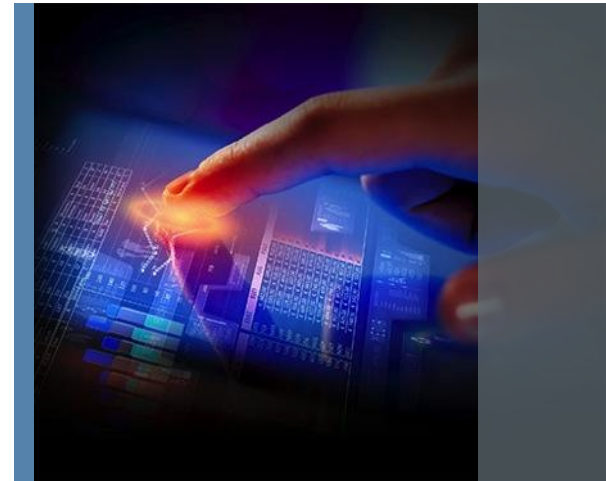


UHD Video Interfaces



AGENDA

Why 4K

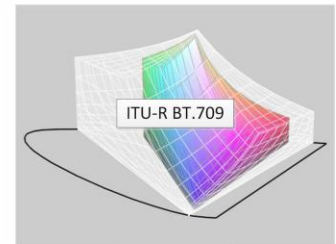
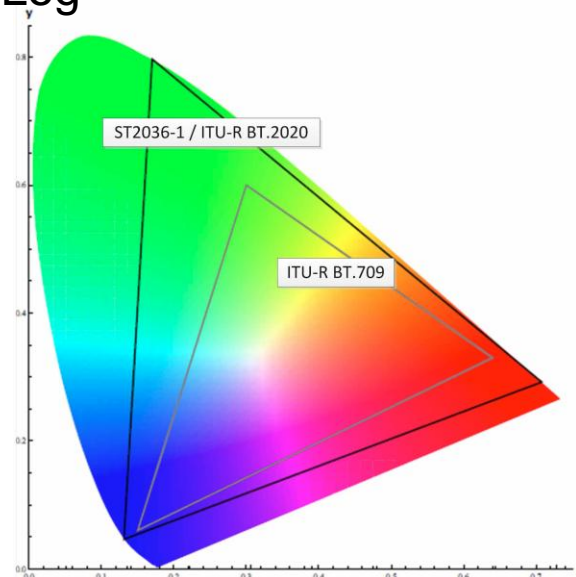
4K Standards

Methods to Distribute 2K & 4K

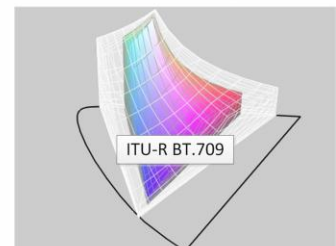
WFM8300 & SPG/TG8000 Solution

Why 4K?

- Higher Resolution (8192x4320), (4096x2160), (3840x2160)
- Higher Frame Rates 48, 60, 120
- Extended Color Fidelity
 - Greater bit Depth 10, 12, 16-bits
 - Extend Gamut, P3 (XYZ), ACES,
 - Look Up Tables (LUT), S-Log
- Digitally Emulate Film



Yxy gamut



Yu' v' gamut

Image Size Matters



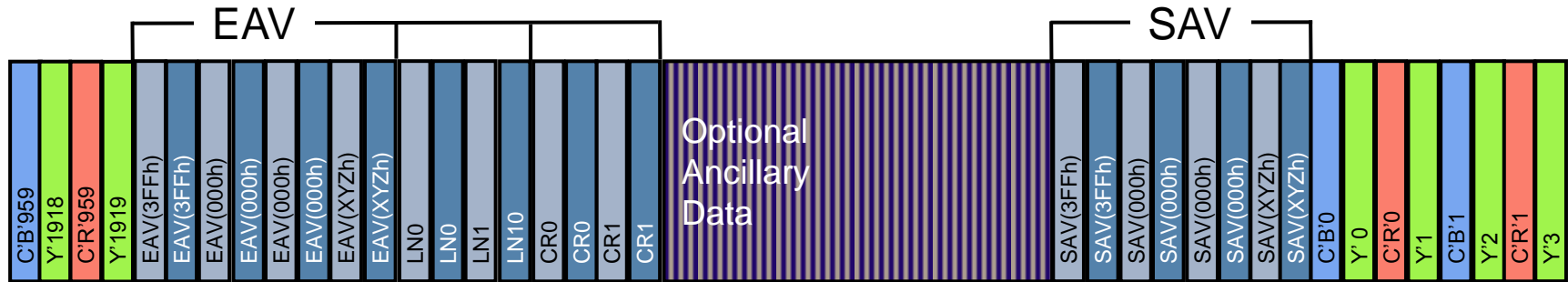
Image Size Matters, How Many Pixels?



4 x HD (2048 or 1920x1080)



Evolution of SDI



- SMPTE 2048 - 0/1/2 2048 × 1080 and 4096 × 2160 Digital Cinematography Production Image Formats FS/709 — Roadmap for the 2048 Document Suite
- SMPTE 2036 Ultra High Definition Television image Parameter Values for Program Production.
- SMPTE 425-5 Image Format and Ancillary Data Mapping for the Quad Link 3 Gb/s Serial Interface
- 12Gb/s & 6Gb/s SMPTE Standards 2082/2081 in progress.
- 10Gb/s Optical Standardized in SMPTE 435 10Gb/s Serial Signal/Data Interface
 - Part 1 Basic Stream Distribution
 - Part 2 10.692 Gb/s Stream - Basic Stream Data Mapping
 - Part 3 10.6921 Gb/s Optical Fiber Interface

Image Structure Multiplexed

- Data Stream one and two of the virtual interfaced are multiplexed together producing twice the data rate
- Channel Coding uses NRZI

$$G_1(X) = X^9 + X^4 + 1.$$

$$G_2(X) = X + 1.$$

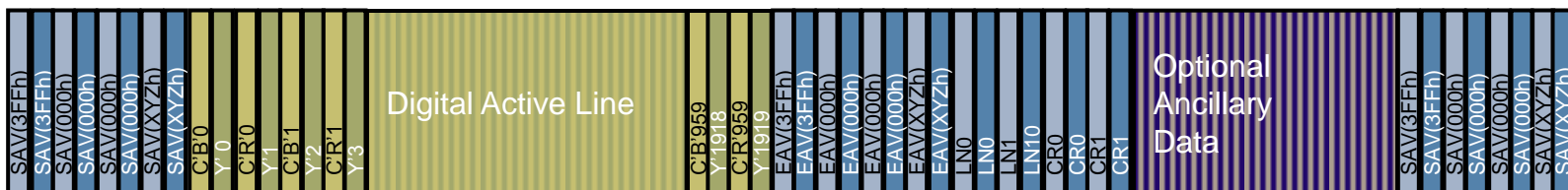
Data Stream One
Virtual Interface



Data Stream Two
Virtual Interface



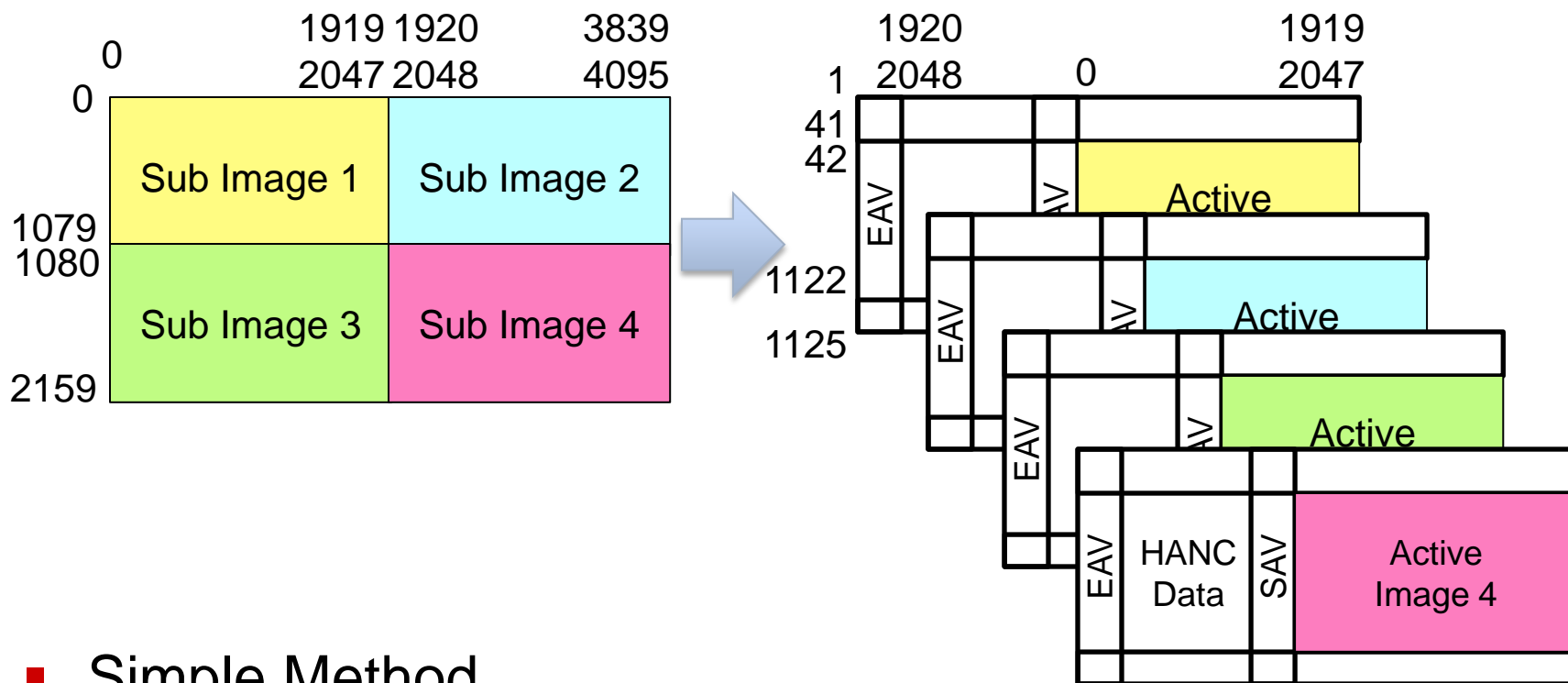
Multiplexed 10-bit
Parallel interface



SMPTE Standards

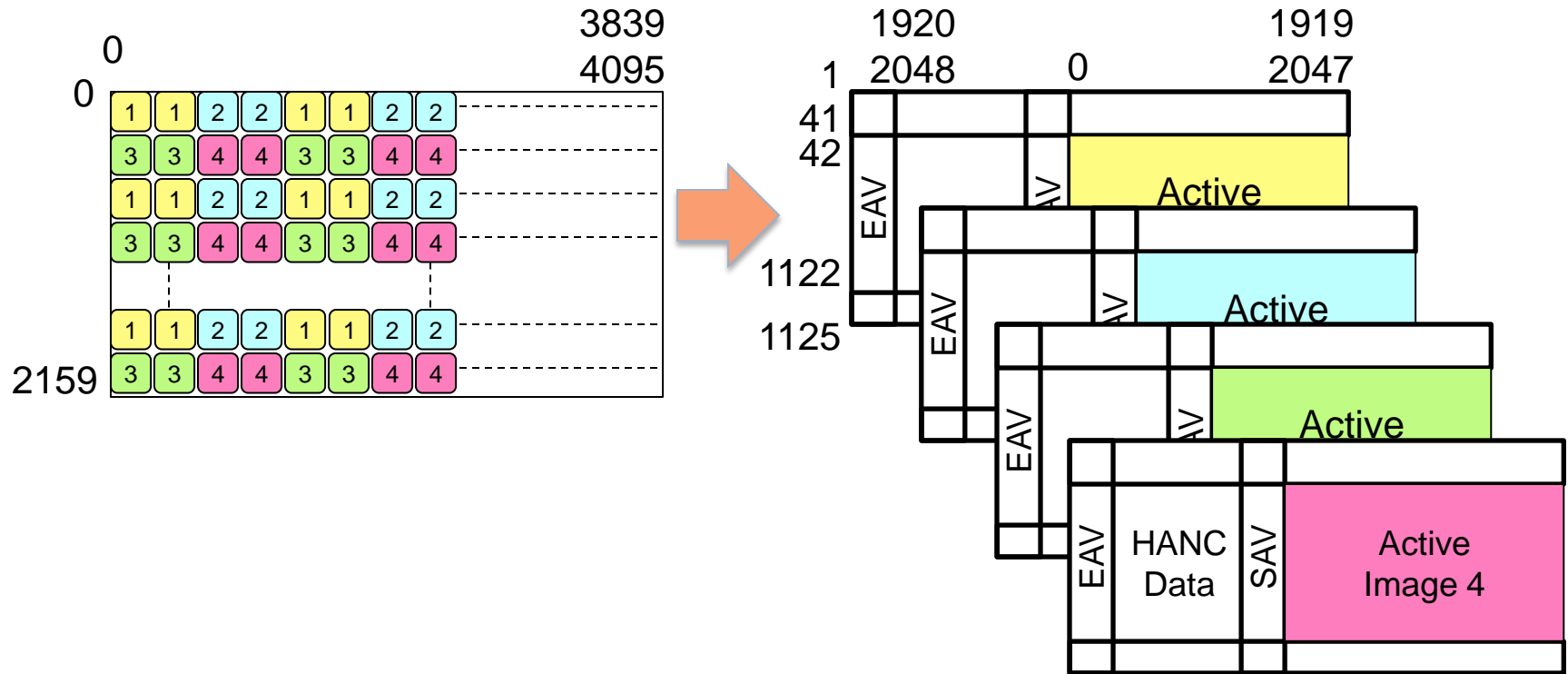
- SMPTE 425-5 Image Format and Ancillary Data Mapping for the Quad Link 3Gb/s Serial Interface
- Combines four 3G-SDI signals in Quad Link 3Gb/s
 - Link 1, Link 2, Link 3, Link 4
- Image Format 2160 Line
 - Uncompressed 10-bit or 12-bit
- Supports of 3840x2160 or 4096x2160
- Tile and Sample Interleaved modes
- Support of 352 Video Payload ID

Four Sub Images



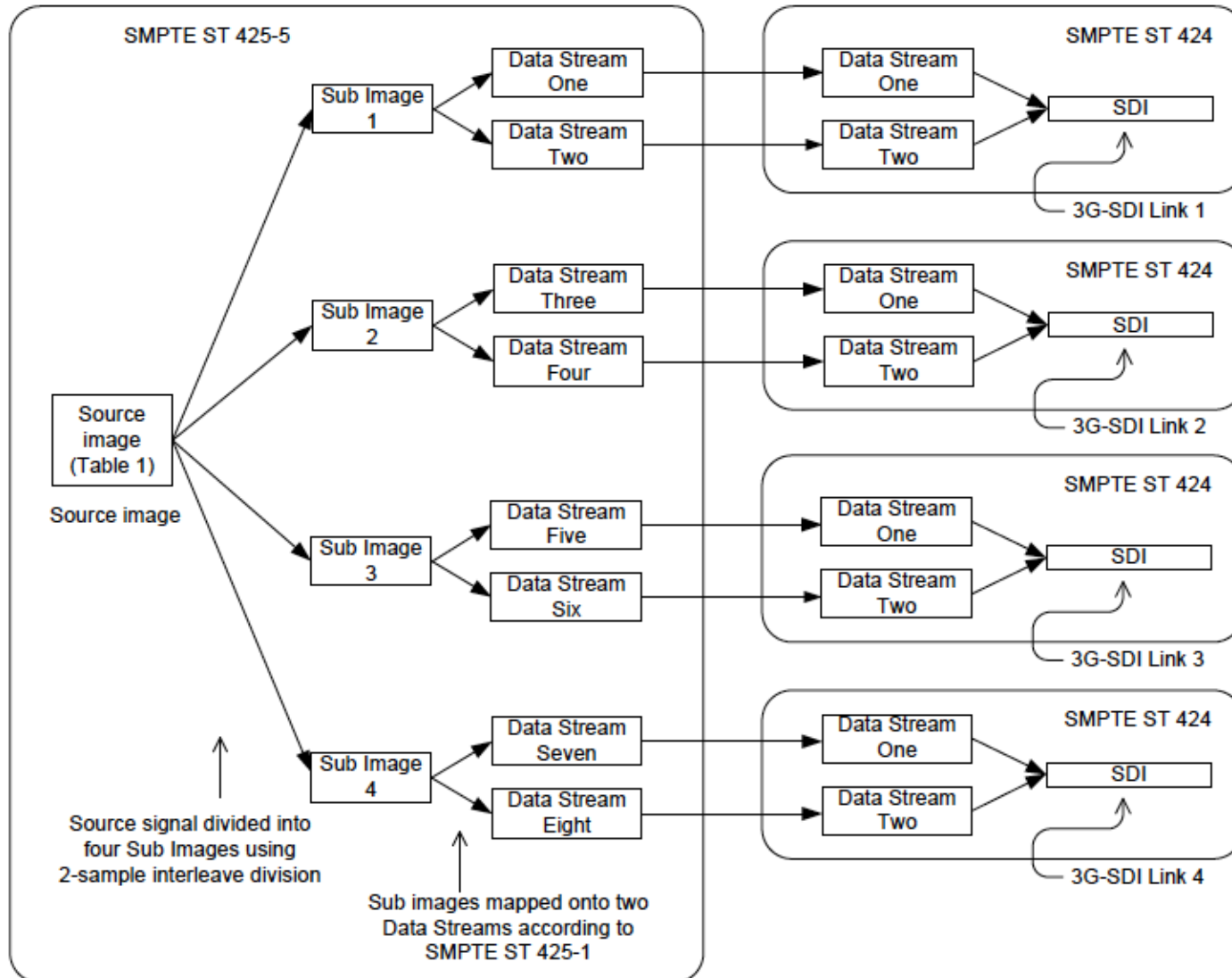
- Simple Method
- Need to ensure correct timing for alignment of Image.
- Requires large memory to store images.
- Used within post production and camera application.

Sample Interleaved



- More complex multiplex of data
- Simpler memory configuration and less processing delay
- Used for transmission and encoding

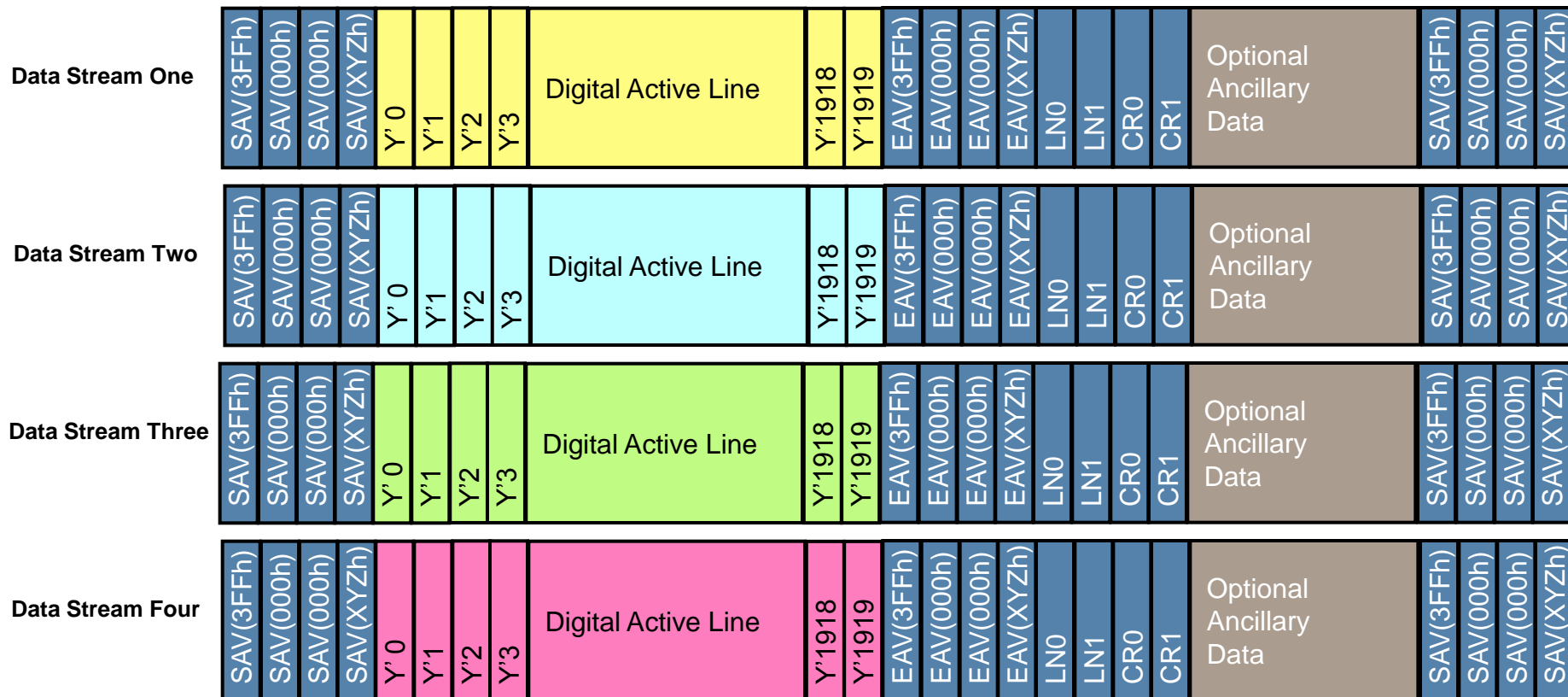
Mapping Overview of 2160 Source Image



SMPTE 2081 & 2082

- SMPTE 2081-1 6Gb/s Signal/Data Serial interface – Electrical
- SMPTE 2081-2 6Gb/s Signal/Data Serial interface – Optical
- SMPTE 2082-1 12Gb/s Signal/Data Serial interface – Electrical
- SMPTE 2082-2 12Gb/s Signal/Data Serial interface – Optical

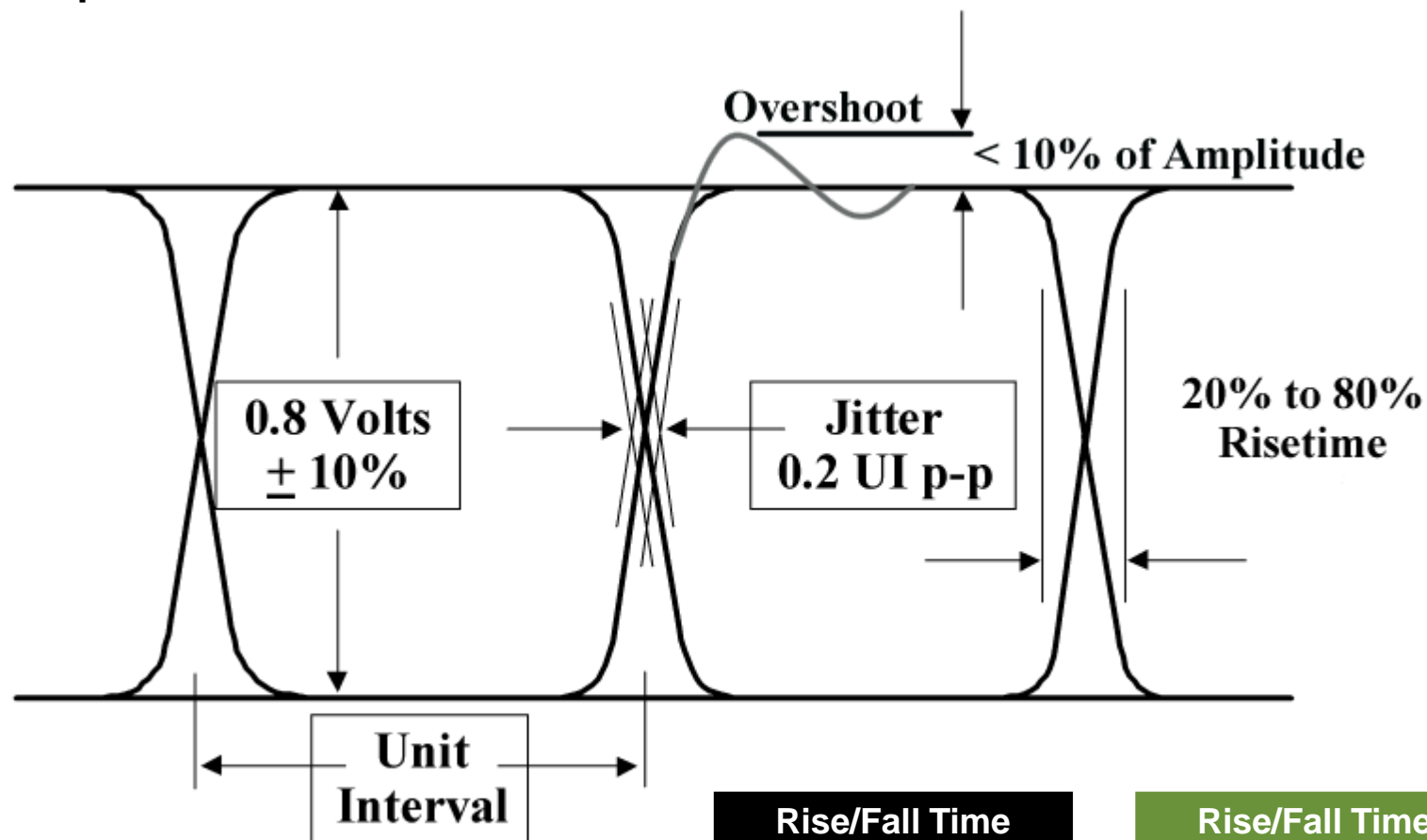
2081/2082 10-bit Multiplex



6Gb/s SDI 10-bit Interface



Eye Specifications



Rise/Fall Time

2081

No greater than 80ps,
and shall not differ by
more than 30ps

Rise/Fall Time

2082

No greater than 45ps,
and shall not differ by
more than 14ps

WFM8300 4K Support

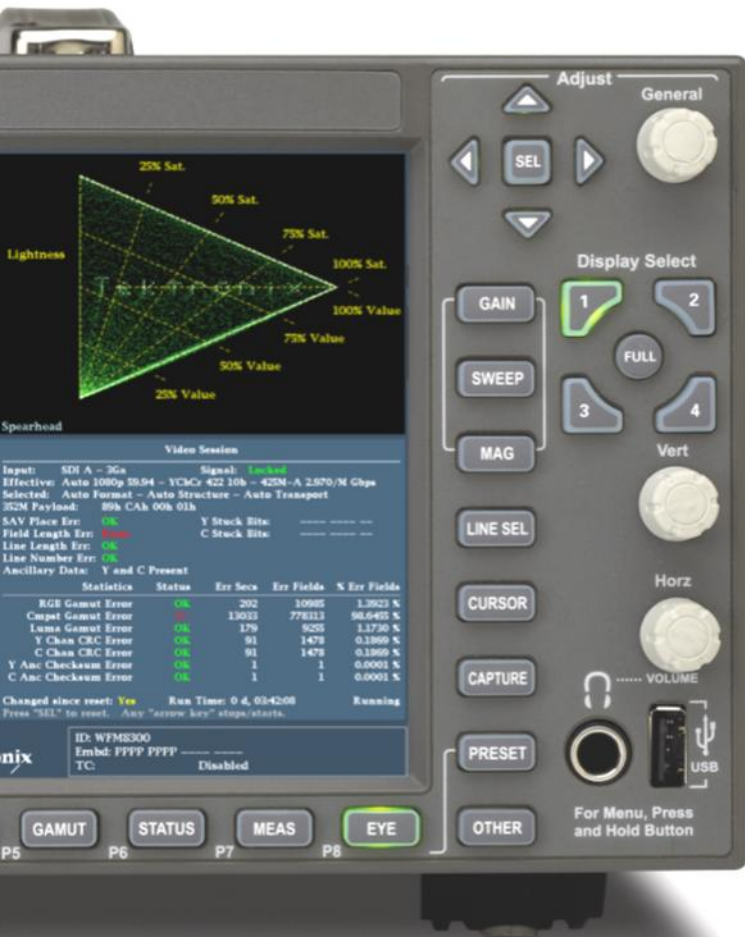


8000 Series 4K Support

- 4K Option requires 3G and 2SDI option
- Allows customer to upgrade their current 8000 series product to support 4K
- Combines 4 SDI inputs
 - Four HD-SDI
 - Four 3Gb/s Level A & B
- Combines Picture & Traces
- New Video Session display
- New Timing Display
- ANC Data monitored from Link 1 & 2
 - Embedded Audio



8000 Series 4K Requirements



- Needs 4 signals of the same format and timed together
- Need 4K option key installed
- Need 2SDI option
- Ideally correct VPID
- Maximum two traces available
- ANC Data from Channel 1 & 2
 - e.g. Embedded Audio
- Demo with TG8000 and 2 SDI7s

4K Monitoring



- 4 Input Buttons illuminated
- Picture Combined
- Traces Combined
- Limited ANC Data (CH1 & 2)
- Limited Embedded Audio (CH1 & 2)

4K Monitoring – 4 Tile



- Max 2 Trace Tiles
- Combined Picture

4K Monitoring – Video Session



- Select **Status** button
- Push & Hold **Status** to access menu
- Select **Display Type**
- Select **Video Session**
- Use **Up/Down Arrows** to select pages

4K Monitoring – Timing Display

Tektronix WFM 8300

Input Timing To External Reference

Vertical Offset:
13 lines delayed

Horizontal Offset:
2.197 us advanced

Relative to:
Analog(DAC)

Link B to Link A:
26.936 ns delayed
2 clocks delayed

Link C to Link A:
13.468 ns advanced
1 clocks advanced

Link D to Link A:
13.468 ns advanced
1 clocks advanced

Circle will be in the center when input timing matches the Reference

3840x2160p 59.94
SDI In Quad-3Gb
Ref: NTSC

ID: WFM8300_1c6bb8
Embd: -----
TC: ----- Disabled

Input
1A
Slot 1
1B
2A
Slot 2
2B
EXT REF
HELP
CONFIG
DISPLAY
MAIN

Adjust
General
Display
GAIN
SWEEP
MAG
LINE SEL
CURSOR
CAPTURE
PRESET
OTHER

Vert
Horz
VOLUME
USB

For Menu, Press and Hold Button

MEAS

P1 P2 P3 P4 P5 P6 P7 P8

WFM **VECTOR** **PICT** **AUDIO** **GAMUT** **STATUS** **MEAS** **EYE**

- Select **MEAS** button
- Push & Hold **MEAS** to access menu
- Select **Display Type**
- Select **Timing**
- Ensure **EXT** selected

Quad Link Timing Display

- Reference Signal vs Input Signal
- Vertical = Line , Horizontal = us Delay
- HDTV Sampling Frequency (fs) = 74.25MHz

- $1 \text{ Clock} = \frac{1s}{74.25MHz} = 13.468ns$

