SMPTE RECOMMENDED PRACTICE

Special Considerations for Standard Definition Video Using SMPTE ST 2110-20

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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 its Standards Operations Manual. This SMPTE Engineering Document was prepared by Technology Committee 32NF.

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 clause 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.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; tables shall be next; then formal languages; then figures; and then any other language forms.

Introduction

This clause is entirely informative and does not form an integral part of this Engineering Document.

The SMPTE 2110 family of documents provides an extremely flexible methodology for transporting video, audio, and ancillary essences, separately, over IP networks. When transporting Standard-Definition essences, such as those specified in SMPTE ST 125:2013, special considerations apply regarding the potential to transport signals in the vertical blanking area, where situational flexibility is desirable. This document recommends specific practices that will improve interchange between the 2110-20 and Serial Digital Interface (SDI) interfaces, and enhance end-to-end interoperability across vendors.

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

1   Scope

This Recommended Practice specifies a relationship between the Sample Rows of SMPTE ST 2110-20 signals and the line numbering of SMPTE ST 125:2013. It also provides guidance on values for certain Media Type Parameters.

2   Normative References

The following documents contain provisions that, through reference in this text, constitute provisions of this standard. Dated references require that the specific edition cited shall be used as the reference. Undated citations refer to the edition of the referenced document (including any amendments) current at the date of publication of this document. All documents are subject to revision, and users of this engineering document are encouraged to investigate the possibility of applying the most recent edition of any undated reference.

Recommendation ITU-R BT.1700-0 (02/2005) Characteristics of composite video signals for conventional analogue television systems

SMPTE RP 202:2008 Video Alignment for Compression Coding

SMPTE ST 125:2013 SDTV Component Video Signal Coding 4:4:4 and 4:2:2 for 13.5 MHz and 18 MHz Systems

SMPTE ST 2110-20:2022 Professional Media over Managed IP Networks: Uncompressed Active Video

3   Terms and Definitions

3.1
Sample Row

Sample Row as defined in SMPTE ST 2110-20

3.2
Image Format Line Number

line within the SMPTE ST 125:2013 image numbered as defined by Recommendation ITU-R BT.1700

4 Vertical Size and Position Relative to SDI

4.1 Overview (Informative)

In the SDTV systems described in SMPTE ST 125:2013, a fixed structure of interface lines is defined. When using SMPTE ST 2110-20 to transport standard-definition video from SDI interfaces, senders need to determine how many of the interface lines to send, and which Interface Format Line Numbers to send.

SMPTE ST 125 defines active video regions for Field 1 and Field 2, and also defines Pre- and Post-Switched VANC regions for each field. While these VANC data regions might contain SMPTE ST 291 compliant Ancillary Data Packets, in some applications non-ANC information might be present in these regions. Examples of non-ANC information include SMPTE ST 266 D-VITC, SMPTE RP 186 VideoIndex, Nielsen AMOL, closed captions and XDS (in accordance with ANSI/CTA-608-E R-2014), and several types of teletext, perhaps including subtitles.

4.2 General

The Media Type Parameter `height` is defined in SMPTE ST 2110-20 to signal the number of Sample Rows per frame. Senders must determine how many (and which) lines of the SDI Interface information to transport, and thus calculate the SMPTE ST 2110-20 `height` parameter, subject to the constraints within ST 2110-20 and the requirements of this document. This determination can take into account the active video area defined in SMPTE ST 125:2013, and also any local practices or application-specific requirements concerning non-image information which might be present in the SDI signal.

SMPTE ST 2110-20:2020 stipulates that the first Sample Row of the temporally first field is spatially "above" the first Sample Row of the second field, and by implication if the `height` parameter is odd, the extra line is at the bottom of the temporally first field.

Senders under this Recommended Practice should select which Image Format Line Numbers to map into the SMPTE ST 2110-20 Sample Rows such that the Receiver behavior specified below will reconstruct the SDI output with the same information on the same Interface Format Line Numbers.

In the absence of other application requirements, the values for "coded lines" specified in Table 1 of SMPTE RP 202:2008 for 480i and 576i should be used in determining which Interface Format Line Numbers to send, and by inference the ST 2110-20 `height` value.

SMPTE ST 125:2013 describes both 4:2:2 and 4:4:4 representations of the signal. Senders and Receivers of standard-definition signals under this Recommended Practice shall use the 4:2:2 sampling structure and shall use the 13.5 MHz sampling system (720 active samples horizontally).

This Recommended Practice defines two operating modes, which differ in their constraints on the allowed value for the height parameter as specified in paragraphs 4.3 and 4.4:

- *Standard Mode*, in which the `height` parameter is constrained to the typical active video range. All implementations of this Recommended Practice shall implement the *Standard Mode*.
- *Extended Window Mode*, in which the `height` parameter is allowed to take values which include some of the interface lines which typically might contain non-ANC information. Implementation of the *Extended Window Mode* is optional.

4.3   525-line, 60/1.001 field/s Systems

In the 525-line system, when reconstructing SMPTE ST 125:2013 SDI signals from SMPTE ST 2110-20 Sample Rows under this Recommended Practice, receivers shall position the Sample Rows within the SDI Interface such that the last Sample Row of the second field is positioned on Image Format Line Number 525. The last Sample Row of the first field shall fall on Image Format Line Number 262 if `height` is even, and line 263 if `height` is odd.

In the *Standard Mode*, for the 525-line system, the image `height` parameter shall be no less than 480 lines (corresponding to SDI lines 23..262 and 286..525), and shall be no larger than 486 lines (SDI lines 20..262 and 283..525). Receivers shall support any value within the allowed range.

In the *Extended Window Mode*, the image `height` parameter may exceed 486 lines, but shall not exceed 512 lines (SDI lines 7..262 and 270..525). Receivers compliant with the *Extended Window Mode* shall support any value within the allowed range.

4.4   625-line, 50 field/s Systems

In the 625-line system, when reconstructing SMPTE ST 125:2013 SDI signals from SMPTE ST 2110-20 Sample Rows under this Recommended Practice, receivers shall position the Sample Rows within the SDI Interface such that the last Sample Row of the second field is positioned on Interface Format Line Number 623. The last Sample Row of the first field shall fall on Interface Format Line Number 310 if `height` is even, and line 311 if `height` is odd.

In the *Standard Mode*, for the 625-line system, the image `height` parameter shall be exactly 576 lines (corresponding to SDI lines 23..310 and 336..623).

In the *Extended Window Mode*, in the 625-line system, the image `height` parameter may exceed 576 lines, but shall not exceed 608 lines (SDI lines 7..310 and 320..623). Receivers compliant with the *Extended Window Mode* shall support any value within the allowed range.

5   Pixel Aspect Ratio and Horizontal Size

5.1   General

The Media Type Parameter `width` defined in SMPTE ST 2110-20 shall match the number of luminance samples in the representation of the signal in SMPTE ST 125:2013, taking the value 720 for 13.5 MHz systems.

SMPTE ST 2110-20 represents the Pixel Aspect Ratio as an integer ratio of the width and height of a luminance sample, and signals it using the Media Type Parameter `PAR` as a colon-separated pair of integers. Since luminance samples in the SDTV formats are not square, a value of `PAR` must be constructed and sent as noted below for each system.

NOTE   The use of 704 in the formulae below when deriving the default `PAR` reflects the typical practice of how the analogue waveform was applied to the screen area in practice. The signaled `width` parameter of 720 samples reflects the actual number samples to be transmitted. SMPTE RP 187:1995 gives slightly different figures for `PAR` but the values below reflect typical practice in current systems.

5.2   525-line, 60/1.001 field/s Systems

Unless there is specific application information to the contrary, the following values of PAR should be used for 525-line systems.

For 13.5 MHz 525-line systems, when targeting a 4x3 display aspect ratio, the PAR should be signaled as

$$\frac{704}{480} \times \frac{3}{4} = \frac{11}{10} \quad (\text{PAR} = 10{:}11)$$

For 13.5 MHz 525-line systems, when targeting a 16x9 display aspect ratio, the PAR should be signaled as

$$\frac{704}{480} \times \frac{9}{16} = \frac{33}{40} \quad (\text{PAR} = 40{:}33)$$

Even in the case that additional lines beyond the 480 minimum are transported, it is recommended to use the PAR values above, recognizing that the additional lines are not generally intended for display within the 4x3 or 16x9 display area.

5.3   625-line, 50 field/s Systems

Unless there is specific application information to the contrary, the following values of PAR should be used for 625-line systems.

For 13.5 MHz 625-line systems, when targeting a 4x3 display aspect ratio, the PAR is determined as

$$\frac{704}{576} \times \frac{3}{4} = \frac{11}{12} \quad (\text{PAR} = 12{:}11)$$

For 13.5 MHz 625-line systems, when targeting a 16x9 display aspect ratio, the PAR is determined as

$$\frac{704}{576} \times \frac{9}{16} = \frac{11}{16} \quad (\text{PAR} = 16{:}11)$$

Even in the case that additional lines beyond the 576 minimum are transported, it is recommended to use the PAR values above, recognizing that the additional lines are not generally intended for display within the 4x3 or 16x9 display area.

Bibliography

ANSI/CTA-608-E R-2014 "Line 21 Data Services" April 2008

SMPTE RP 186:2008 "Video Index Information Coding for 525- and 625-Line Television Systems"

SMPTE RP 187:1995 "Center, Aspect Ratio and Blanking of Video Images"

SMPTE ST 291-1:2011 Ancillary Data Packet and Space Formatting

SMPTE ST 266:2012 "SD Digital Component Systems — Digital Vertical Interval Time Code"