SMPTE STANDARD

2048 × 1080 Digital Cinematography Production Image FS/709 Formatting for Serial Digital Interface

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Approved
March 30, 2011

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 2048-2 was prepared by Technology Committee 10E

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

1.1 This standard defines the mapping of 2048 × 1080 pixel array into a 2200 sample × 1125 line interface structure as defined in SMPTE ST 274.

This standard specifies:

— Pixel array structure, Digital Timing Reference Sequences (SAV, EAV) and Digital Representation for transmission with single link or multi-link SMPTE ST 292-1 or SMPTE ST 424.

— Recommended Location of the color VANC packet defined in § 6.3 of SMPTE ST 2048-1.

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 274:2008) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 274M-2008). Documents with the same root number (e.g. 274) 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 standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

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

SMPTE ST 2048-1:2011, 2048 × 1080 and 4096 × 2160 Digital Cinematography Production Image Formats FS/709

4 General

4.1 An implementation of a system claiming compliance with this standard should state:

— which of the systems of Table 1 in Section 5 are implemented;

— which of the signal representations are implemented (R'G'B', $Y'C'_BC'_R$, R'G'B'A, $Y'C'_BC'_RA$, $R'_{FS}G'_{FS}B'_{FS}$ or $R'_{FS}G'_{FS}B'_{FS}A$); and

— whether the pixel representation employs a depth of 10 bits or 12 bits

It is not necessary for an implementation to support all formats to be compliant with this standard..

4.2 This standard specifies multiple frame rate formats as shown in Table 1 in Section 5.

4.3 Annex A of this standard defines the Progressive segmented Frame interface structure.

5 Digital Sample Structure and Digital Reference Sequences (SAV, EAV)

5.1 The image pixel array of 2048 × 1080 is mapped into the active area of the interface as shown in Figure 1.

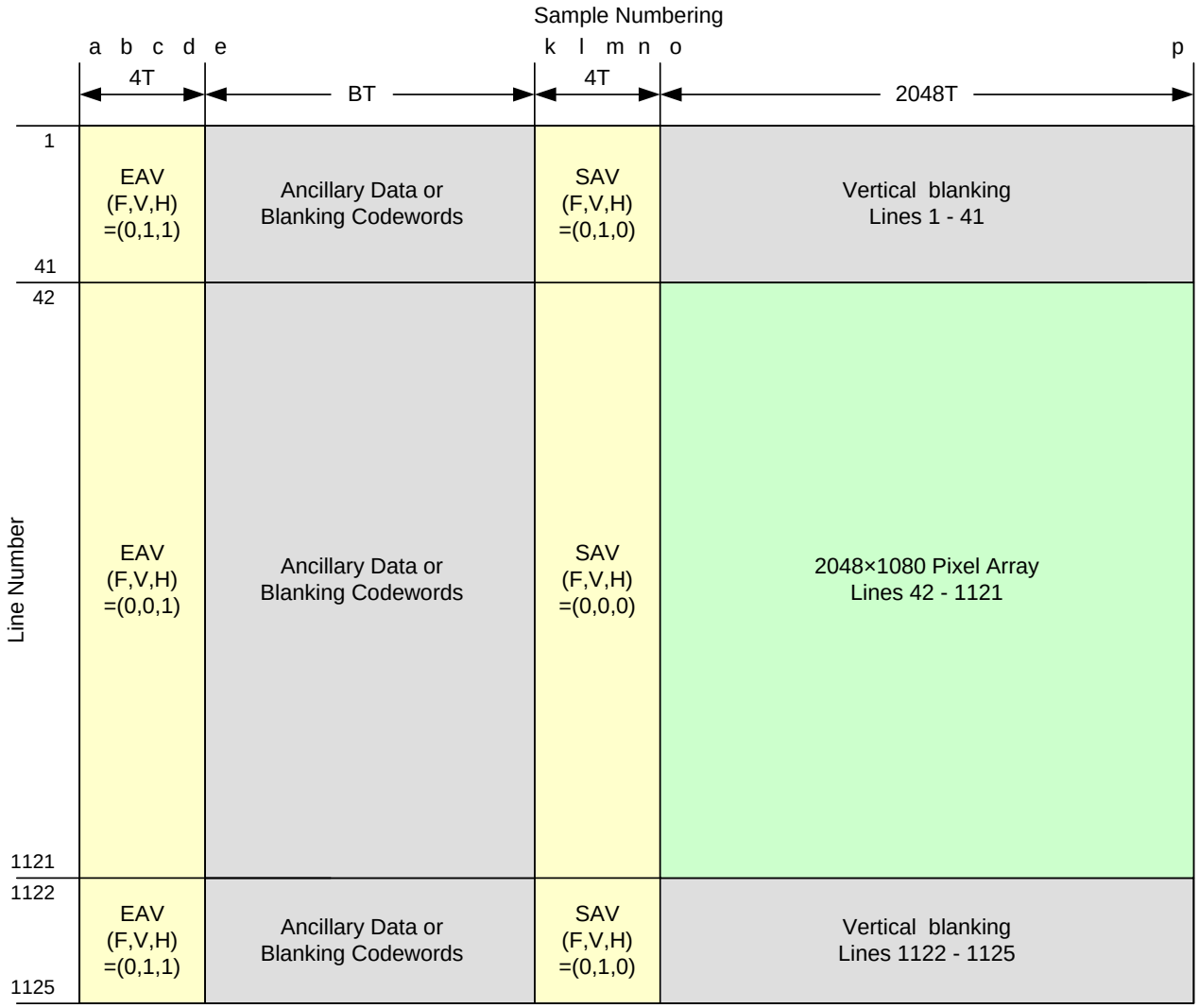
5.2 The digital timing reference sequence (SAV/EAV) shall be in conformance with the 10-bit and 12-bit definition in Section 9 of SMPTE ST 274. The sample numbering of one horizontal line and definitions of F, V, H shall be as defined in Figure 1.

5.3 The ancillary data shall be in conformance with Annex B of SMPTE ST 274.

Table 1 – 2048 × 1080 image pixel array, frame rates, and interface parameters

System No.	System nomenclature	Luma, R'G'B' or $R'_{FS}G'_{FS}B'_{FS}$ samples per active line (S/AL)	Active lines per frame (AL/F)	Frame rate (Hz)	Interface sampling frequency fs (MHz)	Luma sample periods per total line (S/TL)	Total lines per frame
1	2048 × 1080/60/P	2048	1080	60	148.5	2200	1125
2	2048 × 1080/59.94/P	2048	1080	$\frac{60}{1.001}$	$\frac{148.5}{1.001}$	2200	1125
3	2048 × 1080/50/P	2048	1080	50	148.5	2640	1125
4	2048 × 1080/48/P	2048	1080	48	148.5	2750	1125
5	2048 × 1080/47.95/P	2048	1080	$\frac{48}{1.001}$	$\frac{148.5}{1.001}$	2750	1125
6	2048 × 1080/30/P	2048	1080	30	74.25	2200	1125
7	2048 × 1080/29.97/P	2048	1080	$\frac{30}{1.001}$	$\frac{74.25}{1.001}$	2200	1125
8	2048 × 1080/25/P	2048	1080	25	74.25	2640	1125
9	2048 × 1080/24/P	2048	1080	24	74.25	2750	1125
10	2048 × 1080/23.98/P	2048	1080	$\frac{24}{1.001}$	$\frac{74.25}{1.001}$	2750	1125

Note: Throughout this standard, references to signals represented by a single primed letter (e.g., R', G', B', Y', C'_B, C'_R and R'_{FS}, G'_{FS}, B'_{FS}) refer to signals to which the transfer characteristics defined in Section 6 of SMPTE ST 2048-1 have been applied. Such signals are commonly described as being gamma corrected.



System	a	b	c	d	e	k	l	m	n	o	p	BT
1,2,6,7	2048	2049	2050	2051	2052	2196	2197	2198	2199	0	2047	144T
3,8	2048	2049	2050	2051	2052	2636	2637	2638	2639	0	2047	584T
4,5,9,10	2048	2049	2050	2051	2052	2746	2747	2748	2749	0	2047	694T

NOTES

1. Horizontal axis not to scale.
2. A line of digital video extends from the first word of EAV through the last word of video data.
3. The number of samples of video data (sample number ‘o’ through ‘p’ in Figure 1) is 2048. That is, the letter ‘o’ denotes sample number 0 and the letter ‘p’ denotes sample number 2047.
4. T is the reference clock period.
5. At the interface, there are variations in the mapping known as “PsF”. See Annex A for a description.

Figure 1 – Image mapping structure and Digital timing reference sequences of 2048 × 1080 progressive images

6 Color VANC

The Color VANC packet defined in SMPTE ST 2048-1, when transported through a single-link or a multiple-link HD-SDI shall be transmitted in link A or the first link of a multi-link interface transport once per frame.

The recommended mapping location of the Color VANC packet should be in the vertical ancillary data space following the last word of SAV of the line 18 of the Y data stream of a progressive interface as shown in Figure 2. SMPTE ST 291 compliant ANC data receivers shall detect the Color VANC packet by its DID and SDID,not by any suggested location.

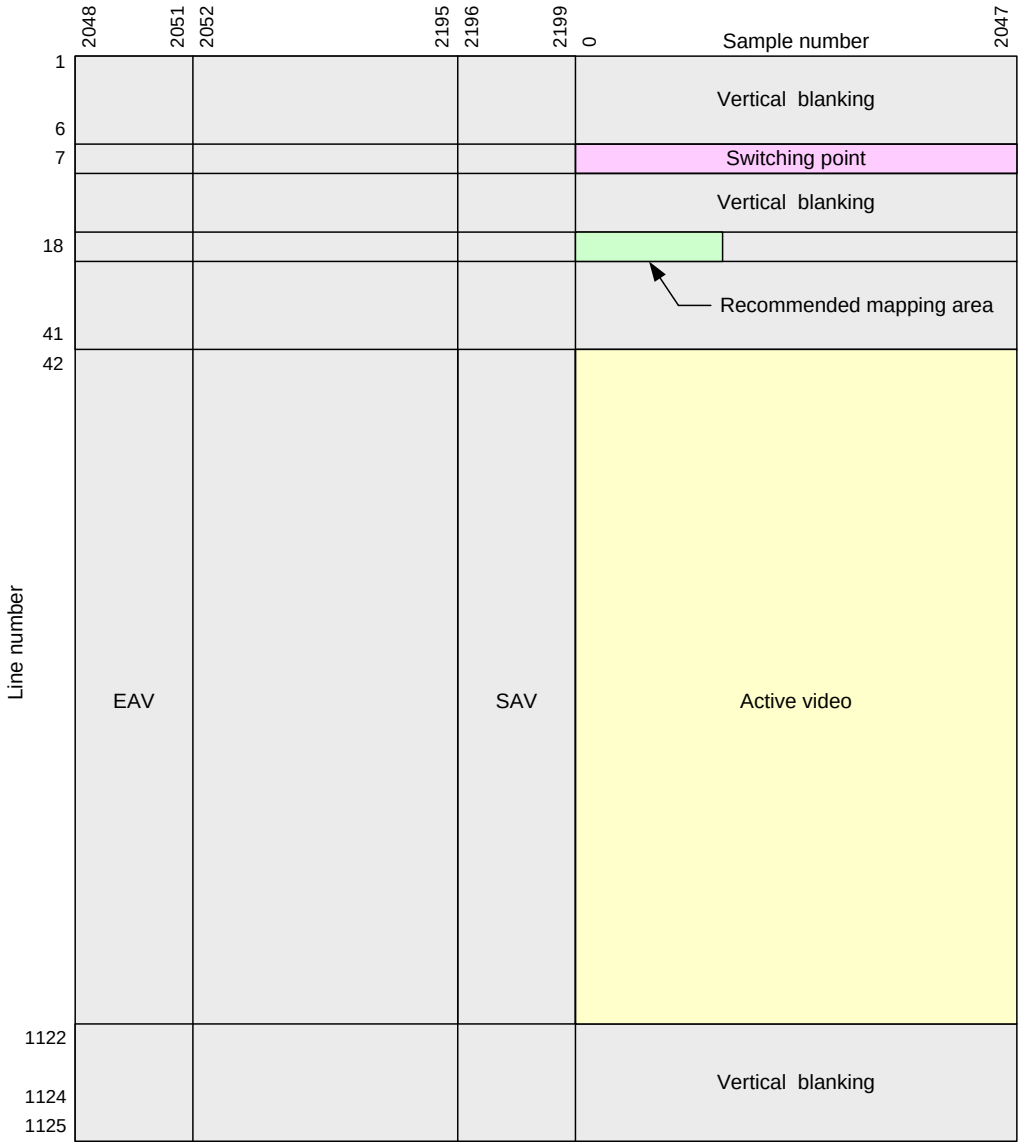


Figure 2 – Color VANC Packet- Recommended location

7 Digital Representation

7.1 10-bit code values $000_h(0_{(10)})$ through $003_h(3_{(10)})$ and $3FC_h(1020_{(10)})$ through $3FF_h(1023_{(10)})$, and 12-bit code values $000_h(0_{(12)})$ through $00F_h(15_{(12)})$ and $FF0_h(4080_{(12)})$ through $FFF_h(4095_{(12)})$ are employed exclusively for synchronization purposes.

Annex A Progressive Segmented Frame System (Normative)

The structure of the 2048 × 1080 Progressive segmented Frame system (Table A.1) shall be in conformance with Annex A of SMPTE ST 274.

Table A.1 – Interface ordering of 2048 × 1080 PsF systems

No.	Interface nomenclature	Table 1. system number
A	2048 × 1080/30/PsF	6
B	2048 × 1080/29.97/PsF	7
C	2048 × 1080/25/PsF	8
D	2048 × 1080/24/PsF	9
E	2048 × 1080/23.98/PsF	10

Annex B Bibliography (Informative)

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 424:2006) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 424M-2006). Documents with the same root number (e.g. 424) and publication year (e.g. 2006) are functionally identical.

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

SMPTE ST 299-1:2009, 24-Bit Digital Audio Format for SMPTE 292 Bit-Serial Interface (Note: Document previously numbered SMPTE 299-2009 – Content Unchanged)

SMPTE ST 372:2011, Dual Link 1.5 Gb/s Digital Interface for 1920 × 1080 and 2048 × 1080 Picture Formats

SMPTE ST 424:2006, Television – 3 Gb/s Signal/Data Serial Interface

Annex C Document Road Map (Informative)