2:4 ($Y'C'_BC'_R$A)/12-bit		§ 5.5
ST 428-9	2048 × 1080	4:4:4 (*X'Y'Z'*)/12-bit	24 Frames Progressive or PsF	§ 5.3
ST 428-19	2048 × 1080	4:4:4 (*X'Y'Z'*)/12-bit	25 and 30 Frames Progressive or PsF	§ 5.3

NOTE: In accordance with Recommendation ITU-R BT.2100, IC_TC_P sampling is only applied to High Dynamic Range (HDR) progressive image formats.

*1 Definition of the A channel is application-dependent. An auxiliary component signal designated A or Alpha may optionally accompany the R'G'B', $R'_{FS}G'_{FS}B'_{FS}$, $Y'C'_BC'_R$ or IC_TC_P video signal. If present it shall have the same characteristics as the Y', G' or I channel. Interfaces containing the auxiliary component are denoted as R'G'B'+A, $Y'C'_BC'_R$ +A and IC_TC_P + A.. In the cases when the A channel is used for non- picture data, the payload is constrained to 8-bit words maximum

*2 R'G'B' indicates either R'G'B' or $R'_{FS}G'_{FS}B'_{FS}$