SMPTE ST 2081-10:2018
Revision of ST 2081-10:2015

SMPTE STANDARD

2160-line and 1080-line Source Image and Ancillary Data Mapping for 6G-SDI

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Approved January 2, 2018

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.

ST 2081-10 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.

Introduction

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

SMPTE ST 2081-10 defines the mapping of various source images and associated ancillary data into a Single-link 6 Gb/s [nominal] SDI bit-serial interface.

The general process for creating a single-link 6G-SDI is illustrated below in Figure 1, Figure 2 and Figure 3. Detailed definitions of how this process applies to each of the modes defined in the scope follow in other sections of this document.

Parameter values included in tables or described in sections marked as (Informative), are based on reference documents of the specific version indicated in the reference section and identified in applicable normative sections of this standard.

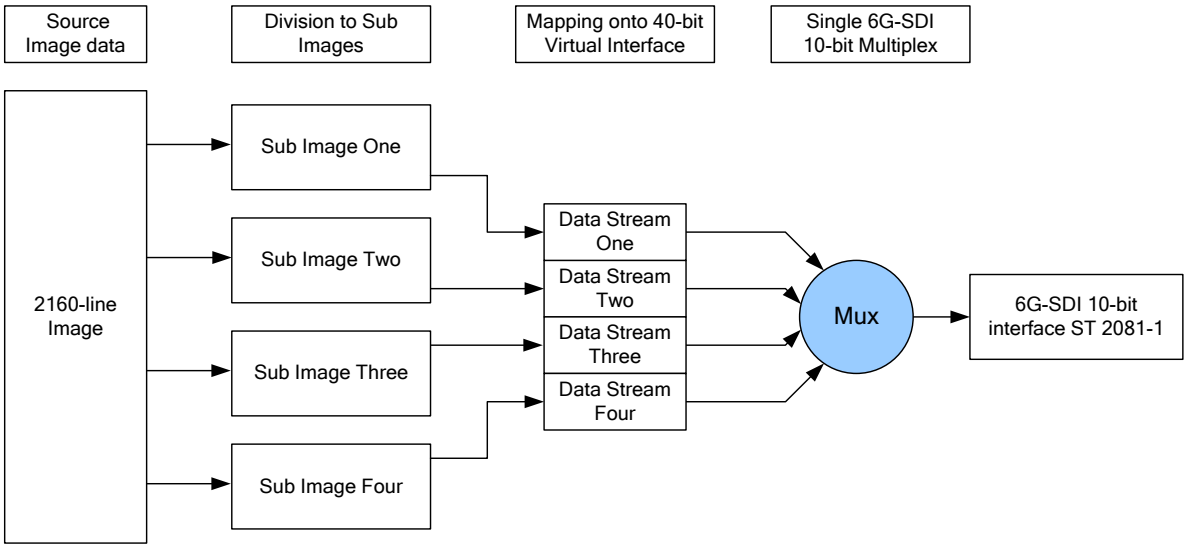


Figure 1 – Carriage of 2160-line images in a Single-link 6G-SDI interface – generalized process

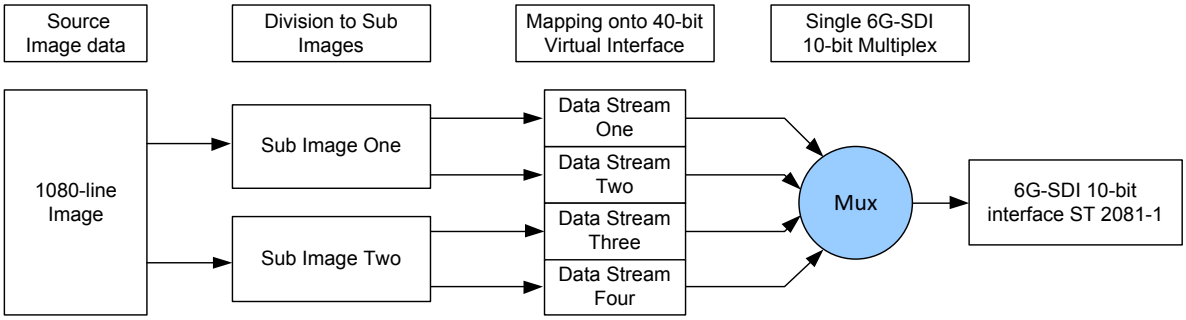


Figure 2 – Carriage of 1080-line images in a Single-link 6G-SDI interface – generalized process

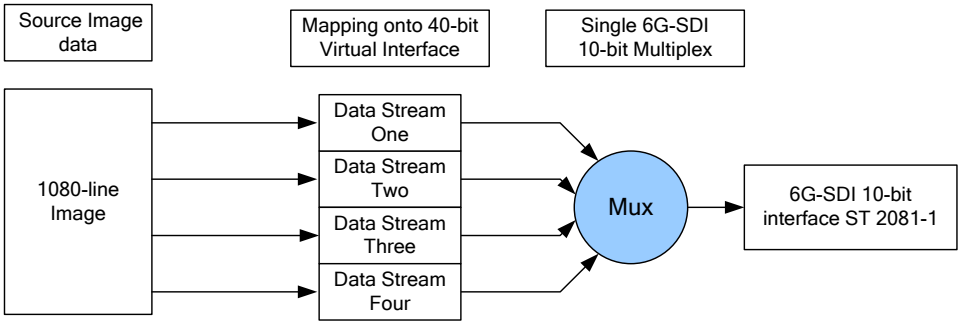


Figure 3 – Carriage of 1080-line HFR images in a Single-link 6G-SDI interface – generalized process

Formatting

The source images are divided into two or four 1080-line sub images, depending on the format of the source image. HFR source images are not divided.

The HFR source image, or the sub images, are then mapped onto a 40-bit virtual interface consisting of four 10-bit data streams.

Multiplex

The 40-bit virtual interface is multiplexed onto a single 6G-SDI 10-bit interface in the order data stream four, data stream two, data stream three, data stream one.

1 Scope

This Standard defines the mapping of:

- **Mode 1:** 2160-line Source image formats identified in Table 1 into a 6G-SDI 10-bit interface as defined in section 7 Single-link 6G-SDI 10-bit Multiplex, which can then be serialized
- **Mode 2:** 1080-line Source image formats identified in Table 6 into a 6G-SDI 10-bit interface as defined in section 7 Single-link 6G-SDI 10-bit Multiplex, which can then be serialized
- **Mode 3:** 1080-line HFR Source image formats identified in Table 8 into a 6G-SDI 10-bit interface as defined in section 7 Single-link 6G-SDI 10-bit Multiplex, which can then be serialized

This Standard also defines the carriage of ancillary data, and the SMPTE ST 352 payload ID's for the Single-link 6Gb/s SDI interface.

It is not necessary for implementations to include support for all operating modes or image formats that are included in this standard. Implementers are encouraged to indicate supported operating modes and image formats in commercial publications.

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.

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; followed by formal languages; then figures; and then any other language forms.

3 Normative References

The following standards contain provisions that, 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 12-3:2016, Time Code for High Frame Rate Signals and Formatting in the Ancillary Data Space

SMPTE ST 274:2008, 1920 x 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 299-1:2009, 24-Bit Digital Audio Format for SMPTE 292 Bit-Serial Interface

SMPTE ST 299-2:2010, Extension of the 24-Bit Digital Audio Format to 32 Channels for 3 Gb/s Bit-Serial Interfaces

SMPTE ST 352:2013, Payload Identification Codes for Serial Digital Interfaces

SMPTE ST 425-3:2015, Image Format and Ancillary Data Mapping for the Dual Link 3 Gb/s Serial Interface

SMPTE ST 2036-1:2014, Ultra High Definition Television — Image Parameter Values for Program Production

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

Amendment 1:2016 to SMPTE ST 2048-1:2011, 2048 × 1080 and 4096 × 2160 Digital Cinematography Production Image Formats FS/709 — Amendment 1

SMPTE RP 2077:2013, Full Range Image Mapping

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 Mode 1: Carriage of 2160-line Source image formats and ancillary data

In the case of 2160-line mapping, the image formats supported shall be as defined in Table 1.

Table 1 – 2160-line Source Image Formats

Reference Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate (Hz)
SMPTE ST 2036-1, Rec. ITU-R BT.2100	3840 × 2160	4:2:2 ($Y'C'_BC'_R$)/10-bit 4:2:2 (IC_TC_P)/10-bit 4:2:0 ($Y'C'_BC'_R$)/10-bit 4:2:0 (IC_TC_P)/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive
SMPTE ST 2048-1,	4096 × 2160	4:2:2 ($Y'C'_BC'_R$)/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive
Note: In accordance with Recommendation ITU-R BT.2100, IC_TC_P sampling is only applied to High Dynamic Range (HDR) progressive image formats			

The image shall be mapped onto a 40-bit virtual interface in accordance with SMPTE ST 425-3 “Mapping of 2160-line Source Image”.

For IC_TC_P formats the mappings for $Y'C'_BC'_R$ formats shall be used with Y' replaced by I, C'_B replaced by C_T and C'_R replaced by C_P.

The 40-bit virtual interface shall include sync and timing (TRS) words, Cyclic redundancy code (CRC) words, line numbers, HANC and VANC data – except audio - according to SMPTE ST 425-3 “Mapping of 2160-line Source Image”.

Time code, when present, shall be included in the 40-bit virtual interface according to SMPTE ST 425-3 “Mapping of 2160-line Source Image”.

Informative annex A provides information about the amount of HANC and VANC data space available in this operating mode.

4.1 **Image Mapping** (Informative)

Figure 4 illustrates the process for the carriage of SMPTE ST 2036-1 and SMPTE ST 2048-1 2160-line source image formats in a Single-link 6G-SDI interface.

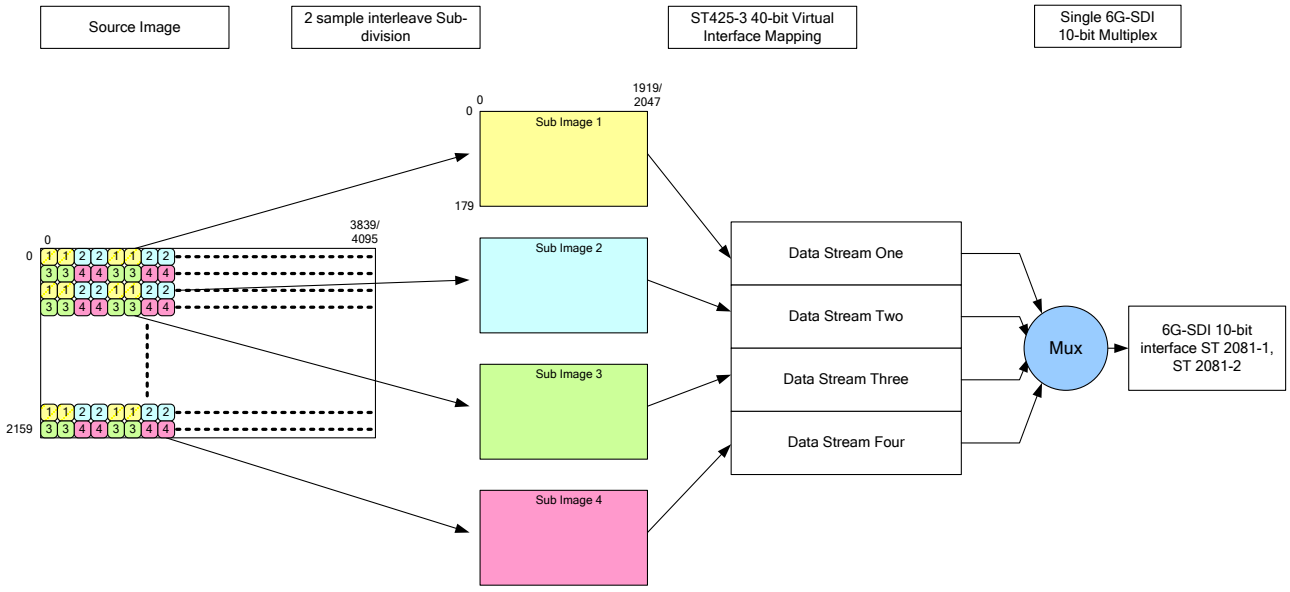


Figure 4 – Carriage of 2160-line source image formats in a single-link 6G-SDI interface

4.1.1 **Image sub-division** (Informative)

The 2160-line source image is divided into four 1080-line sub images in accordance with the 2 sample interleave sub-division method referenced in SMPTE ST 425-3 2160-line Mapping.

For 4:2:0 source images, the 10-bit C'_B and C'_R samples in sub images 3 and 4 are set to the value 200h.

Each 1080-line sub image conforms to the sub image format defined in Table 14 – “Sub Image Formats for 2160-line Source Image” of SMPTE ST 425-3 repeated here for convenience in Table 2.

Table 2 – 1080-line Sub Image Formats for 2160-line Source Images (Informative)

Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/Pixel Depth	Frame Rate (Hz)
ST 274	1920 × 1080	4:2:2 ($Y'C'_BC'_R$)/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive
ST 2048-2	2048 × 1080	4:2:2 ($Y'C'_BC'_R$)/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive

Each sub image is then mapped into one of four data streams each of which complies with the 1.5 Gb/s data stream defined in SMPTE ST 292-1. Each data stream consists of two interleaved channels. Each channel includes sync and timing (TRS) words, Cyclic redundancy code (CRC) words, line numbers, HANC and VANC data including audio and time code as defined in SMPTE ST 425-3 2160-line Mapping

Sub image 1 is mapped into data stream one. Sub image 2 is mapped into data streams two. Sub image 3 is mapped into data stream three. Sub image 4 is mapped into data stream four.
The four 10-bit data streams are then combined onto a 40-bit virtual interface.

4.1.2 2160-line 40-bit Virtual Interface Mapping (Informative)

The video data words from each sub image are conveyed in the following order in the data streams of the 40-bit virtual interface:
Sub image 1 is mapped into data stream one:
data stream one: C'_B0, $Y'0$, C'_R0, $Y'1$, C'_B2, $Y'4$, C'_R2, $Y'5$…from even lines as per Figure 4
Sub image 2 is mapped into data stream two:
data stream two: C'_B1, $Y'2$, C'_R1, $Y'3$, C'_B3, $Y'6$, C'_R3, $Y'7$…from even lines as per Figure 4
Sub image 3 is mapped into data stream three:
data stream three: C'_B0, $Y'0$, C'_R0, $Y'1$, C'_B2, $Y'4$, C'_R2, $Y'5$…from odd lines as per Figure 4
Sub image 4 is mapped into data stream four:
data stream four: C'_B1, $Y'2$, C'_R1, $Y'3$, C'_B3, $Y'6$, C'_R3, $Y'7$…from odd lines as per Figure 4
For 4:2:0 source images, the 10-bit C'_B and C'_R samples in sub images 3 and 4 are set to the value 200h.

For IC_TC_P, Y' is replaced with I, C'_B with C_T and C'_R with C_P

4.1.2.1 6G-SDI Link Multiplex Structure (Informative)

Following the 6G SDI 10-bit multiplex according to Section 7, the 6G-SDI data stream is conveyed in the following order:
6G-SDI data stream: C'_B1_{Odd}, C'_B1, C'_B0_{Odd}, C'_B0, $Y'2_{Odd}$, $Y'2$, $Y'0_{Odd}$, $Y'0$, C'_R1_{Odd}, C'_R1, C'_R0_{Odd}, C'_R0, $Y'3_{Odd}$, $Y'3$, $Y'1_{Odd}$, $Y'1$, C'_B3_{Odd}, C'_B3, C'_B2_{Odd}, C'_B2, $Y'6_{Odd}$, $Y'6$, $Y'4_{Odd}$, $Y'4$, C'_R3_{Odd}, C'_R3, C'_R2_{Odd}, C'_R2, $Y'7_{Odd}$, $Y'7$, $Y'5_{Odd}$, $Y'5$ …
Note: the term “Odd” in subscript above indicates that the samples are derived from the odd numbered lines of the original source image.

4.2 Audio Data

When present, audio data shall be mapped into the HANC space of data streams one, two, three and four as defined in SMPTE ST 425-3 “Mapping of 2160-line Source Image – Audio Data”.

4.2.1 Number of Audio Channels

The number of audio channels shall be as defined in SMPTE ST 425-3 “Mapping of 2160-line Source Image – Number of Audio Channels”.

4.2.2 Audio Copy

As an alternative to the mapping of the maximum number of unique audio channels described above, blocks of audio channels may be copied within the interface. This may be as a result of the single-link 6G-SDI signal being created by combining dual-link 3G-SDI signals. It may alternatively be done in the original single-link 6G-SDI signal in order to permit simple splitting of the single-link 6G-SDI signal into a dual-link 3G-SDI signal.

Note: Audio copy reduces the number of channels that can be transported by the interface.

In the case where the audio data has been embedded according to SMPTE ST 425-3, for example when the audio was embedded in a dual-link 3G interface that has been combined into a single-link 6G interface, the audio in data stream pair three/four may be a copy of the audio in data stream pair one/two.

The audio copy status of each data stream shall be signaled in the PID as described in Section 4.3.

Figure 5 shows a dual-link 3G interface combined into a single 6G-SDI interface, and the possible status of audio copy on each data stream.

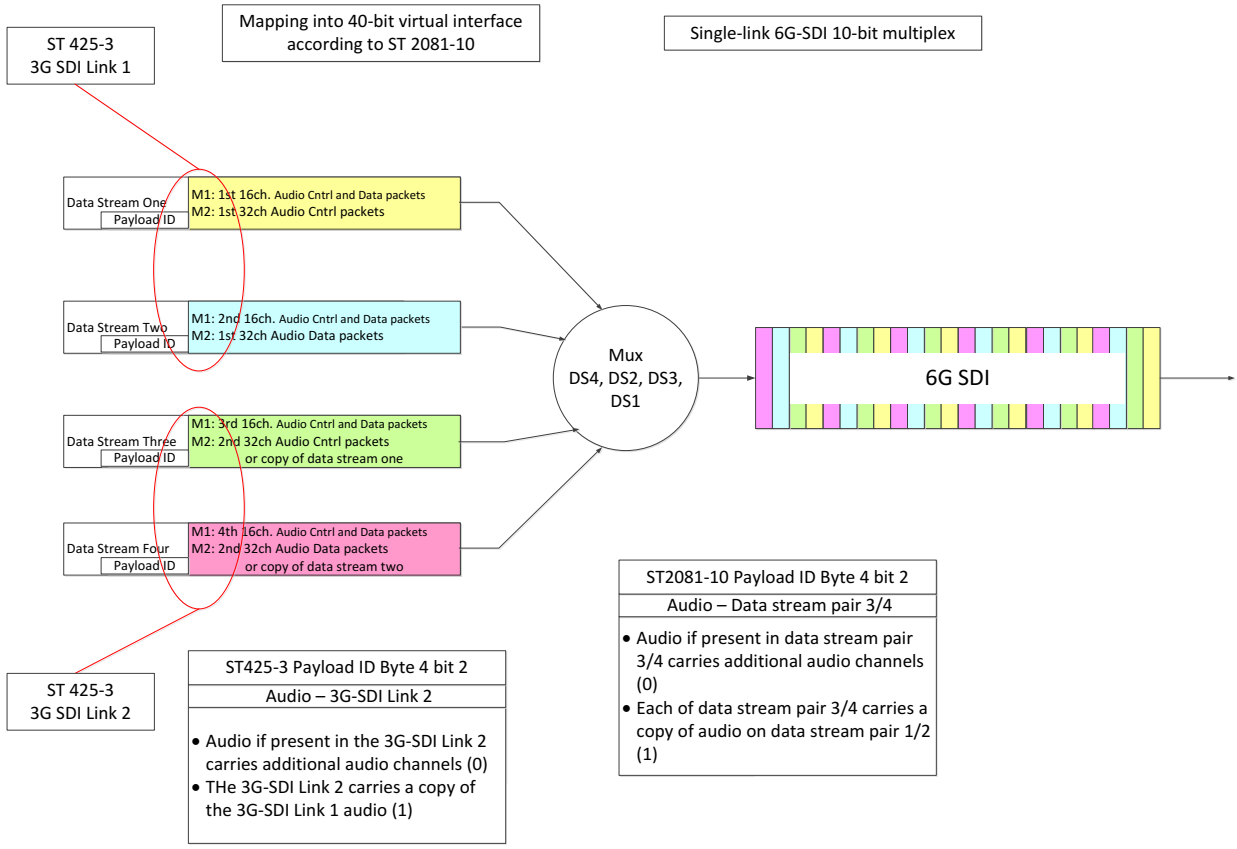


Figure 5 – Inherited audio copy as a result of combining a dual-link 3G-SDI signal

4.2.2.1 Originated Audio Copy in 6G-SDI signal

Audio may also be copied within the 6G interface in order to simplify division of a single 6G signal into dual-link 3G with audio copy between links.

Note: Audio copy reduces the number of channels that can be transported by the interface.

If audio is copied:

Data stream pair one/two shall always carry original audio

Data stream pair three/four shall carry a copy of the audio data and control packets from data stream pair one/two.

The audio copy status of each data stream shall be signaled in the PID as described in Section 4.3.

4.3 Payload Identifier Structure

Table 3 shows the payload identifier definitions for 2160-line Video Payloads. As stated in SMPTE ST 352, the payload identifier consists of 4 bytes where each byte has a separate significance. The first byte of the payload identifier has the highest significance and subsequent bytes define lower order video and ancillary payload information.
The recommended location for the payload identifier is defined in SMPTE ST 425-3.

Table 3 – Payload Identifier Definitions for Mode 1 - 2160-line mapping on a single-link 6Gb/s (nominal) Serial Interface

<table>
<tr><th>Bits</th><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th></tr>
<tr><td>Bit 7</td><td>1</td><td>Progressive transport (1)</td><td>Aspect Ratio
16:9 (1) or Unknown (0)</td><td rowspan="3">Link assignment
Single link 6G-SDI (0h)</td></tr>
<tr><td>Bit 6</td><td>1</td><td>Progressive picture (1)</td><td>Sub image horizontal sampling
1920 (0) or 2048 (1)</td></tr>
<tr><td>Bit 5</td><td>0</td><td rowspan="2">Transfer characteristics
SDR-TV (0h)
HLG (1h)
PQ (2h)
Unspecified (3h)</td><td rowspan="2">Colorimetry
Rec 709*1 (0h)
Color VANC Packet (1h)
UHDTV*2 (2h)
Unknown (3h)</td></tr>
<tr><td>Bit 4</td><td>0</td><td>Luminance and color difference signal
$Y'C'_BC'_R$ (0)
IC_TC_P (1)</td></tr>
<tr><td>Bit 3</td><td>0</td><td rowspan="4">Picture rate
(See Table 4)</td><td rowspan="4">Sampling structure
(see Table 5)</td><td>Reserved (0)</td></tr>
<tr><td>Bit 2</td><td>0</td><td>Audio copy status:
Audio in this data stream carries additional channels (0)
Audio in this data stream is copied (1)</td></tr>
<tr><td>Bit 1</td><td>0</td><td rowspan="2">Bit depth
10-bit Full Range (0h)
10-bit (1h)
Other Values are Reserved</td></tr>
<tr><td>Bit 0</td><td>0</td></tr>
<tr><td colspan="5">Notes:
*1 Rec 709 indicates Recommendation ITU-R BT.709 colorimetry is employed, and is equivalent to SMPTE ST 2036-1 Conventional System Colorimetry.
*2 UHDTV indicates SMPTE ST 2036-1 UHDTV colorimetry and is equivalent to Recommendation ITU-R BT.2020 colorimetry
3 The usage of bytes 2, 3 and 4 is consistent for all modes in this document but the definitions are repeated for the convenience of the reader</td></tr>
</table>

4.3.1 Byte 1 - Digital Interface and Payload Identification

Byte 1 of the payload identifier identifies the video payload and the digital interface and shall be set to [C0h] for 2160-line image formats listed in Table 1 on to single-link 6G-SDI.

4.3.2 Byte 2 – Picture Rate and Scanning Method

Byte 2 of the payload identifier shall be used to identify the picture and transport scanning methods and the picture rate.

Bit b7 shall be set to 1 (progressive transport).

Bit b6 shall be set to 1 (progressive picture).

Bits b5 and b4 shall be used to indicate Transfer Characteristic such that:

b5:b4 = 0h identifies SDR-TV in accordance with SMPTE ST 274 or SMPTE ST 2036-1

b5:b4 = 1h identifies HLG HDR-TV in accordance with Recommendation ITU-R BT.2100

b5:b4 = 2h identifies PQ HDR-TV in accordance with Recommendation ITU-R BT.2100

b5:b4 = 3h identifies Unspecified Transfer Characteristics

In the case where bits b5:b4 of Byte 3 indicates “Color VANC packet as defined in SMPTE ST 2048-1”, if the Transfer Characteristic signaled in the Color VANC packet is active, then it takes precedence over the Transfer Characteristic signaled in b5:b4.

Note: The Reference EOTF as defined in SMPTE ST 2084 is the same as the Reference PQ EOTF defined in Recommendation ITU-R BT.2100.

Bits b3 to b0 shall be used to identify the picture rate in Hz according to Table 4 and shall only use the values as permitted for image formats in Table 1.

Table 4 SMPTE ST 352 Byte 2 Picture rate extended to include high picture (frame) rates

Value	Picture rate Hz	Value	Picture rate Hz	Value	Picture rate Hz	Value	Picture rate Hz
0h	Not defined	1h	96/1.001	2h	24/1.001	3h	24
4h	48/1.001	5h	25	6h	30/1.001	7h	30
8h	48	9h	50	Ah	60/1.001	Bh	60
Ch	96	Dh	100	Eh	120/1.001	Fh	120

4.3.3 Byte 3 – Sub Image Sampling Structure, Aspect Ratio, Horizontal Size and Colorimetry

Byte 3 of the payload identifier shall be used to identify the aspect ratio, horizontal pixel array size, sampling structure and colorimetry of the sub image video payload.

Bit b7 shall be used to identify the aspect ratio such that:

b7 = 0 identifies unknown aspect ratio

b7 = 1 identifies a 16:9 aspect ratio

Bit b6 shall be used to identify the number of active Luma/R′G′B′ samples for the sub image such that:

b6 = 0 identifies 1920 active Luma/R′G′B′ samples

b6 = 1 identifies 2048 active Luma/R′G′B′ samples

Bits b5 and b4 shall identify the colorimetry in accordance with the image format in Table 1 such that:

b5:b4 = 0h identifies Rec 709 colorimetry in accordance with Recommendation ITU-R BT.709 as referenced by SMPTE ST 274

b5:b4 = 1h identifies that the colorimetry is defined in the Color VANC packet as defined in SMPTE ST 2048-1

b5:b4 = 2h identifies UHDTV colorimetry in accordance with the reference primaries and reference white as defined in SMPTE ST 2036-1. See Note 2 to Table 3.

b5:b4 = 3h identifies unknown colorimetry

Bits b3 to b0 shall be used to identify the sampling structure in accordance with Table 5 and shall only use the values as permitted for image formats in Table 1.

Table 5 Byte 3 Sampling Structure

Value	Sampling	Value	Sampling	Value	Sampling	Value	Sampling
0h	4:2:2 ($Y'C'_BC'_R$) or (IC_TC_P)	1h	4:4:4 ($Y'C'_BC'_R$)	2h	4:4:4 ($R'G'B'$)	3h	4:2:0 ($Y'C'_BC'_R$) or (IC_TC_P)
4h	4:2:2:4 ($Y'C'_BC'_R$+A) or (IC_TC_P+A)	5h	4:4:4:4 ($Y'C'_BC'_R$+A) or (IC_TC_P+A)	6h	4:4:4:4 ($R'G'B'$+A)	7h	Reserved
8h	4:2:2:4 ($Y'C'_BC'_R$+D) or (IC_TC_P+D)	9h	4:4:4:4 ($Y'C'_BC'_R$+D) or (IC_TC_P+D)	Ah	4:4:4:4 ($R'G'B'$+D)	Bh	Reserved
Ch	Reserved	Dh	Reserved	Eh	4:4:4 ($X'Y'Z'$)	Fh	Reserved

4.3.4 Byte 4 – Sub Image Identification, Luminance and color difference signal interpretation, Audio copy status and Quantization Bit Depth

Byte 4 of the payload identifier shall be used to identify the sub image, and bit depth of the sample quantization.

Bits b7 to b5 shall be used to identify sub image and link assignment such that:

b7:b5 = 0h shall identify Single link 6G-SDI

other values are reserved

Bit b4 shall be used to indicate the interpretation of the Luminance and color difference signal such that:

b4 = 0 indicates $Y'C'_BC'_R$ in accordance with SMPTE ST 2036-1

b4 = 1 indicates IC_TC_P in accordance with Recommendation ITU-R BT.2100

See informative Annex B – Further Guidance on luminance and color difference signal Identification.

Bit b3 shall be Reserved and set to 0

For data streams one and two bit b2 shall be set to 0 (Reserved)

For data streams three and four, bit b2 shall be used to identify whether audio data in this data stream is copied:

b2 = 0 identifies that all audio if present in this data stream carries additional channels

b2 = 1 identifies that audio if present in this data stream is copied

Bits b1 to b0 shall be used to identify the bit depth of the sample quantization such that:

b1:b0 = 0h identifies quantization using Full Range 10-bit per sample as defined in Recommendation ITU-R BT.2100.

The prohibited code values shall be protected in accordance with RP 2077 - Mapping to Interfaces and Formats that Rely upon Protected Code Values with CV_{LOW} = 4 and CV_{HIGH} = 1019

b1:b0 = 1h identifies quantization using 10-bit per sample

Other values are reserved.

4.4 Blanking (Informative)

As defined in the sub image source format documents SMPTE ST 274 and SMPTE ST 2048-2, HANC and VANC spaces with no ancillary data packets or audio data packets contain data words that represent video black level for the video structure being carried.

In the case of 4:2:2 $Y'C'_BC'_R$ / IC_TC_P 10-bit video structures, even numbered words in each data stream take the value 200h and odd numbered words in each data stream take the value 040h.

In the case of 4:2:2 $Y'C'_BC'_R$ / IC_TC_P 10-bit Full Range video structures, even numbered words in each data stream take the value 200h and odd numbered words in each data stream take the value 004h

The word numbering is defined such that the first word of active video in each line in each data stream is numbered zero, and so is an even numbered word.

4.5 10-Bit Multiplex

The 40-bit virtual interface with the modified PID values shall then be multiplexed onto a 6G-SDI 10-bit interfaces according to Section 7.

4.6 Levels of Operation (Informative)

To define the level of support for SMPTE ST 2081-10 Mode 1, manufacturers are encouraged to indicate in publications which mapping format is supported. For example:

SMPTE ST 2081-10 MODE 1 – 2160-line Source image formats and ancillary data into a Single-link 6 Gb/s [nominal] SDI bit-serial interface

Manufacturers are also encouraged to indicate in publications supported audio and image formats.

5 Mode 2: Carriage of 1080-line Source image formats and ancillary data

In the case of 1080-line mapping, the image formats supported are defined in SMPTE ST 425-3 “Table 2 – 1080-line Source Image Formats”, and Table 1 and Table 8 of Recommendation ITU-R BT.2100, repeated here for convenience in Table 6.

Table 6 – 1080-line Source Image Formats (Informative)

Mapping Structure	Reference Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate (Hz)
II	SMPTE ST 274, Rec. ITU-R BT.2100	1920 × 1080	4:4:4 (R′G′B′), 4:4:4:4 (R′G′B′ +A*3)/10-bit	50, 60/1.001 and 60 Progressive
	SMPTE ST 2048-2	2048 × 1080*2	4:4:4 (R′G′B′*1), 4:4:4:4 (R′G′B′*1+A*3)/10-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
	SMPTE ST 274, Rec. ITU-R BT.2100	1920 × 1080	4:4:4 ($Y'C'_BC'_R$)/10-bit 4:4:4 (IC_TC_P*4)/10-bit, 4:4:4:4 ($Y'C'_BC'_R$+A*3)/10-bit 4:4:4:4 (IC_TC_P*4+A*3)/10-bit	50, 60/1.001 and 60 Progressive
	SMPTE ST 2048-2	2048 × 1080*2	4:4:4 ($Y'C'_BC'_R$)/10-bit, 4:4:4:4 ($Y'C'_BC'_R$+A*3)/10-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
III	SMPTE ST 274, Rec. ITU-RBT.2100	1920 × 1080	4:4:4 (R′G′B′)/12-bit	50, 60/1.001 and 60 Progressive
	SMPTE ST 2048-2	2048 × 1080*2	4:4:4 (R′G′B′*1)/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
	SMPTE ST 274, Rec. ITU-R BT.2100	1920 × 1080	4:4:4 ($Y'C'_BC'_R$)/12-bit 4:4:4 (IC_TC_P*4)/12-bit	50, 60/1.001 and 60 Progressive
	SMPTE ST 2048-2	2048 × 1080*2	4:4:4 ($Y'C'_BC'_R$)/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
IV	SMPTE ST 274, Rec ITU-R BT.2100	1920 × 1080	4:2:2 ($Y'C'_BC'_R$)/12-bit 4:2:2:4 ($Y'C'_BC'_R$+A*3)/12-bit 4:2:2 (IC_TC_P*4)/12-bit 4:2:2:4 (IC_TC_P*4+A*3)/12-bit	50, 60/1.001 and 60 Progressive
	SMPTE ST 2048-2	2048 × 1080*2	4:2:2 ($Y'C'_BC'_R$)/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
	SMPTE ST 2048-2	2048 × 1080*2	4:2:2:4 ($Y'C'_BC'_R$+A*3)/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive

Notes:

*1 In this image format R′G′B′ indicates either R′G′B′ or $R'_{FS}G'_{FS}B'_{FS}$. The suffix FS and an additional Color VANC packet to describe the FS characteristics are defined by SMPTE ST 2048-1.

*2 This is the maximum pixel array, the active image might not fill the maximum array.

*3 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. 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

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

The source images shall be divided into two sub images in accordance with Mapping Structures II, III or IV of SMPTE ST 425-3. Each sub image shall then be mapped into two 10-bit data streams in accordance with Mapping Structure 1, as defined in SMPTE ST 425-3.

For IC_TC_P formats the mappings for $Y'C'_BC'_R$ formats shall be used with Y′ replaced by I, C'_B replaced by C_T and C'_R replaced by C_P.

The 10-bit data streams shall then be combined into a 40-bit virtual interface.

The 40-bit virtual interface shall include sync and timing (TRS) words, Cyclic redundancy code (CRC) words, line numbers, HANC and VANC data and time code – except audio - according to SMPTE ST 425-3 “1080-line Level A Mapping”.

Informative annex A provides information about the amount of HANC and VANC data space available in this operating mode.

5.1 **Image Mapping** (Informative)

Figure 6 illustrates the process for the carriage of SMPTE ST 274 and SMPTE ST 2048-2 1080-line source image formats in a Single-link 6G-SDI interface.

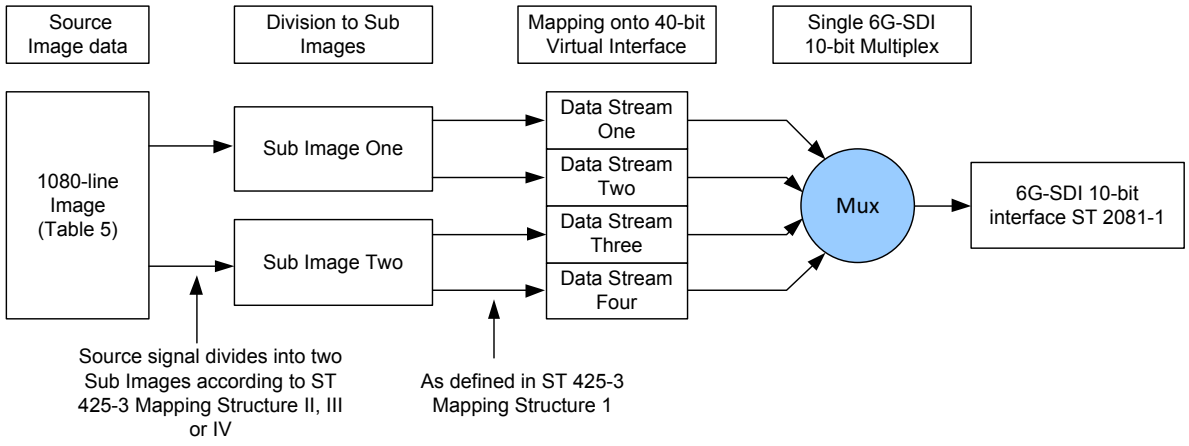


Figure 6 – Carriage of 1080-line images in a Single-link 6G-SDI interface – generalized process

5.1.1 **Image sub-division** (Informative)

The 1080-line source image is divided into two 1080-line sub images in accordance with SMPTE ST 425-3 mapping structure rules II, III or IV.

Each sub image is then mapped into two 10-bit data streams such that sub image 1 is mapped into data streams one and two and sub image 2 is mapped into data streams three and four.

Each data stream includes sync and timing (TRS) words, Cyclic redundancy code (CRC) words, line numbers, HANC and VANC data including audio and time code.

The four 10-bit data streams are combined onto a 40-bit virtual interface.

The video data words from each sub image are conveyed in the following order in the data streams of the 40-bit virtual interface in accordance with SMPTE ST 425-3 Mapping Structure II, III or IV:

5.1.1.1 1080-line 40-bit virtual interface mapping - Mapping Structure II (Informative)

The 4:4:4 (R′G′B′) / (Y′C′$_B$C′$_R$) / (IC$_T$C$_P$) and 4:4:4:4 (R′G′B′+A) / (Y′C′$_B$C′$_R$+A) / (IC$_T$C$_P$+A) 10-bit Signals are conveyed in the data streams as follows:

data stream one: G′0, G′1, G′2, G′3…

data stream two: B′0, R′0, B′2, R′2…

data stream three: A0, A1, A2, A3 …

data stream four: B′1, R′1, B′3, R′3…

For the 4:4:4 (Y′C′$_B$C′$_R$) and the 4:4:4:4 (Y′C′$_B$C′$_R$+A)/10-bit images, the image data is conveyed as above such that:

The G′ samples are replaced with Y′ samples,
the B′ samples are replaced with C′$_B$ samples
and the R′ samples are replaced with C′$_R$ samples.

For the 4:4:4 (IC$_T$C$_P$) and the 4:4:4:4 (IC$_T$C$_P$ +A)/10-bit images, the image data is conveyed as above such that:

The G′ samples are replaced with I samples,
the B′ samples are replaced with C$_T$ samples
and the R′ samples are replaced with C$_P$ samples.

If Alpha samples are not present they are replaced with the value 040h.

5.1.1.1.1 6G-SDI Link Multiplex Structure (Informative)

Following the 6G SDI 10-bit multiplex according to Section 7, the 6G-SDI data stream for mapping structure II is conveyed in the following order:

6G-SDI data stream: B′1, B′0, A0, G′0, R′1, R′0, A1, G′1, B′3, B′2, A2, G′2, R′3, R′2, A3, G′3 …

5.1.1.2 1080-line 40-bit virtual interface mapping - Mapping Structure III (Informative)

The 4:4:4 (R′G′B′) / (Y′C′$_B$C′$_R$) / (IC$_T$C$_P$) /12-bit Signals are conveyed in the data streams as follows:

data stream one: G′0:2-11, G′1:2-11, G′2:2-11, G′3:2-11 …

data stream two: B′0:2-11, R′0:2-11, B′2:2-11, R′2:2-11 …

data stream three: R′G′B′0:0-1, R′G′B′1:0-1, R′G′B′2:0-1, R′G′B′3:0-1 …

data stream four: B′1:2-11, R′1:2-11, B′3:2-11, R′3:2-11 …

For the 4:4:4 (Y′C′$_B$C′$_R$)/12-bit images, the image data is conveyed as above such that:

The G′ samples are replaced with Y′ samples,
the B′ samples are replaced with C'_B samples
and the R′ samples are replaced with C'_R samples.

For the 4:4:4 (IC_TC_P)/12-bit images, the image data is conveyed as above such that:

The G′ samples are replaced with I samples,
the B′ samples are replaced with C_T samples
and the R′ samples are replaced with C_P samples.

If Alpha samples are not present they are replaced with the value 040h.

5.1.1.2.1 6G-SDI Link Multiplex Structure (Informative)

Following the 6G SDI 10-bit multiplex according to Section 7, the 6G-SDI data stream for mapping structure III is conveyed in the following order:

6G-SDI data stream: B′1:2-11, B′0:2-11, G′B′R′0:0-1, G′0:2-11, R′1:2-11, R′0:2-11, G′B′R′1:0-1, G′1:2-11, B′3:2-11, B′2:2-11, G′B′R′2:0-1, G′2:2-11, R′3:2-11, R′2:2-11, G′B′R′3:0-1, G′3:2-11 …

5.1.1.3 1080-line 40-bit virtual interface mapping - Mapping Structure IV (Informative)

The 4:2:2 ($Y'C'_BC'_R$) and 4:2:2:4 ($Y'C'_BC'_R$ +A)/12-bit signals are conveyed in the data streams as follows:

data stream one: Y′0:2-11, Y′1:2-11, Y′2:2-11, Y′3:2-11 …

data stream two: C'_B0:2-11, C'_R0:2-11, C'_B 2:2-11, C'_R2:2-11 …

data stream three: $Y'C'_BC'_R$0:0-1, Y′1:0-1, $Y'C'_BC'_R$2:0-1, Y′3:0-1 …

data stream four: A0, A1, A2, A3 …

For IC_TC_P and IC_TC_P+A, Y′ is replaced with I, C'_B with C_T and C'_R with C_P

If Alpha samples are not present they are replaced with the value 040h.

5.1.1.3.1 6G-SDI Link Multiplex Structure (Informative)

Following the 6G SDI 10-bit multiplex according to Section 7, the 6G-SDI data stream for mapping structure IV is conveyed in the following order:

6G-SDI data stream: A0, C'_B0:2-11, $Y'C'_BC'_R$0:0-1, Y′0:2-11, A1, C'_R0:2-11, Y′1:0-1, Y′1:2-11, A2, C'_B 2:2-11, $Y'C'_BC'_R$2:0-1, Y′2:2-11, A3, C'_R2:2-11, Y′3:0-1, Y′3:2-11 …

5.2 Audio Data

When present, audio data shall be mapped into the HANC space of data streams one, two, three and four as defined in SMPTE ST 425-3 “1080-Line Level A Mapping – Audio Data”.

5.2.1 Number of Audio Channels

The number of audio channels shall be as defined in SMPTE ST 425-3 “1080-Line Level A Mapping – Number of Audio Channels”.

5.2.2 Audio Copy

As an alternative to the mapping of the maximum number of unique audio channels described above, blocks of audio channels may be copied within the interface. This may be as a result of the single-link 6G-SDI signal being created by combining dual-link 3G-SDI signals. It may alternatively be done in the original single-link 6G-SDI signal in order to permit simple splitting of the single-link 6G-SDI signal into a dual-link 3G-SDI signal. Note: Audio copy reduces the number of channels that can be transported by the interface.

5.2.2.1 Inherited Audio Copy as a result of combining multi-link 3G-SDI signals

In the case where the audio data has been embedded according to SMPTE ST 425-3, for example when the audio was embedded in a dual-link 3G interface that has been combined into a single-link 6G interface, the audio in data stream pair three/four may be a copy of the audio in data stream pair one/two.
The audio copy status of each data stream shall be signaled in the PID as described in Section 5.3.
Figure 7 shows a dual-link 3G interface combined into a single 6G-SDI interface, and the possible status of audio copy on each data stream.

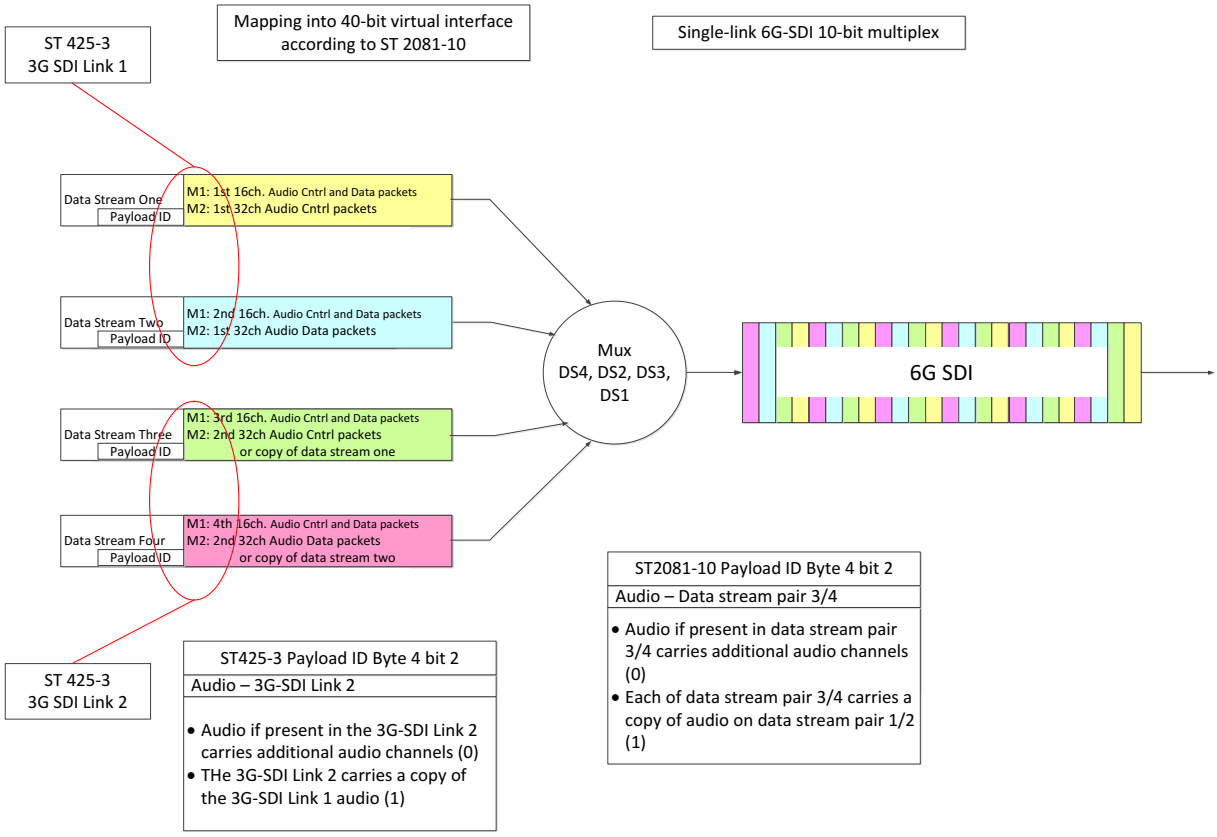


Figure 7 – Inherited audio copy as a result of combining a dual-link 3G-SDI signal

5.2.2.2 Originated Audio Copy in 6G-SDI signal

Audio may also be copied within the 6G interface in order to simplify division of a single 6G signal into dual-link 3G with audio copy between links.

Note: Audio copy reduces the number of channels that can be transported by the interface.

If audio is copied:

Data stream pair one/two shall always carry original audio

Data stream pair three/four shall carry a copy of the audio data and control packets from data stream pair one/two.

The audio copy status of each data stream shall be signaled in the PID as described in Section 5.3.

5.3 Payload Identifier Structure

Table 7 shows the payload identifier definitions for 1080-line Video Payloads.

The recommended location for the payload identifier is defined in SMPTE ST 425-3.

Table 7 – Payload Identifier Definitions for Mode 2 - 1080-line Mapping on a single-link 6Gb/s (nominal) Serial Interface

<table>
<tr><th>Bits</th><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th></tr>
<tr><td>Bit 7</td><td>1</td><td>Progressive transport (1)</td><td>Aspect Ratio
16:9 (1) or Unknown (0)</td><td rowspan="3">Link assignment
Single link 6G-SDI (0h)</td></tr>
<tr><td>Bit 6</td><td>1</td><td>Progressive picture (1)</td><td>Horizontal sampling
1920 (0) or 2048 (1)</td></tr>
<tr><td>Bit 5</td><td>0</td><td rowspan="2">Transfer characteristics
SDR-TV (0h)
HLG (1h)
PQ (2h)
Unspecified (3h)</td><td rowspan="2">Colorimetry
Rec 709*1 (0h)
Color VANC Packet (1h)
UHDTV*2 (2h)
Unknown (3h)</td></tr>
<tr><td>Bit 4</td><td>0</td><td>Luminance and color difference signal
$Y'C'_BC'_R$ (0)
IC_TC_P (1)</td></tr>
<tr><td>Bit 3</td><td>0</td><td rowspan="4">Picture rate
(See Table 4)</td><td rowspan="4">Sampling structure
(See Table 5)</td><td>Reserved (0)</td></tr>
<tr><td>Bit 2</td><td>0</td><td>Audio copy status:
Audio in this data stream carries additional channels (0)
Audio in this data stream is copied (1)</td></tr>
<tr><td>Bit 1</td><td>0</td><td rowspan="2">Bit depth
10-bit Full Range (0h)
10-bit (1h)
12-bit (2h)
12-bit Full Range (3h)</td></tr>
<tr><td>Bit 0</td><td>1</td></tr>
<tr><td colspan="5">Notes:
*1 Rec 709 indicates Recommendation ITU-R BT.709 colorimetry as referenced by SMPTE ST 274 is employed.
*2 UHDTV indicates Recommendation ITU-R BT.2020 colorimetry as referenced by Recommendation ITU-R BT.2100
3 The usage of bytes 2, 3 and 4 is consistent for all modes in this document but the definitions are repeated for the convenience of the reader</td></tr>
</table>

5.3.1 Byte 1 - Digital Interface and Payload Identification

Byte 1 of the payload identifier identifies the video payload and the digital interface and shall be as defined below.

Byte 1 shall be set to [C1h] for 1080-line image formats listed in Table 6.

5.3.2 Byte 2 – Picture Rate and Scanning Method

Byte 2 of the payload identifier shall be used to identify the picture and transport scanning methods and the picture rate.

Bit b7 shall be set to 1 (progressive transport).

Bit b6 shall be set to 1 (progressive picture).

Bits b5 and b4 shall be used to indicate Transfer Characteristic such that:

b5:b4 = 0h identifies SDR-TV in accordance with SMPTE ST 274 or SMPTE ST 2036-1

b5:b4 = 1h identifies HLG HDR-TV in accordance with Recommendation ITU-R BT.2100

b5:b4 = 2h identifies PQ HDR-TV in accordance with Recommendation ITU-R BT.2100

b5:b4 = 3h identifies Unspecified Transfer Characteristics

In the case where bits b5:b4 of Byte 3 indicates “Color VANC packet as defined in SMPTE ST 2048-1”, if the Transfer Characteristic signaled in the Color VANC packet is active, then it takes precedence over the Transfer Characteristic signaled in b5:b4.

Note: The Reference EOTF as defined in SMPTE ST 2084 is the same as the Reference PQ EOTF defined in Recommendation ITU-R BT.2100.

Bits b3 to b0 shall be used to identify the picture rate in Hz according to Table 4 and shall only use the values as permitted for image formats in Table 6.

5.3.3 Byte 3 – Sub Image Sampling Structure, Aspect Ratio, Horizontal Size and Colorimetry

Byte 3 of the payload identifier shall be used to identify the aspect ratio, horizontal pixel array size, sampling structure and colorimetry of the sub image video payload.

Bit 7 shall be used to identify the aspect ratio such that:

b7 = 0 identifies unknown aspect ratio

b7 = 1 identifies a 16:9 aspect ratio

Bit 6 shall be used to identify the number of active Luma/R′G′B′ samples for the sub image such that:

b6 = 0 identifies 1920 active Luma/R′G′B′ samples

b6 = 1 identifies 2048 active Luma/R′G′B′ samples

Bits b5 and b4 shall identify the colorimetry in accordance with the image format in Table 6 such that:

b5:b4 = 0h identifies Rec 709 colorimetry in accordance with Recommendation ITU-R BT.709 as referenced by SMPTE ST 274

b5:b4 = 1h identifies that the colorimetry is defined in the Color VANC packet as defined in SMPTE ST 2048-1

b5:b4 = 2h identifies UHDTV colorimetry in accordance with the reference primaries and reference white defined in Recommendation ITU-R BT.2100.

b5:b4 = 3h identifies unknown colorimetry

Bits b3 to b0 shall be used to identify the sampling structure in accordance with Table 5 and shall only use the values as permitted for image formats in Table 6.

5.3.4 Byte 4 – Sub Image Identification, Luminance and color difference signal interpretation, Audio copy status and Quantization Bit Depth

Byte 4 of the payload identifier shall be used to identify the sub image, and bit depth of the sample quantization.

Bits b7 to b5 shall be used to identify link assignment such that:

0h shall identify Single link 6G-SDI

Other values are reserved

Bit b4 shall be used to indicate the interpretation of the Luminance and color difference signal such that:

b4 = 0 indicates $Y'C'_BC'_R$ in accordance with SMPTE ST 2036-1

b4 = 1 indicates IC_TC_P in accordance with Recommendation ITU-R BT.2100

Note: In the case where Byte 3 bits b3:b0 indicate R′G′B′(+A), bit b4 can be ignored

See informative Annex B – Further Guidance on luminance and color difference signal Identification.

Bit b3 shall be Reserved and set to 0

For data streams one and two bit b2 shall be set to 0 (Reserved)

For data streams three and four, bit b2 shall be used to identify whether audio data in this data stream is copied:

b2 = 0 identifies that all audio if present in this data stream carries additional channels

b2 = 1 identifies that audio if present in this data stream is copied

Bits b1 to b0 shall be used to identify the bit depth of the sample quantization such that:

b1:b0 = 0h identifies quantization using Full Range 10-bit per sample as defined in Recommendation ITU-R BT.2100.

The prohibited code values shall be protected in accordance with SMPTE RP 2077 “Mapping to Interfaces and Formats that Rely upon Protected Code Values” with CV_{LOW} = 4 and CV_{HIGH} = 1019.

b1:b0 = 1h identifies quantization using 10 bits per sample

b1:b0 = 2h identifies quantization using 12 bits per sample

b1:b0 = 3h identifies quantization using Full Range 12-bit per sample as defined in Recommendation ITU-R BT.2100.

The prohibited code values shall be protected in accordance with SMPTE RP 2077 “Mapping to Interfaces and Formats that Rely upon Protected Code Values” with CV_{LOW} = 16 and CV_{HIGH} = 4079.

5.4 Blanking (Informative)

As defined in the sub image source format documents SMPTE ST 274 and SMPTE ST 2048-2, HANC and VANC spaces with no ancillary data packets or audio data packets contain data words that represent video black level for the video structure being carried.

In the case of 4:4:4 R′G′B′ or 4:4:4:4 R′G′B′+A 10-bit video structure, all words in each data stream take the value 040h.

In the case of 4:4:4 R′G′B′ or 4:4:4:4 R′G′B′+A 10-bit Full Range video structure, all words in each data stream take the value 004h.

In the case of 4:4:4 $Y'C'_BC'_R$ / IC_TC_P or 4:4:4:4 $Y'C'_BC'_R$+A / IC_TC_P+A 10-bit video structure, all words in odd numbered data streams take the value 040h and all words in even numbered data streams take the value 200h.

In the case of 4:4:4 $Y'C'_BC'_R$ / IC_TC_P or 4:4:4:4 $Y'C'_BC'_R$+A / IC_TC_P+A 10-bit Full Range video structure, all words in odd numbered data streams take the value 004h and all words in even numbered data streams take the value 200h.

In the case of 4:4:4 R′G′B′ 12-bit video structure, all words in data streams one, two and four take the value 040h. All words in data stream three take the value 200h

In the case of 4:4:4 R′G′B′ 12-bit Full Range video structure, all words in data streams one, two and four take the value 004h. All words in data stream three take the value 200h

In the case of 4:4:4 $Y'C'_BC'_R$ 12-bit video structure, all words in data streams one take the value 040h. All words in data streams two, three and four take the value 200h.

In the case of 4:4:4 $Y'C'_BC'_R$ 12-bit Full Range video structure, all words in data streams one take the value 004h. All words in data streams two, three and four take the value 200h.

In the case of 4:2:2 $Y'C'_BC'_R$ or IC_TC_P 12-bit or 4:2:2:4 $Y'C'_BC'_R$+A or IC_TC_P+A 12-bit video structures, all words in data streams one and four take the value 040h. All words in data streams two and three take the value 200h.

In the case of 4:2:2 $Y'C'_BC'_R$ or IC_TC_P 12-bit Full Range or 4:2:2:4 $Y'C'_BC'_R$+A or IC_TC_P+A 12-bit Full Range video structures, all words in data streams one and four take the value 004h. All words in data streams two and three take the value 200h.

5.5 10-Bit Multiplex

The 40-bit virtual interface with the modified PID values shall then be multiplexed onto a 6G-SDI 10-bit interfaces according to Section 7.

5.6 **Levels of Operation** (Informative)

To define the level of support for SMPTE ST 2081-10 Mode 2, manufacturers are encouraged to indicate in publications which mapping format is supported. For example:

SMPTE ST 2081-10 MODE 2 – 1080-line Source image formats and ancillary data into a Single-link 6 Gb/s [nominal] SDI bit-serial interface.

Manufacturers are also encouraged to indicate in publications supported audio and image formats.

6 Mode 3: Carriage of 1080-line $Y'C'_BC'_R$ or IC_TC_P 4:2:2 and 4:2:0 10-bit High Frame Rate (HFR) Source image formats and ancillary data

For this mode, the Source Image Formats shall be as defined in Table 8.

Table 8 – Supported Image sample structures and frame rates

Reference Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate
Rec. ITU-R BT.2100	1920 x 1080	4:2:2 ($Y'C'_BC'_R$)/10-bit 4:2:2 IC_TC_P/10-bit 4:2:0 ($Y'C'_BC'_R$)/10-bit 4:2:0 (IC_TC_P)/10-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
SMPTE ST 2048-1	2048 x 1080	4:2:2 ($Y'C'_BC'_R$)/10-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
			96 frames progressive
			96/1.001 frames progressive
Note: In accordance with Recommendation ITU-R BT.2100, IC_TC_P sampling is only applied to High Dynamic Range (HDR) progressive image formats			

Image data values shall be constrained to avoid SDI prohibited codes.

- The image data values shall be constrained to values 004h through 3FBh to avoid SDI prohibited codes 000h through 003h and 3FCh through 3FFh after mapping

6.1 Mapping

Figure 8 illustrates the process for the carriage of 1080-line HFR source image formats in a 6G-SDI interface.

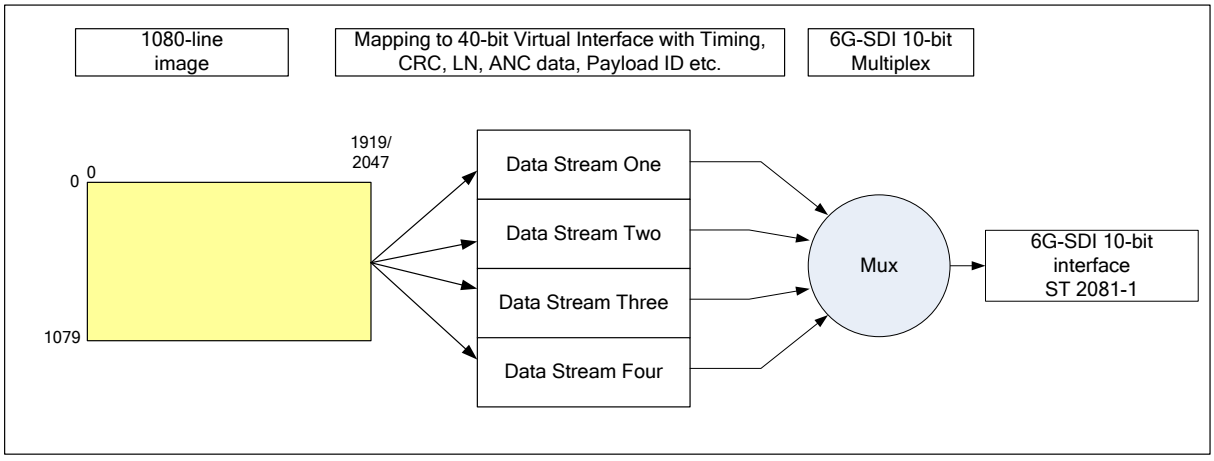
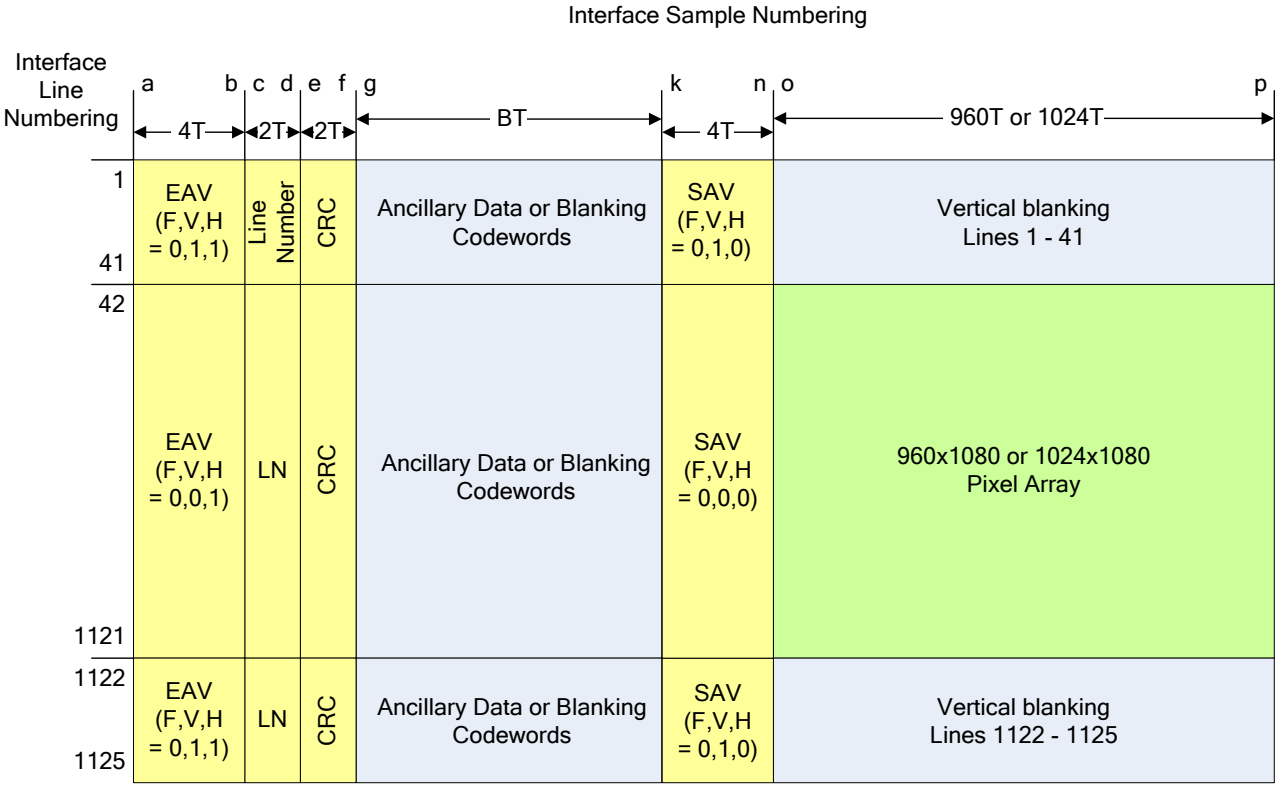


Figure 8 – Carriage of 1080-line image on 6G-SDI interface – overall process

The 1080-line 4:2:2 image shall be mapped to a 40-bit virtual interface consisting of four data streams. The structure of each data stream shall be as illustrated in Figure 9.



Sub Image Format	a	b	c	d	e	f	g	BT	k	n	o	p
1920 x 1080 / 120	960	963	964	965	966	967	968	128	1096	1099	0	959
1920 x 1080 / 120/1.001	960	963	964	965	966	967	968	128	1096	1099	0	959
1920 x 1080 / 100	960	963	964	965	966	967	968	348	1316	1319	0	959
2048 x 1080 / 120	1024	1027	1028	1029	1030	1031	1032	64	1096	1099	0	1023
2048 x 1080 / 120/1.001	1024	1027	1028	1029	1030	1031	1032	64	1096	1099	0	1023
2048 x 1080 / 100	1024	1027	1028	1029	1030	1031	1032	284	1316	1319	0	1023
2048 x 1080 / 96	1024	1027	1028	1029	1030	1031	1032	339	1371	1374	0	1023
2048 x 1080 / 96/1.001	1024	1027	1028	1029	1030	1031	1032	339	1371	1374	0	1023

Figure 9 – Structure of each Data Stream for 120 Hz, 120/1.001 Hz, 100 Hz, 96 Hz or 96/1.001 Hz frame rates

The image shall be mapped on to data streams one through four.

Data stream one shall carry the odd Y′ samples Y′1, Y′3, Y′5, Y′7 …

Data stream two shall carry the C'_R samples C'_R0, C'_R1, C'_R2…

Data stream three shall carry the even Y′ samples Y′0, Y′2, Y′4, Y′6 …

Data stream four shall carry the C'_B samples C'_B0, C'_B1, C'_B2…

For 4:2:2 (IC_TC_P)/ 10-bit images and 4:2:0 (IC_TC_P)/10-bit images, the image shall be mapped as above such that:

The Y′ samples are replaced with I samples,
the C'_B samples are replaced with C_T samples
and the C'_R samples are replaced with C_P samples.

The four data streams, data stream one through data stream four, shall be combined into a 40-bit virtual interface having an interface frequency of 148.5 MHz or 148.5/1.001 MHz.

6.1.1 6G-SDI Link Multiplex Structure (Informative)

Following multiplexing onto a 6G-SDI 10-bit interface according to section 7 the 6G-SDI data streams are conveyed in the following order:

C'_B0, C'_R0, Y′0, Y′1, C'_B1, C'_R1, Y′2, Y′3, C'_B2, C'_R2, Y′4, Y′5, C'_B3, C'_R3, Y′6, Y′7, ….

Figure 10 shows the mapping structure for mapping a 1920 x 1080 image onto data streams one through four. 2048 x 1080 images have maximum sample numbers of 2047 where the 1920 x 1080 image has maximum sample numbers of 1919

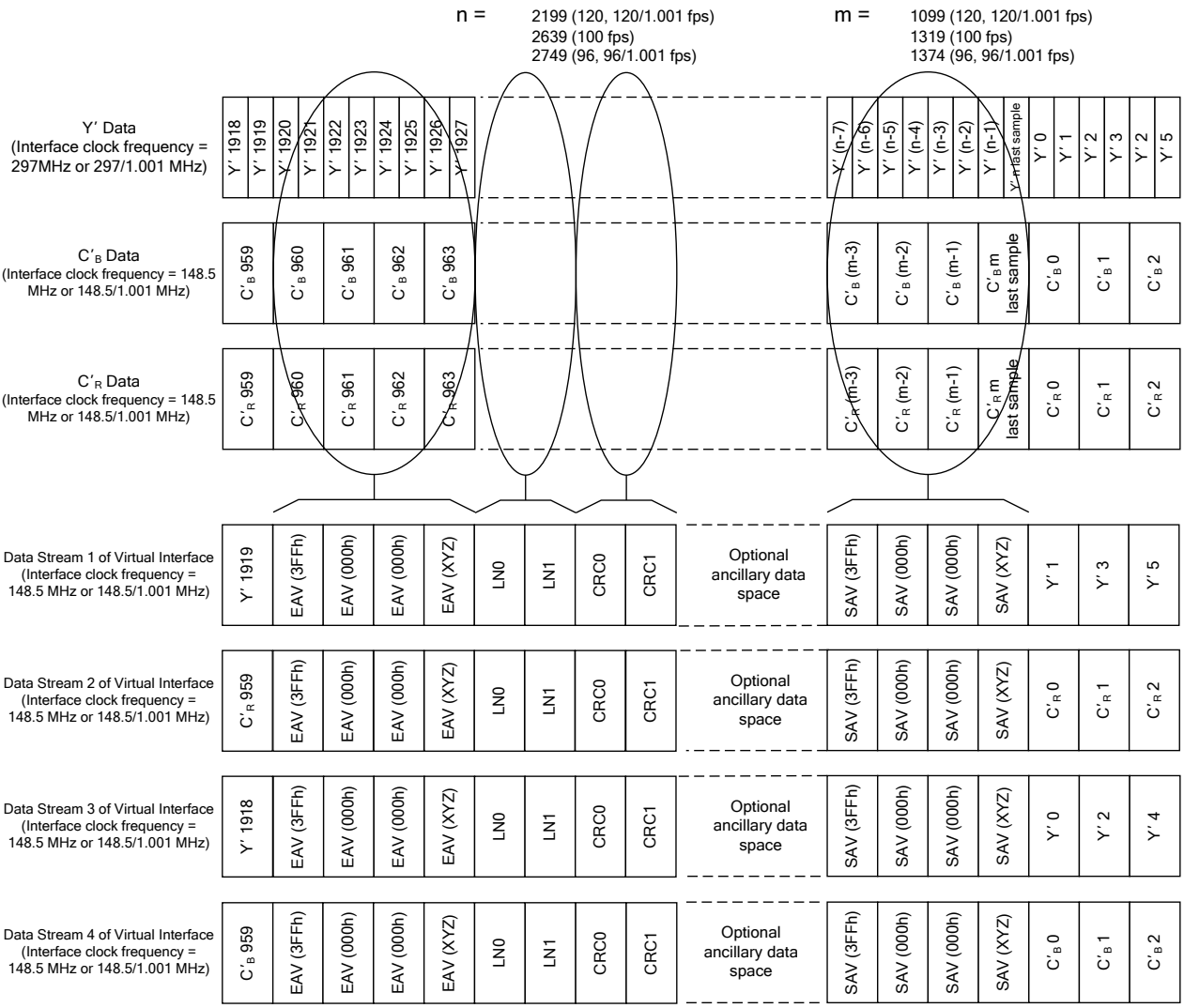


Figure 10 – Mapping Structure 1920 x 1080 4:2:2 (Y′C′BC′R)/10-Bit Signals at 96, 96/1.001, 100, 120 and 120/1.001 Progressive Frames/Sec

6.2 Timing and Reference Signals

EAV (End of Active Video) and SAV (Start of Active Video) timing references shall be inserted into each data stream of the 40-bit virtual interface on a line-by-line basis as illustrated in Figure 10.

The EAV and SAV sequence, F (field/ frame), V (vertical), H (horizontal) and parity bits P3 through P1 shall be as defined in Table 9 and Table 10.

Table 9 – Bit assignment for timing reference codes

Word	Value	Bit number									
		b9 (MSB)	b8	b7	b6	b5	b4	b3	b2	b1	b0 (LSB)
1	FFFh	1	1	1	1	1	1	1	1	1	1

2	000h	0	0	0	0	0	0	0	0	0	0
3	000h	0	0	0	0	0	0	0	0	0	0
4	XYZ	1	F	V	H	P_3	P_2	P_1	P_0	0	0

Table 10 – Protection Parity bits for timing reference codes

Bit number	b8	b7	b6	b5	b4	b3	b2
Function	F	V	H	P_3	P_2	P_1	P_0
Bit pattern 0	0	0	0	0	0	0	0
Bit pattern 1	0	0	1	1	1	0	1
Bit pattern 2	0	1	0	1	0	1	1
Bit pattern 3	0	1	1	0	1	1	0

6.3 Line Numbers

Line numbers shall be inserted into each data stream of the 40-bit virtual interface starting at the first data word (of the virtual interface) following the EAV XYZ word, as illustrated in Figure 10.

Line number data are composed of two words, LN0 and LN1, and shall be as shown in Table 11.

Table 11 – Line Number Data

	B9 (msb)	B8	B7	B6	B5	B4	B3	B2	B1	B0 (lsb)
LN0	$\overline{B8}$	L6	L5	L4	L3	L2	L1	L0	Res	Res
LN1	$\overline{B8}$	Res	Res	Res	L10	L9	L8	L7	Res	Res
Notes: 1 L10 : L0 = line number in binary code. 2 Res = reserved, set to “0”.										

6.4 Line CRC Codes

CRC (Cyclic Redundancy Check) codes shall be inserted into each data stream of the 40-bit virtual interface starting at the first data word (of the virtual interface) following the final word of the line number – LN1, as illustrated in Figure 10.

The CRC code words are used to detect errors in the active digital line, the EAV timing reference signal and line number words that follow it. The error detection code consists of two words determined by the polynomial generator equation:

$CRC(X) = X^{18} + X^5 + X^4 + 1$

The initial value of the CRC shall be zero. The calculation shall start at the first active line word of the interface and shall end at the final word of the line number – LN1.

Independent CRC codes shall be produced for each data stream of the 40-bit virtual interface.

The two words of the CRC code shall be as shown in Table 12.

Table 12 – CRC Data

	B9(msb)	B8	B7	B6	B5	B4	B3	B2	B1	B0(lsb)
CR0	$\overline{B8}$	CRC8	CRC7	CRC6	CRC5	CRC4	CRC3	CRC2	CRC1	CRC0
CR1	$\overline{B8}$	CRC17	CRC16	CRC15	CRC14	CRC13	CRC12	CRC11	CRC10	CRC9

6.5 HANC and VANC Space of Data Streams

When present, ancillary data packets shall be mapped into the HANC or the VANC spaces of each data stream and shall be in accordance with SMPTE ST 291-1.

The HANC and VANC spaces of each data stream are defined in Figure 9 of section 6.1.

Unless otherwise stated, the ancillary data shall be preferentially mapped into data stream one first and any remaining data shall then be mapped onto data stream three. Data space requirements and locations for each data service are defined by their respective application documents. In some cases it is required by specific applications that ancillary data be mapped into all four data streams (e.g. Payload ID.)

Informative Annex A provides information about the amount of HANC and VANC data space available in this operating mode.

6.6 Audio Data

When present, audio data shall be mapped into the HANC space of data streams one through four and shall be in conformance with SMPTE ST 299-1.

Audio control packets shall be mapped into the odd numbered data streams.

Audio data packets shall be mapped into the even numbered data streams.

Audio control and data packets shall be mapped into the data stream pair one/two first and any remaining data shall then be mapped onto data stream pair three/four.

The audio clock phase data as defined in the section “CLK (audio clock phase data)” of SMPTE ST 299-1 shall be calculated at the data stream clock frequency of 148.5 MHz or 148.5/1.001 MHz.

6.6.1 Number of Audio Channels

Informative Note:

1080p images at 96, 100 and 120 fps have horizontal line rates of 108 kHz, 112.5 kHz and 135 kHz respectively.

As SMPTE ST299-1 states that an audio sample should be placed in the next available line, and calculates the phase word from the line, it is only possible to embed audio samples in one line every 20.833 us on average (i.e. at 48 kHz). This means that the majority of the lines are not available for audio embedding, and the number of audio channels that can be transported is significantly less than appears from a simple calculation of the total HANC space.

Informative Note ends

Up to 32 audio channels sampled at 32 kHz, 44.1 kHz or 48 kHz may be mapped into data streams one through four of the 40-bit virtual interface. At 96 kHz sampling, up to 64 audio channels may be mapped into the virtual interface.

The maximum number of audio channels that can be mapped into the available ancillary data space of each data stream pair varies in accordance with the video format and the video frame rate. Table 13 shows the overall capacity of the 400-bit virtual interface.

Table 13 – Number of Audio Channels supported Source Image Format, Frame Rate and Audio Sampling Rate

Source Image Format	Frame Rate	Maximum number of audio channels at 32 kHz, 44.1 kHz or 48 kHz sampling	Maximum number of audio channels at 96 kHz sampling
1920 x 1080	100 and 120 Progressive	Up to 32 channels	Up to 16 channels
2048 x 1080	96 and 100 Progressive	Up to 32 channels	Up to 16 channels
	120 Progressive	Up to 16 channels	Up to 8 channels

6.6.1.1 Carriage of up to 32 Channels of Audio at up to 48 kHz Sampling

For audio at up to 48 kHz sampling embedded into 2048 x 1080 image formats at frame rates of 120, the audio data and control packets for the first 8 channels shall be mapped into data stream pair one and two in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

The audio data and control packets for the second 8 channels shall be mapped into data stream pair three and four in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

For audio at up to 48 kHz sampling, embedded into all other 1080-line image formats shown in Table 13, the audio data and control packets for the first 16 channels shall be mapped into data stream pair one and two in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

The audio data and control packets for the second 16 channels shall be mapped into data stream pair three and four in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

6.6.1.2 Carriage of up to 16 Channels of Audio at 96 kHz Sampling

For audio at 96 kHz sampling embedded into 2948 x 1080 image formats at frame rates of 120, the audio data and control packets for the first 4 channels shall be mapped into data stream pair one and two in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

The audio data and control packets for the second 4 channels shall be mapped into data stream pair three and four in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

For audio at 96 kHz sampling, embedded into all other 1080-line image formats shown in Table 13, the audio data and control packets for the first 8 channels shall be mapped into data stream pair one and two in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

The audio data and control packets and audio data and control packets for the second 8 channels shall be mapped into data stream pair three and four in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

6.7 Time Code Data

When present the data format of ATC packets shall be in conformance with SMPTE ST 12-3.

Where present the packet or packets shall be mapped into the HANC or VANC space of data stream one. The preferred location should be as indicated in Table 14.

Table 14 – Preferred locations for time code insertion into data streams

Payload Type	Location
ATC_HFRTC	HANC, Line 11
ATC_HFRTC *	HANC, Line 12
ATC_HFRTC * ATC_HFRTC *	HANC, Line 13 HANC, Line 14
Note: * Transmissions of multiple ancillary time code packets with different instance identifications (bitstream numbers) per video frame are permissible under the provisions of SMPTE ST 12-3. The default bitstream number is zero. Lines 12, 13 and 14 are for use when necessary based on the number of bitstreams	

The ATC_HFRTC packet with bitstream number zero shall be preferentially mapped onto line 11 first and any remaining bitstreams shall then be mapped onto the same line. If there is insufficient space remaining on the same line, remaining bitstreams shall be mapped onto line 12, then onto line 13, then onto line 14.

The time code may also be mapped into data stream three, in which case the corresponding Time Address values shall be identical.

6.8 Payload Identifier

A payload identifier packet shall be placed in each data stream.

Table 15 shows the payload identifier definitions for 1080-line HFR Video Payloads. As stated in SMPTE ST 352, the payload identifier consists of 4 bytes where each byte has a separate significance. The first byte of the payload identifier has the highest significance and subsequent bytes define lower order video and ancillary payload information.

The horizontal placement of the packet should be immediately following the last CRC code word (CR1) of the line(s) specified in SMPTE ST 352 for 1125-line systems.

Note: The line numbers defined in SMPTE ST 352 for the placement of the payload identifier packet in 1125-line systems avoid those lines used by SMPTE ST 299-1 and SMPTE ST 299-2 for the carriage of digital audio control packets and extended audio control packets, respectively.

Table 15 – Payload Identifier Definitions for Mode 3 1080-line Video Payload for Mapping on a Single-link 6Gb/s (nominal) Serial Interface

<table>
<tr><th>Bits</th><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th></tr>
<tr><td>Bit 7</td><td>1</td><td>Progressive transport (1)</td><td>Aspect Ratio
16:9 (1) or Unknown (0)</td><td rowspan="3">Link assignment
Single link 6G-SDI (0h)</td></tr>
<tr><td>Bit 6</td><td>1</td><td>Progressive picture (1)</td><td>Sub image horizontal sampling
1920 (0) or 2048 (1)</td></tr>
<tr><td>Bit 5</td><td>0</td><td rowspan="2">Transfer characteristics
SDR-TV (0h)
HLG (1h)
PQ (2h)
Unspecified (3h)</td><td rowspan="2">Colorimetry
Rec 709*1 (0h)
Color VANC Packet (1h)
UHDTV*2 (2h)
Unknown (3h)</td></tr>
<tr><td>Bit 4</td><td>0</td><td>Luminance and color difference signal
$Y'C'_BC'_R$ (0)
IC_TC_P (1)</td></tr>
<tr><td>Bit 3</td><td>0</td><td rowspan="4">Picture rate
(See Table 4)</td><td rowspan="4">Sampling structure
(See Table 5)</td><td>Reserved (0)</td></tr>
<tr><td>Bit 2</td><td>0</td><td>Audio copy status:
Audio in this data stream carries additional channels (0)
Audio in this data stream is copied (1)</td></tr>
<tr><td>Bit 1</td><td>0</td><td rowspan="2">Bit depth
10-bit Full Range (0h)
10-bit (1h)
Other values are Reserved</td></tr>
<tr><td>Bit 0</td><td>1</td></tr>
<tr><td colspan="5">NOTE:
*1 Rec 709 indicates ITU-R recommendation BT.709 colorimetry and is equivalent to SMPTE ST 2036-1 Conventional System Colorimetry.
*2 UHDTV indicates Recommendation ITU-R BT.2020 colorimetry as referenced by Recommendation ITU-R BT.2100
3 The usage of bytes 2, 3 and 4 is consistent for all modes in this document but the definitions are repeated for the convenience of the reader</td></tr>
</table>

6.8.1 Byte 1 - Digital Interface and Payload Identification

Byte 1 of the payload identifier identifies the video payload and the digital interface and shall be as defined below.

Byte 1 shall be set to [C1h] for 1080-line image formats listed in Table 8 transported via single-link 6G-SDI.

6.8.2 Byte 2 – Picture Rate and Scanning Method

Byte 2 of the payload identifier shall be used to identify the picture and transport scanning methods and the picture rate.

Bit b7 shall be set to 1 (progressive transport).

Bit b6 shall be set to 1 (progressive picture).

Bits b5 and b4 shall be used to indicate Transfer Characteristic such that:

b5:bit 4 = 0h identifies SDR-TV in accordance with SMPTE ST 274 or SMPTE ST 2036-1

b5:bit 4 = 1h identifies HLG HDR-TV in accordance with Recommendation ITU-R BT.2100

b5:bit 4 = 2h identifies PQ HDR-TV in accordance with Recommendation ITU-R BT.2100

b5:b4 = 3h identifies Unspecified Transfer Characteristics

In the case where bits b5:b4 of Byte 3 indicates “Color VANC packet as defined in SMPTE ST 2048-1”, if the Transfer Characteristic signaled in the Color VANC packet is active, then it takes precedence over the Transfer Characteristic signaled in b5:b4.

Note: The Reference EOTF as defined in SMPTE ST 2084 is the same as the Reference PQ EOTF defined in Recommendation ITU-R BT.2100.

Bits b3 to b0 shall be used to identify the picture rate in Hz according to Table 4 and shall only use the values as permitted for image formats in Table 8.

6.8.3 Byte 3 – Sampling Structure, Aspect Ratio, Horizontal Size and Colorimetry

Byte 3 of the payload identifier shall be used to identify the aspect ratio, horizontal pixel array size, sampling structure and colorimetry of the video payload.

Bit b7 shall be used to identify the aspect ratio such that:

b7 = 0 identifies unknown aspect ratio

b7 = 1 identifies a 16:9 aspect ratio

Bit b6 shall be used to identify the number of active Luma samples for the sub image such that:

b6 = 0 identifies 1920 active Luma samples

b6 = 1 identifies 2048 active Luma samples

Bits b5 and b4 shall identify the colorimetry for the image formats identified in Table 8 such that:

b5:b4 = 0h identifies Rec 709 colorimetry in accordance with Recommendation ITU-R BT.709 as referenced by SMPTE ST 274

b5:b4 = 1h identifies that the colorimetry is defined in the Color VANC packet as defined in ST 2048-1

b5:b4 = 2h identifies UHDTV colorimetry in accordance with Recommendation ITU-R BT.2020 reference primaries and reference white as referenced in Recommendation ITU-R BT.2100

b5:b4 = 3h identifies unknown colorimetry

Bits b3 to b0 shall be used to identify the sampling structure in accordance with Table 5 and shall only use the values as permitted for image formats in Table 8.

6.8.4 Byte 4 – Link Identification, Audio Copy Status and Quantization Bit Depth

Byte 4 of the payload identifier shall be used to identify the link assignment, the audio copy status and the bit depth of the sample quantization.

Bits b7 to b5 shall be used to identify Link assignment and set to:

b7:b5 = 0h for 6G-SDI Link 1

other values are reserved

Bit b4 shall be used to indicate the interpretation of the Luminance and color difference signal such that:

b4 = 0 indicates that the $Y'C'_BC'_R$ sampling structure defined in Byte 3 bits b3:b0, is interpreted as $Y'C'_BC'_R$

b4 = 1 indicates that the $Y'C'_BC'_R$ sampling structure defined in Byte 3 bits b3:b0, is interpreted as IC_TC_P in accordance with Recommendation ITU-R BT.2100.

Note: Non Constant Luminance (NCL) $Y'C'_BC'_R$ sampling as referenced by Recommendation ITU-R BT.2100 is equivalent to $Y'C'_BC'_R$ sampling in this document.

Bit b3 shall be Reserved and set to 0

Bit b2 shall be set to 0 (Audio in this data stream carries additional channels or audio not present)

Bits b1 to b0 shall be used to identify the bit depth of the sample quantization such that:

b1:b0 = 0h identifies quantization using Full Range 10-bit per sample as defined in Recommendation ITU-R BT.2100.

The prohibited code values shall be protected in accordance with SMPTE RP 2077 “Mapping to Interfaces and Formats that Rely upon Protected Code Values” with CV_{LOW} = 4 and CV_{HIGH} = 1019.

b1:b0 = 1h identifies using 10-bit per sample

Other values are reserved.

6.9 Blanking

HANC and VANC space with no ancillary data packets or audio data packets shall contain data words that represent video black level for the video structure being carried.

6.9.1 Blanking Values (Informative)

In the case of 4:2:2 or 4:2:0 $Y'C'_BC'_R$ / IC_TC_P10-bit video structures, all words in all odd numbered data streams take the value 040h. All words in all even numbered data streams take the value 200h.

In the case of 4:2:2 or 4:2:0 $Y'C'_BC'_R$ / IC_TC_P10-bit Full Range video structures, all words in all odd numbered data streams take the value 004h. All words in all even numbered data streams take the value 200h.

6.10 Multiplex

The 40-bit virtual interface shall then be multiplexed onto a 6G-SDI 10-bit interface according to section 7.

6.11 Levels of Operation (Informative)

To define the level of support for SMPTE ST 2081-10 Mode 3, manufacturers are encouraged to indicate in publications which mapping format is supported. For example:

SMPTE ST 2081-10 MODE 3 – 1080-line HFR Source image formats and ancillary data into a 6 Gb/s [nominal] SDI bit-serial interface

Manufacturers are also encouraged to indicate in publications supported audio and video formats.

7 Single-link 6G-SDI 10-bit Multiplex

Prior to serialization data streams one through four of the 40-bit virtual interface shall be multiplexed word-by-word into a 6G-SDI 10-bit interface.

The 10-bit interface shall consist of a word multiplex of data streams one through four, in the order data stream four, data stream two, data stream three, data stream one…etc.

The 10-bit parallel interface so produced will have an interface frequency of 594 MHz or 594/1.001MHz as shown in the illustrative examples of Figure 11 and Figure 12.

This 10-bit interface can then be serialized according to SMPTE ST 2081-1 to create the 6G-SDI serial interface.

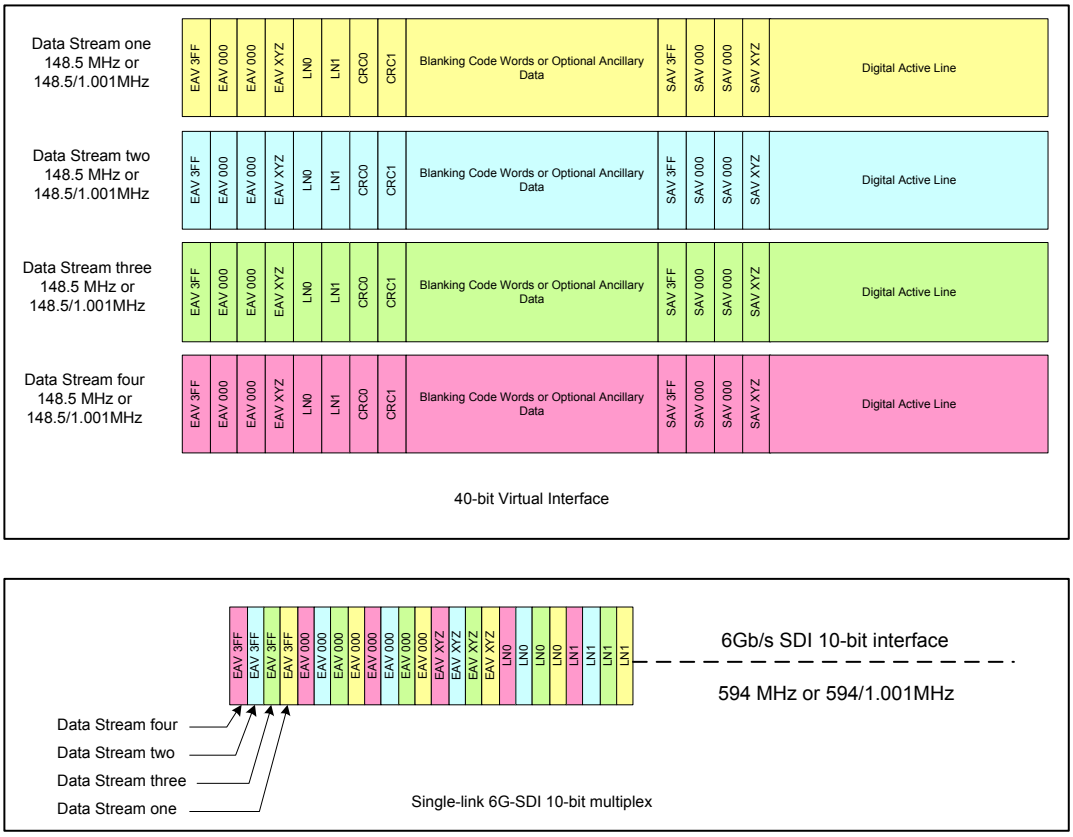


Figure 11 – Single-link 6G-SDI 10-bit Multiplex Type 1 for Mode 2 and Mode 3

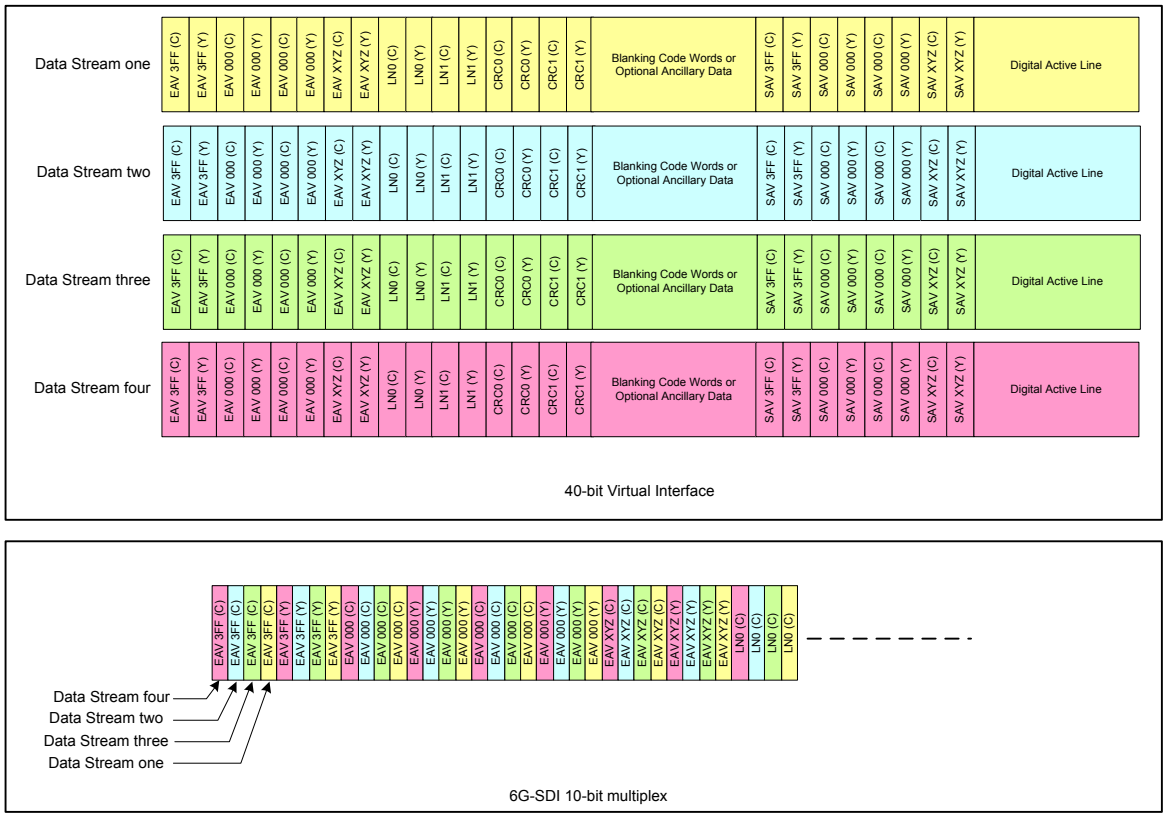


Figure 12 – Single-link 6G-SDI 10-bit Multiplex Type 2 for Mode 1

Note:

Figure 11 shows the Type 1 10-bit multiplex resulting from mapping modes in which each data stream has a single instance of TRS words, Line Numbers, CRC Words, etc.

Figure 12 shows the Type 2 10-bit multiplex resulting from mapping modes in which each data stream has two instances of TRS words, Line Numbers, CRC Words, etc. A type 2 multiplex is the result of SMPTE ST 292-1 mapping of each sub image. It is generated for 4:2:2 10-bit formats with frame rates of 30fps or less.

Annex A Ancillary Data Capacity of the 6G-SDI Interface (Informative)

The ancillary data space available in serial digital interface transports is approximately equivalent to horizontal interval space and vertical interval space for the image format being transported. In the case of images transported on the interface specified in this standard, it is dependent on the horizontal interval space and vertical interval space for each of the data streams being carried on the interface, multiplied by the number of data streams.

SMPTE RP 291-2 provides information on the size of the ancillary data space in a SMPTE ST 425-1 and SMPTE ST 292-1 interface.

For Mode 1 2160-line source image formats specified in this standard, the available HANC and VANC data space on the interface is 4 times the HANC and VANC data space available (as shown in the tables of SMPTE RP 291-2) on a SMPTE ST 292-1 interface carrying the corresponding sub-image.

For Mode 2 1080-line source image formats specified in this standard, the available HANC and VANC data space on the interface is 2 times the HANC and VANC data space available (as shown in the tables of SMPTE RP 291-2) on a SMPTE ST 425-1 3G SDI link interface carrying the corresponding sub-image.

For Mode 3 1080-line HFR source image formats specified in this standard, the available HANC and VANC data space on each of the four data streams of the interface is defined section 6.5 of this standard.

SMPTE RP 291-2 also provides a method of calculating the available ancillary data space on any interface. These calculations provide the reader with the underlying formulas used to calculate the numbers in the tables, as well as providing a mechanism to calculate the space for interfaces not covered explicitly by SMPTE RP 291-2.

Annex B Further Guidance on Luminance and Color Difference Signal Identification (Informative)

The following table provides additional information for the logical association and meaning of “transfer characteristics”, “sampling structure” and “luminance and color difference signal” Identification as signaled in the Payload Identifier for UHDTV1 and UHDTV2 image structures applicable to this interface.

Table B1 – Transfer Characteristics, Sampling Structure and Luminance and Color Difference Signal “truth table”

Transfer Characteristics	Sampling Structure	Luminance and color difference (L&CD) identifier	Meaning of L&CD Identifier
SDR-TV	$Y'C'_BC'_R$	0	Indicates $Y'C'_BC'_R$ in accordance with SMPTE ST 2036-1
	$Y'C'_BC'_R$	1	Indicates Constant luminance $Y'C'_BC'_R$ in accordance with Recommendation ITU-R BT.2020 This is not permitted in this document.
HLG or PQ	$Y'C'_BC'_R$	0	Indicates Non-constant luminance $Y'C'_BC'_R$ in accordance with Recommendation ITU-R BT.2100
	IC_TC_P	1	Indicates IC_TC_P in accordance with Recommendation ITU-R BT.2100.
SDR-TV HLG or PQ	G′B′R′	Not valid	L&CD can be ignored

Bibliography (Informative)

SMPTE RP 157:2012, Key and Alpha Signals

SMPTE ST 12-1:2014, Television - Time and Control Code

SMPTE ST 12-2:2014, Transmission of Time Code in the Ancillary Data Space

SMPTE RP 291-2:2013 Ancillary Data Space Use — 4:2:2 SDTV and HDTV Component Systems and 4:2:2 2048 ×1080 Production Image Formats

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

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

SMPTE ST 424:2012, Television 3 Gb/s Signal/Data Serial Interface

SMPTE ST 425-1:2014, Source Image Format and Ancillary Data Mapping for the 3 Gb/s Serial Interface

SMPTE ST 428-11:2013, Additional Frame Rates for D-Cinema

SMPTE ST 2036-1:2014, Ultra High Definition Television — Image Parameter Values for Program Production

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

Amendment 1:2016 to SMPTE ST 2048-1:2011, 2048 × 1080 and 4096 × 2160 Digital Cinematography Production Image Formats FS/709 — Amendment 1

SMPTE ST 2081-1:2015, 6G-SDI – Signal/Data Serial Interface – Electrical

SMPTE ST 2084:2014, High Dynamic Range Electro-Optical Transfer Function of Mastering Reference Displays

Recommendation ITU-R BT.709-6 (06/2015), Parameter values for the HDTV* standards for production and international programme exchange

Recommendation ITU-R BT.2020-2 (10/2015), Parameter values for ultra-high definition television systems for production and international programme exchange