

# **SMPTE OVERVIEW**

## **12G-SDI Bit-Serial Interfaces — Overview for the SMPTE ST 2082 Document Suite**



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### **Document Overview**

The SMPTE ST 2082 suite of documents defines the mapping of various source image formats onto a single-link, dual-link and quad-link serial digital interface operating at a nominal rate of 12 Gb/s. This informative “roadmap” describes the documents in the SMPTE ST 2082 suite.

The SMPTE ST 2082 series specify a common virtual interface that is carried on both electrical and optical physical interfaces which are also defined in the document suite.

The diagram of Figure 1 illustrates a simplified ‘Image mapping data flow’ roadmap for the 12G-SDI profile as defined by the ST 2082 document suite. The individual roadmaps of the SMPTE ST 2082 standards include full details of reference standards.

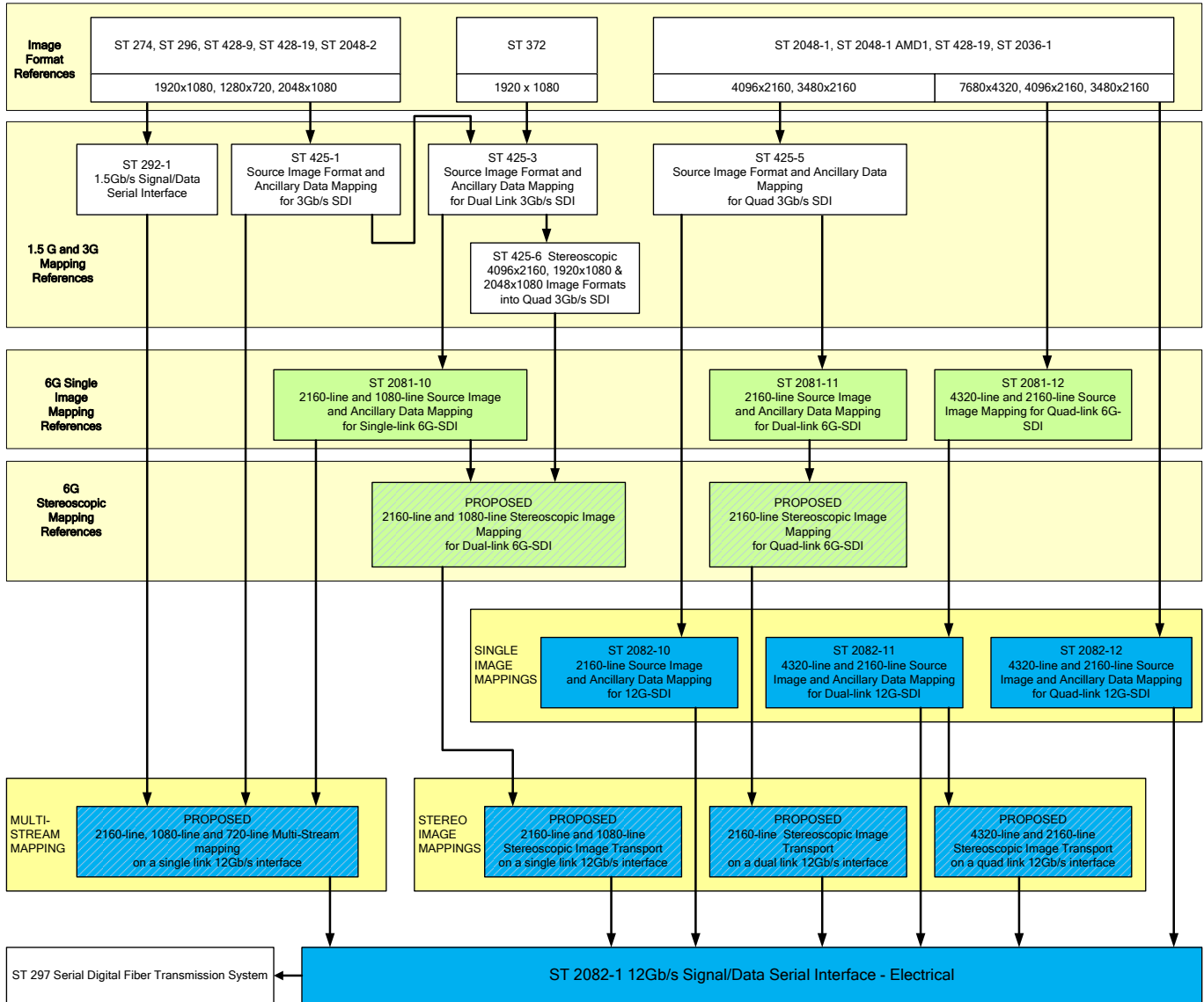


Figure 1 – 12G-SDI Profile

## 1 SMPTE ST 2082-1 – 12 Gb/s Signal/Data Serial Interface — Electrical

This standard defines a bit-serial data structure, electrical signal and coaxial cable interface for the transport of signals with a total payload of 11.88 Gb/s or 11.88/1.001 Gb/s.

This standard also specifies the electrical and physical characteristics of coaxial cables and connectors.

## 2 SMPTE ST 2082-10 – 2160-line Source Image and Ancillary Data Mapping for 12G-SDI

This standard defines the carriage of 2160-line image formats and associated ancillary data into a Single-link 12 Gb/s [nominal] SDI bit-serial interface as follows:

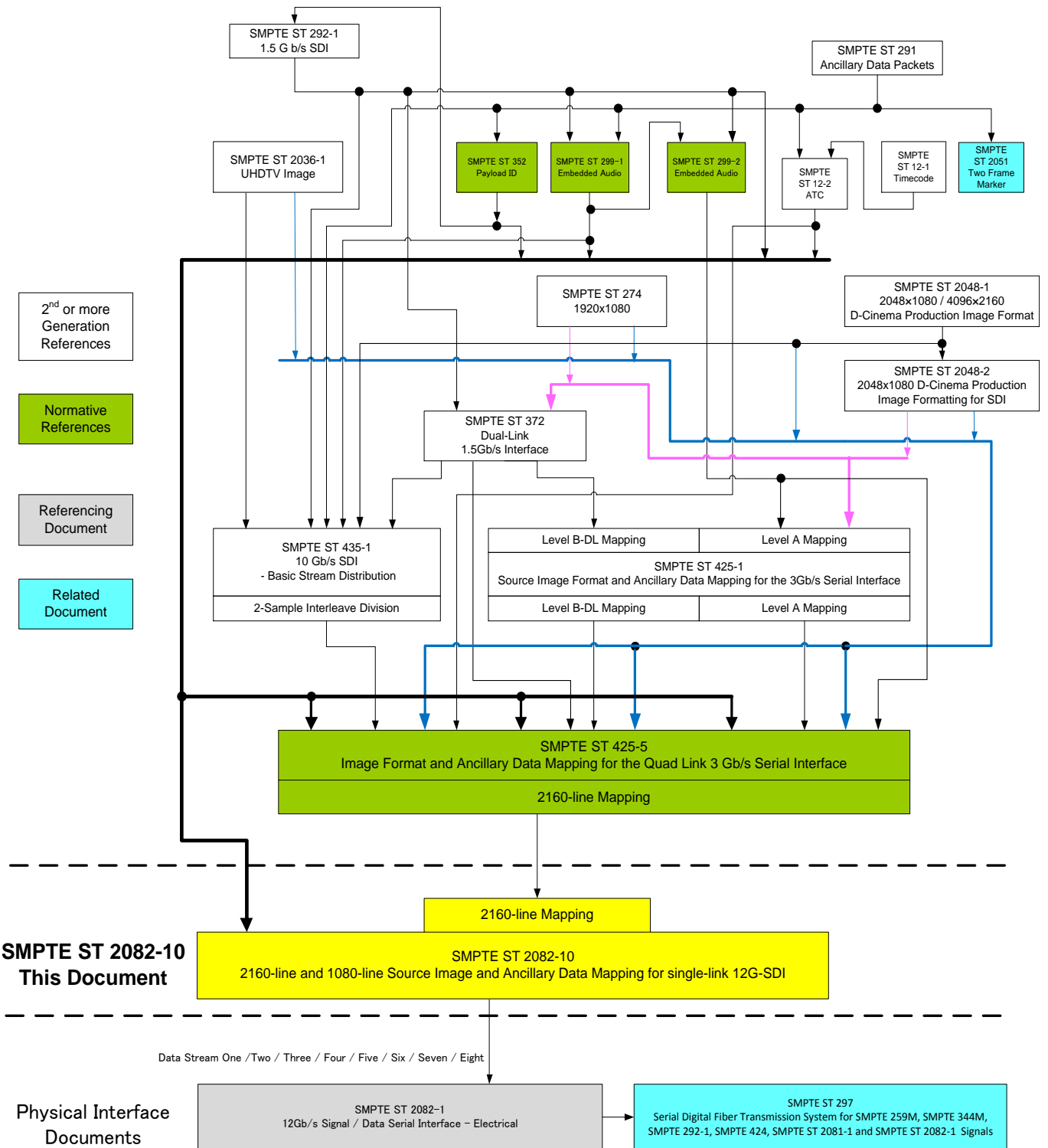
**MODE 1:** 2160-line source image formats and ancillary data into a 12 Gb/s [nominal] SDI bit-serial interface

This standard also defines the carriage of the SMPTE ST 352 payload ID's for the single-link 12Gb/s SDI interface.

### 2.1 SMPTE ST 2082-10 Supported image Formats

UHDTV1 and 4K Digital Cinematography Production			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate
ST 2036-1	3840 × 2160	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit 4:2:0 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit	50, 60/1.001 and 60 frames progressive
ST 2048-1	4096 × 2160	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit	48/1.001, 48, 50, 60/1.001 and 60 frames progressive
ST 2036-1	3840 × 2160	4:4:4 (R'G'B')/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive
ST 2048-1	4096 × 2160	4:4:4 (R'G'B'), 4:4:4:4 (R'G'B'+A)/10-bit	
ST 2036-1	3840 × 2160	4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )	
ST 2048-1	4096 × 2160	4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> ), 4:4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> +A)/10-bit	
ST 2036-1	3840 × 2160	4:4:4 (R'G'B')/12-bit	
ST 2048-1	4096 × 2160	4:4:4 (R'G'B')/12-bit	
ST 2036-1	3840 × 2160	4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	
ST 2048-1	4096 × 2160	4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	
ST 2036-1	3840 × 2160	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	
ST 2048-1	4096 × 2160	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	
ST 2048-1	4096 × 2160	4:2:2:4 (Y'C <sub>B</sub> C <sub>R</sub> +A)/12-bit	

## 2.2 SMPTE ST 2082-10 Document Roadmap



### 3 SMPTE ST 2082-11 – 4320-line and 2160-line Source Image and Ancillary Data Mapping for Dual-link 12G-SDI

This standard defines several mapping modes for the carriage of 4320-line and 2160-line image formats and associated ancillary data into a Dual-link 12 Gb/s [nominal] SDI bit-serial interface as follows:

- **MODE 1:** 4320-line  $Y'C'_B C'_R$  4:2:2 and 4:2:0 10-bit image formats and ancillary data on a Dual-link 12 Gb/s [nominal] SDI bit-serial interface
- **MODE 2:** 2160-line  $R'G'B'$ ,  $Y'C'_B C'_R$  4:4:4(:4) 10-bit and 4:4:4 12-bit image formats and ancillary data on a Dual-link 12 Gb/s [nominal] SDI bit-serial interface
- **MODE 3:** 2160-line  $Y'C'_B C'_R$  4:2:2 and 4:2:0 10-bit Additional Frame Rate Source image formats and ancillary data on a Dual-link 12 Gb/s [nominal] SDI bit-serial interface

This standard also defines the carriage of ancillary data, and the SMPTE ST 352 payload ID's for the dual-link 12Gb/s SDI interface.

#### 3.1 SMPTE ST 2082-11 Supported image Formats

UHDTV2 Production			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate Hz
ST 2036-1	7680 × 4320	4:2:2 ( $Y'C'_B C'_R$ ), 4:2:0 ( $Y'C'_B C'_R$ )/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive
UHDTV1 and 4K Digital Cinematography Production			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate Hz
ST 2036-1	3840 × 2160	4:4:4 ( $R'G'B'$ ), 4:4:4:4 ( $R'G'B' + A$ )/10-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160 <sup>*2</sup>	4:4:4 ( $R'G'B'^*1$ ), 4:4:4:4 ( $R'G'B'^*1 + A$ )/10-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
ST 2036-1	3840 × 2160	4:4:4 ( $Y'C'_B C'_R$ ), 4:4:4:4 ( $Y'C'_B C'_R + A$ )/10-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160 <sup>*2</sup>	4:4:4 ( $Y'C'_B C'_R$ ), 4:4:4:4 ( $Y'C'_B C'_R + A$ )/10-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
ST 2036-1	3840 × 2160	4:4:4 ( $R'G'B'$ )/12-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160 <sup>*2</sup>	4:4:4 ( $R'G'B'^*1$ )/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive

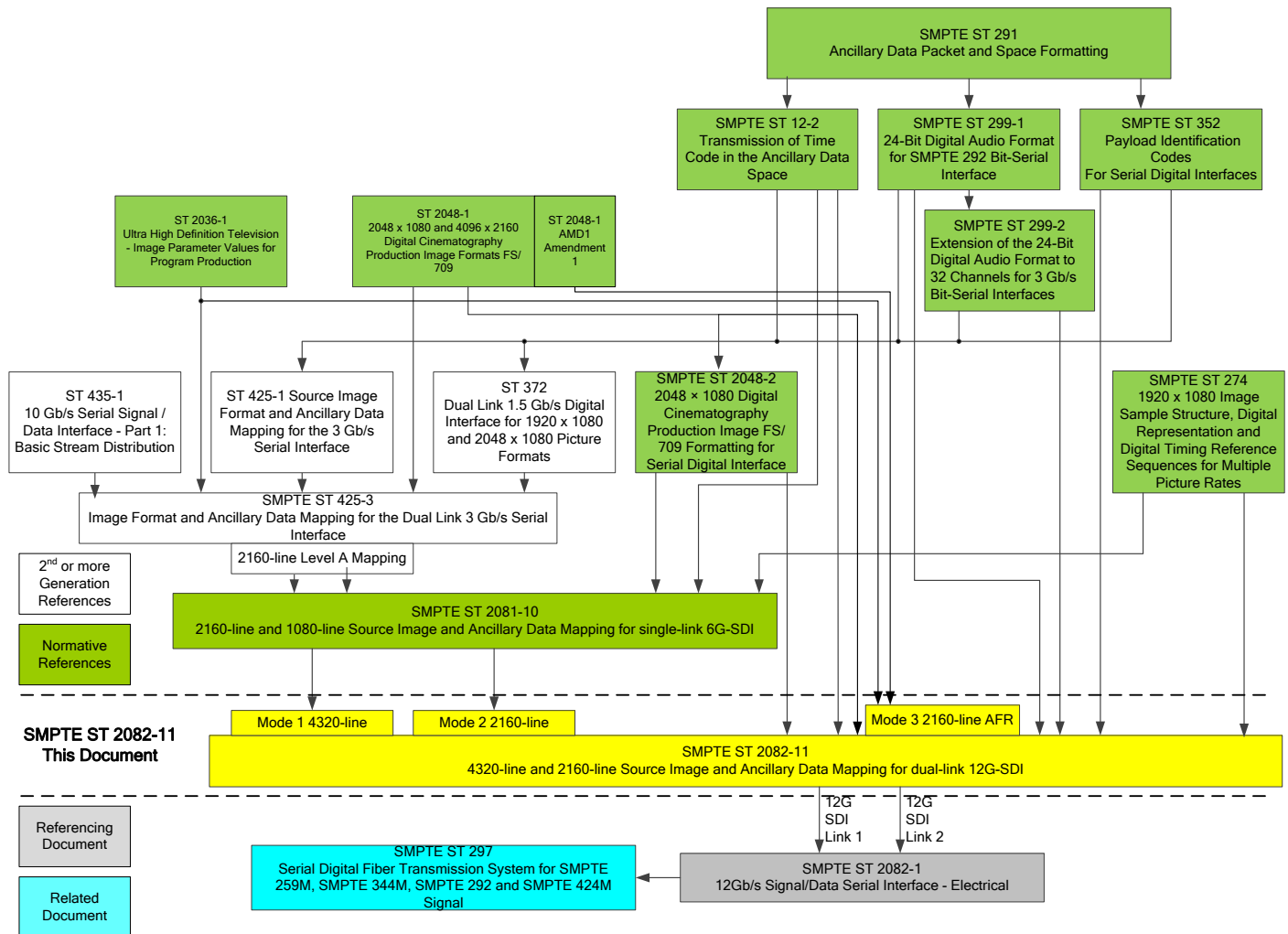
ST 2036-1	3840 × 2160	4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160 <sup>*2</sup>	4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
ST 2036-1	3840 × 2160	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit 4:2:0 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160 <sup>*2</sup>	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160 <sup>*2</sup>	4:2:2:4 (Y'C <sub>B</sub> C <sub>R</sub> +A)/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
<b>UHDTV1 and 4K Digital Cinematography Production AFR</b>			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Additional Frame Rates (AFR) Hz
ST 2036-1	3840 x 2160	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit 4:2:0 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit	120 progressive
			120/1.001 progressive
			100 progressive
ST 2048-1	4096 x 2160	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit	120 progressive
			120/1.001 progressive
			100 progressive
			96 progressive
			96/1.001 progressive

Notes:

<sup>\*1</sup> In this image format R'G'B' indicates either R'G'B' or R'<sub>FS</sub>G'<sub>FS</sub>B'<sub>FS</sub>. An additional Color VANC packet to describe the FS characteristics is defined by SMPTE ST 2048-1.

<sup>\*2</sup> This is the maximum pixel array, the active image may not fill the maximum array.

### 3.2 SMPTE ST 2082-11 Document Roadmap



## 4 SMPTE ST 2082-12 – 4320-line and 2160-line Source Image and Ancillary Data Mapping for Quad-link 12G-SDI

This standard defines several mapping modes for the carriage of 4320-line and 2160-line image formats and associated ancillary data into a Quad-link 12 Gb/s [nominal] SDI bit-serial interface as follows:

- **MODE 1:** 4320-line Source image formats and ancillary data into a Quad-link 12 Gb/s [nominal] SDI bit-serial interface
- **MODE 2:** 2160-line Y'C<sub>B</sub>C<sub>R</sub> or R'G'B' 4:4:4:4 10-bit or 4:4:4 10-bit or 12-bit Additional Frame Rate (AFR) Source image formats and ancillary data into a Quad-link 12 Gb/s [nominal] SDI bit-serial interface

This standard also defines the carriage of ancillary data, and the SMPTE ST 352 payload ID's for the quad-link 12Gb/s SDI interface.

4.1 SMPTE ST 2082-12 Supported image Formats

UHDTV2 Production			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate Hz
ST 2036-1	7680 x 4320	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> ), 4:2:0 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit	50, 60/1.001 and 60 Progressive
ST 2036-1	7680 x 4320	4:4:4 (R'G'B')/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive
ST 2036-1	7680 x 4320	4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit	
ST 2036-1	7680 x 4320	4:4:4 (R'G'B')/12-bit	
ST 2036-1	7680 x 4320	4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	
ST 2036-1	7680 x 4320	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit 4:2:0 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	
UHDTV1 and 4K Digital Cinematography Production AFR			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate Hz
ST 2036-1	3840 x 2160	4:4:4 (R'G'B')/10-bit 4:4:4:4 (R'G'B'+A)/10-bit 4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/10-bit 4:4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> +A)/10-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
ST 2048-1	4096 x 2160*2	4:4:4 (R'G'B'*1), 4:4:4:4 (R'G'B'*1+A)/10-bit, 4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> ), 4:4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> +A)/10-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
			96 frames progressive
ST 2036-1	3840 x 2160	4:4:4 (R'G'B')/12-bit, 4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive

ST 2048-1	4096 x 2160 <sup>*2</sup>	4:4:4 (R'G'B' <sup>*1</sup> )/12-bit, 4:4:4 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
			96 frames progressive
			96/1.001 frames progressive
ST 2036-1	3840 x 2160	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit 4:2:0 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
ST 2048-1	4096 x 2160 <sup>*2</sup>	4:2:2 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit 4:2:0 (Y'C <sub>B</sub> C <sub>R</sub> )/12-bit 4:2:2:4 (Y'C <sub>B</sub> C <sub>R</sub> +A)/12-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
			96 frames progressive
			96/1.001 frames progressive

Notes:

<sup>\*1</sup> In this image format R'G'B' indicates either R'G'B' or R'<sub>FS</sub>G'<sub>FS</sub>B'<sub>FS</sub>. An additional Color VANC packet to describe the FS characteristics is defined by SMPTE ST 2048-1.

<sup>\*2</sup> This is the maximum pixel array, the active image may not fill the maximum array.

### 4.2 SMPTE ST 2082-12 Document Roadmap

