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SDI SMPTE Primer

Serial Digital Interface and SMPTE Standards 101

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Introduction

The transport of uncompressed low latency video used in state-of-the-art surveillance systems and other military EO/IR applications is critical to mission effectiveness. Using standards based methods to implement this has made it both practical and affordable. With its genesis in the television broadcast content generation industry, SDI based systems are now common in military and law enforcement mission systems.

The Society of Motion Picture and Television Engineers (SMPTE) is the standards body that has developed both the technical requirements and standards for the digital transport of video signals over point-to-point serial links known as Serial Digital Interface (SDI). A basic understanding of these standards makes it easier to understand the technology as a whole and the benefits of SDI in video based mission systems.

SDI (Serial Digital Interface) is the digital transport of video signals over point-to-point serial links.

With over 600 standards produced by SMPTE, it can be difficult to understand both the standards and the technology applicable to video based mission systems. Grouping SDI and the SMPTE standards into the **physical interface**, the **timing**, **encoding, payload**, and the **image format** will simplify things considerably. The remainder of this paper will explore these categories, describe the characteristics of each, and sum up the standards in an easy to understand format.

Basic Necessities

Background - Originally standardized by SMPTE 259M, SDI is used to transmit uncompressed video over 75Ω coaxial cable at a maximum rate of 360 Mb/s. HD-SDI is the second generation of SDI originally standardized by SMPTE 292M for transmission of video (1080i, 720p) at a nominal rate of 1.5 Gb/s over a single 75Ω coaxial cable. 3G-SDI is the third generation of SDI originally standardized by SMPTE 424M for transmission of video (1080p60) at a nominal rate of 3 Gb/s over a single coaxial 75Ω cable.

SMPTE Standards Numbering Styles – The document numbering styles for all SMPTE documents have recently changed. It now consists of a two letter prefix, 4 numbers, and year. What used to be SMPTE 292M-1998 is now SMPTE ST 292:2011. The prefix represents the document type – ST for standards, EG for engineering guideline, and RP for recommended practice.

Image sample data (RGB) is normally gamma corrected. Linear RGB samples are converted to non-linear R'G'B' most often using a power function around 2.4.

Image Representation – Color images are based on tristimulus values known as RGB (Red, Green, Blue). Image sensors produce values that approximate RGB in a *linear* fashion. In most systems that use coded image representation, linear RGB values are gamma corrected to imitate the perceptual response of human vision. These gamma corrected tristimulus values are represented by R'G'B' (Primed).

Image Coding - Most image coding systems are based on a three component value derived from R'G'B'. Luma (Y'), is derived by taking the weighted sum of R'G'B'. It is not Luminance. To represent color, two additional components are used called color difference, or chroma. C_B represents B' - Y' or blue color difference and C_R represents R' – Y' or red color difference. Scale factors are then applied to these two components based on the application. This forms the luma and chroma component values ($Y'C_BC_R$) found in SDI and other video systems.

Chroma Subsampling - Human color acuity is less than luminance acuity. This is exploited to reduce the data size when encoding image data by subsampling the chroma components. The subsampling notation is represented by a three or four digit value each separated by a colon. Digit one is the luma horizontal sampling reference. Digit two is the C_BC_R horizontal subsampling factor. Digit three is either the same as the second digit or 1 to indicate a 2:1 vertical subsampling factor. The fourth digit, if present, is the same as luma but represents the alpha (key) component. Encoding schemes used are as follows:

Chroma subsampling results in a 1.5:1 or 2:1 lossy compression of video. However, in SDI applications video is still referred to as uncompressed.

- 4:4:4 – No subsampling.
- 4:2:2 – 1.5 : 1 lossy compression common in SDI mission systems.
- 4:1:1 – 2 : 1 lossy compression.

Scaling and chroma subsampling are defined in ITU-R BT.601-5 for SD SDI and the basic coding standards for HD SDI are defined in ITU-R BT.709-5. Both form the basic coding standards for HD SMPTE image coding.

System Nomenclature - The system nomenclature represents the active video format of an image. For instance, a HD image represented by a 1920 pixels horizontally by 1080 lines vertically, progressively updated (scanned) at 60 times a second is represented by 1080p60. If the image is interlaced and the odd lines are scanned first (30 times a second), followed by the even lines (30 times a second), it is represented by 1080i60.

The Physical Interface

Figure 1 - BNC connector.

The Serial Digital Interface (SDI), standardized by SMPTE, is designed for transmission of serially encoded digital video data over both coaxial and fiber-optic cable. Coaxial interfaces are based on 75Ω impedance using ECL (Emitter-Coupled-Logic) operating at 0 – 0.8 volts. Typically, BNC connectors are used as the terminating connectors on coax cables. EIC 61169-8 is the specification for the BNC.

For SD and HD SDI interfaces, the encoded video is represented by a 10 bit word that is first serialized, then scrambled prior to output on to the cable as a bit stream. Transmission on the cable is one-way. Scrambling of the serialized data allows the bit rate of the coax cable to equal the transfer rate of the video an ancillary data payload. No separate sync or timing references lines or cables are required and sync signals are not coded as a signal level. They are part of the SDI data payload.

The type of image data being transmitted effectively sets the bit rate for the SDI interface. Nominal bit rates for SDI range from 143 Mb/s to 3 Gb/s. The data transmitted by SDI consists of active video framed by timing reference signal (TRS) - bit sequences known as SAV (start of active video) and EAV (end of active video). Ancillary data and digitized ancillary data can also be present in the data stream in any regions not occupied by active video or TRS sequences.

Because of the popular use of SDI in many industries, a large ecosystem of companies supports SMPTE SDI standards with various components at the physical layer. Many chipsets are available for implementing various configurations of the physical interface but they all have common functional blocks:

- Serializer
- Cable Driver
- Cable Equalizer
- Deserializer
- Reclocker

For the transmission side of the SDI interface, these functional blocks consists basically of a serializer and a cable driver. The serializer interfaces to the parallel format of the 8-bit or 10-bit BT.601 or BT-709 video data, maps it to the required SMPTE serial format, then scrambles the serial stream.

The serial stream is then output to the cable driver that conditions the serial stream into a compatible 800 mv, 75Ω signal for transmission on the coax cable.

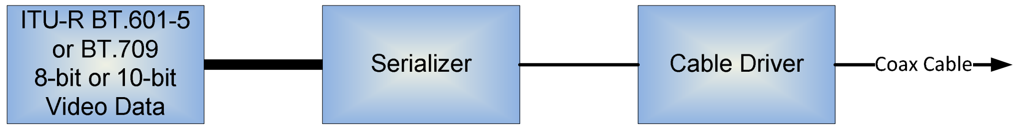


Figure 2 - Simplified SDI transmitter functional block diagram.

Cable length in SDI is dependent on data rate and cable characteristics. Typical signal attenuation of 20 dB to 30 dB with receiver equalization is typical and acceptable.

On the receiver side of the SDI interface, these functional blocks consist basically of a cable equalizer and deserializer. The cable equalizer equalizes the incoming signal adjusting for the dispersive loss associated with the cable and cable connectors. Once equalized, the serial data is passed to the deserializer which descrambles the serial data and reformats it back to 8-bit or 10-bit BT.601 or BT.709 parallel format.

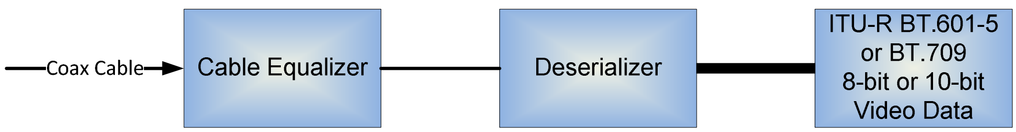


Figure 3 - Simplified SDI receiver functional block diagram.

When an SDI device does not require processing of the video, such as a switch or a distribution amplifier, then serialization or deserialization is not required, but reclocking of the signal is usually necessary to suppress accumulated jitter in the SDI signal.

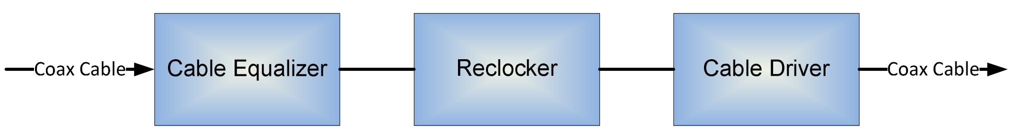


Figure 4 - Simplified SDI reclocking functional block diagram.

Typical transmission distances of SDI data over coaxial cable listed by manufacturers of cable drivers, equalizers, and cable are dependent on the data rate and can range from 23 meters for 3Gb/s data rates to over 800 meters for 143Mb/s data rates. Over 150 meters for some cable types, drivers, and equalizers for 3 Gb/s data is not uncommon.

How the Physical Interface Relates to SMPTE Standards

ST 259:2008 is the SMPTE specification for Standard Definition TV digital signal, data, and the Serial Digital Interface. It is sometimes referred to as SD SDI. It defines the 10-bit serial digital interface operating at 143/270/360 Mb/s nominally.

SMPTE standards, such as ST 269:2008, define the requirements of the SDI interface including signal amplitude, dc offset, signal rise and fall times, signal overshoot, signal jitter, impedance, and return loss. These aspects of the SDI interface are identical between the various SPMTE standards with the exception of jitter.

Again, the type of image data being transmitted effectively sets the bit rate for the SDI interface. The data rate is different between SMPTE standards. The data rate at the physical interface is equal to the word rate times the number of bits. SMPTE ST 259:2008 has standardized the number of bits that are serialized to10. SMPTE ST 425-1 makes provisions for 12-bit data.

The SMPTE specifications for the physical interface to SDI are the same between all SMPTE standards with the exception of jitter.

For HD-SDI, the SMPTE ST 259:2008 270 Mb/s interface was adapted by scaling the bit rate by 5.5 resulting in a 1.485 Gb/s data rate referred to as 1.5 Gb/s standard. ST 292-1:2012[1] is the SMPTE specification for the 1.5 Gb/s (nominal) signal and data serial interface. It is modeled after the SD SDI standard with a few changes.

For 3G-SDI, the SMPTE ST 292-1:2012 data rate was doubled to 3 Gb/s. ST 424:2012 is the SMPTE standard specification for the 3 Gb/s (nominal) signal and data serial interface.

SMPTE ST 435-1:2012 specifies a data rate of 10 Gb/s but it has not been commercialized to the extent that is being used for surveillance mission systems products yet. Other than its data rate, this standard will not be covered in this document. Below is a summary of the SDI data rates encompassing the physical interface.

SMPTE Standard	Bit Rate Mb/s	Nominal Bit Rate Mb/s	Name
ST 259:2008	143.1818182 270 360	143 270 360	SD SDI
ST 292-1:2012	1485 1483.516848	1500	HD SDI
ST 424:2012	2970 2970.032967	3000	3G SDI
ST 435-1:2012	10000 10692 10681.31868	10000	TDB

Table 1 - SMPTE standards interface data rates.

[1] The dash 1 nomenclature (292-1) is used to identify mono (-1) or stereoscopic (-2) video mapping standards.

Timing, Encoding, and Payload

The SDI serial data stream may contain both video data and ancillary data, such as audio and timing codes.

To keep things simple, encoding and payload format for a 4:2:2 sampled 720 line signal will be used as an example. Word length is 10-bits.

In 4:2:2 video, each frame and each line of active video is preceded or terminated by a four word TRS value called SAV or EAV. SAV indicates the start of active video and EAV indicates the end of active video.

$Y'C_BC_R$ video samples in the 4:2:2 format have subsampled chroma values as defined previously. Effectively, there are two luma samples (Y') for every chroma sample (C_BC_R) in the active video stream. The sample numbering for an active line of video (S), are S - 1 for Luma, and (S / 2) – 1 for chroma. Sample numbers are notational only and are not present in the data stream.

An active line of video is started by the four word SAV, followed by the first chroma C_B sample[2] followed by the first luma Y' sample, then the first chroma C_R sample, and then the second luma Y' sample. This is repeated for the required number of samples in the active line. The last sample of video for the active line is followed by the four word EAV.

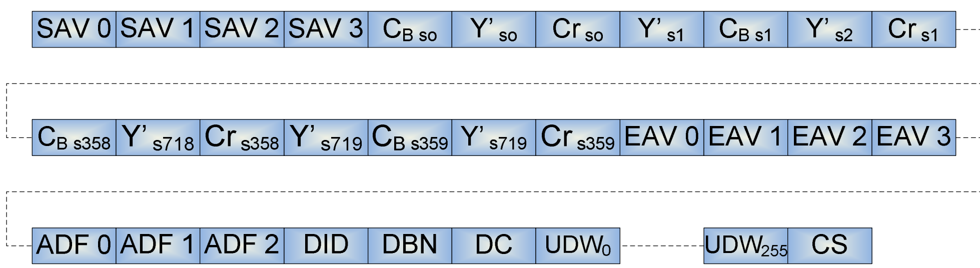


Figure 5 - SD SDI serial stream data encoding format example.

Ancillary data and its format are specified in SMPTE ST 291:2011. Ancillary data payloads allow transport of non-video data in the serial digital stream. These payloads include, but are not limited to, closed caption, audio, time code, and other meta-data or user data.

SMPTE ST 291:2011 defines the ancillary data, packets.

Ancillary data follows the last EAV and is called HANC data. Ancillary data is announced by a three word ancillary data flag (ADF). This is followed by a one word data identifier (DID), then a one word data block number (DBN) or a secondary DID (SDID). This is followed by a one word data count (DC) from 0 – 255, then the 0 – 255 user data words (UDW). The last word is the check sum (CS).

Ancillary data is allowed after the SAV on a line that does not contain active picture or digitized ANC data. This is called VANC. It has the same data structure and format as HANC.

[2] Ancillary data (VANC) is allowed after the SAV on a line that does not contain active picture or digitized ANC data.

An ANC packet must not interfere with any TRS or active video. Multiple but contiguous ANC packet are allowed, however SMPTE ST 291:2011 does reserve ANC areas for specific purposes.

SMPTE ST 425-1 defines a virtual interface carried on the SMPTE ST 424 3 Gb/s physical link.

The example above represents the timing, encoding and payload format for ST 259:2008. For HD SDI (ST 292-1:2012) it is similar, but the luma and chroma samples are separated into to logical streams, each with separate TRS sequences. Both streams can carry ANC data. In addition, four words are appended to each EAV. The first two words provide a line number and the next two provide CRC (Cyclic Redundancy Check). The two streams are word multiplexed, scrambled, and then serialized.

ST 372:2011 defines the mapping of dual 1.5 Gb/s links (link A and Link B) that conform to the standards set in ST 292-1:2012 for a nominal data rate of 3 Gb/s.

The SMPTE 425-1:2012 defines the mapping of single link, dual link and quad link serial digital interfaces operating at a nominal data rate of 3 Gb/s. SMPTE 425 specify a virtual interface that is carried on a physical link specified by SMPTE ST 424 and all data must be mapped into ether dual link SMPTE ST 372 or 2 x SMPTE ST 292-1 standards before mapping to the SMPTE 425 virtual interface.

The Image Format

Image Format Basic Necessities

Raster – The horizontal scanning pattern used to render and image. It is fixed spatially and encompasses the pixel array, the horizontal blanking period, and the vertical blanking period. In digital video, the blanking periods are retained for compatibility with existing equipment and are used for ancillary data.

All SMPTE images have a total sample line length and total number of lines larger than the active video or pixel array.

Pixel array – Image components (pixels) are grouped in columns and rows. In video, columns are referred to as samples per active line, and rows are referred to as active lines. A pixel array represents one image called a frame. A pixel array is normally referenced as a horizontal pixel count by vertical lines such as 1920x1080.

Frame – One full pixel array or two fields.

Field – One half of a frame composed of either odd lines or even lines.

Frame rate – The rate at which a new image for the entire frame is updated.

Field rate – The rate at which a new image for the entire field is updated.

Progressive – The update or scanning of frame data in one cycle at a particular frequency.

Interlaced – The update or scanning of frame data in two cycles – once for the odd field and once for the even field – at a particular frequency.

Aspect ratio – The ratio of a pixel array or image's width to its height. Only 4:3 and 16:9 are considered in this paper.

$4f_{sc}$ – A specific video sampling rate of four times the color subcarrier frequency specifically associated with SD composite video formats.

Image Format Introduction

SMPTE standard image formats are derived from a number of raster components. Graphic diagrams will be used to illustrate the various image format standards that are part of the SMPTE standards family. The figure below describes how the diagrams are labeled[3].

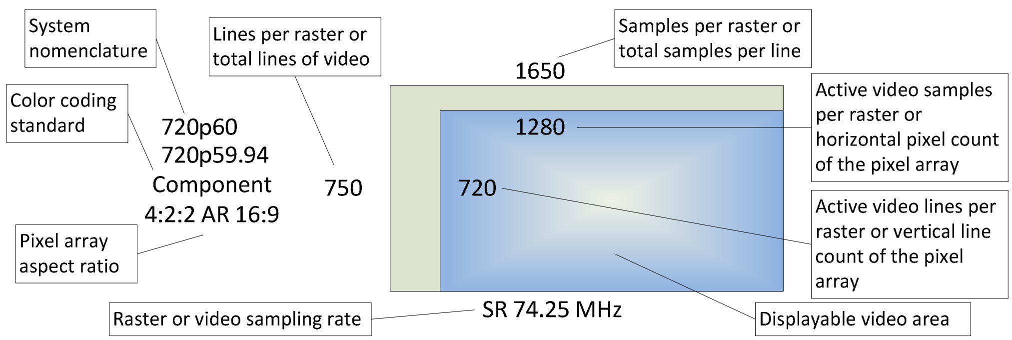


Figure 6 - Definition of image format graphic diagram.

All digital video images consist of a raster of video samples. There are a specific number of samples per line and a specific number of lines. A subset of the samples and lines make up the active video or the displayable image. The format of the active video has a specified aspect ratio of either 4:3 or 16:9. SMPTE HD and 3G video standards are all 16:9.

59.94 Hz and 29.97 Hz frame rate is sometimes referred to as 60/1.001and 30/1.001 or 60 (1.000/1.001) and 30 (1.000/1.001)

All video is sampled at specific sample rates specified in the SMPTE standards. The frame rate determines the total number of lines. The sampling rate determines the corresponding SDI bit rate. Historically, frame rates were different in different countries. There were generally two frame rates – 50Hz and 59.94Hz[4]. There is a carry-over of these frame rates into modern digital video systems, but typical systems use 24Hz, 30Hz, and 60Hz.

SD Image Formats

Standard Definition TV image formats fall under the SMPTE ST 259:2008 specification. SD based video image formats are usually referred to as either

[3] Based on Poynton, Charles, Digital Video and HD, 2012
[4] See Digital Video and HD Algorithms and Interfaces, Charles Poynton, 2012, chapter 32 for a good explanation of the frame rate origins.

525 or 625 line formats. SMPTE provides standards for two types of frame formats - interlaced and progressive.

NTSC and PAL are color encoding and analog sampling definitions – not resolutions or image formats.

The first two formats are composite. They are either NTSC or PAL color encoded and was derived from the original analog television format. They are 4:3 aspect ratio interlaced images. SMPTE ST 259 Level A is the 535 line composite interface with an SDI data output rate of 143.182 Mb/s. SMPTE ST 244 is the bit-parallel interface for this format. SMPTE ST 259 Level B is the 625 composite interface with an SDI data output rate of 177.344 Mb/s. EBU 3246-E is the bit-parallel interface for this format.

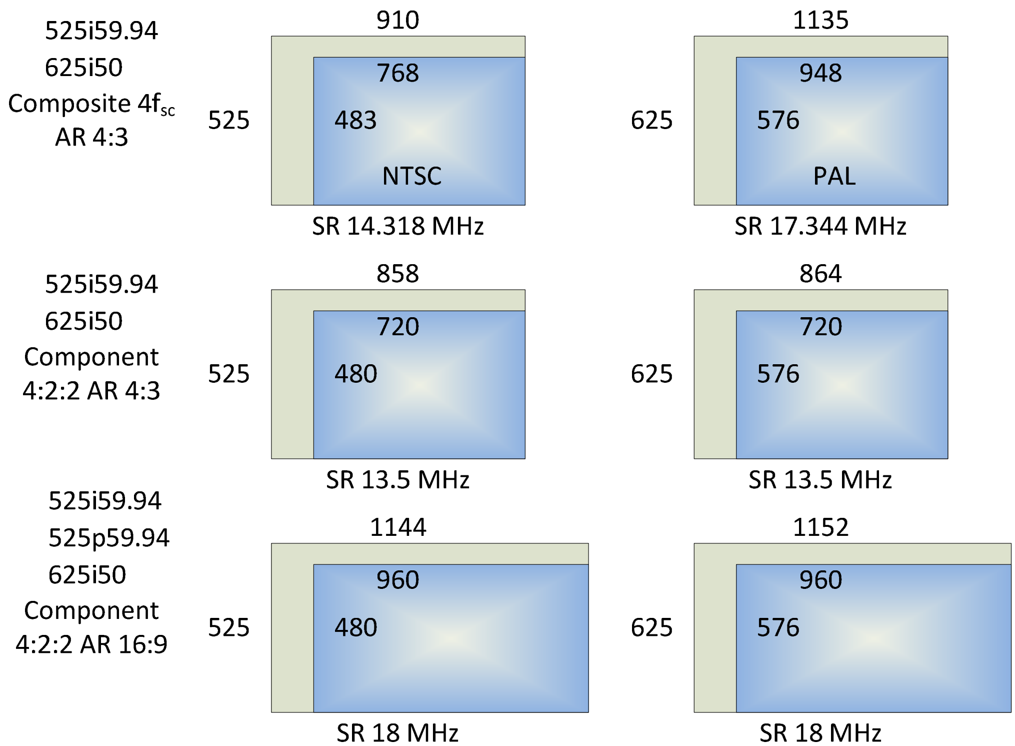


Figure 7 - SDI image formats.

The second two formats are component and both are 4:3 aspect ratio interlaced images. SMPTE ST 259 Level C standardized a fixed sample rate for both formats with a 270 Mb/s SDI data output rate.

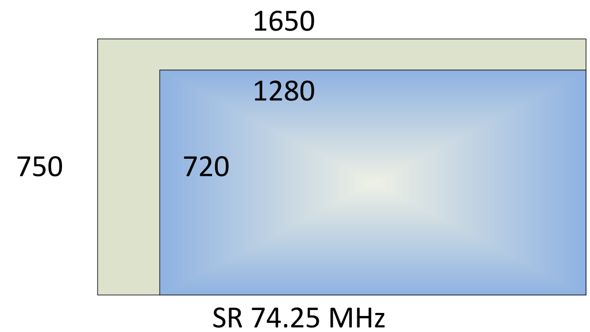
SMPTE 259 Level D represents the last two formats. They are also component, but both are 16:9 aspect ratios. SMPTE ST 267 standardizes the 525i format, while SMPTE ST 293 standardizes the 525p format. EBU 3246-E standardizes the 625i format.

HD Image Formats

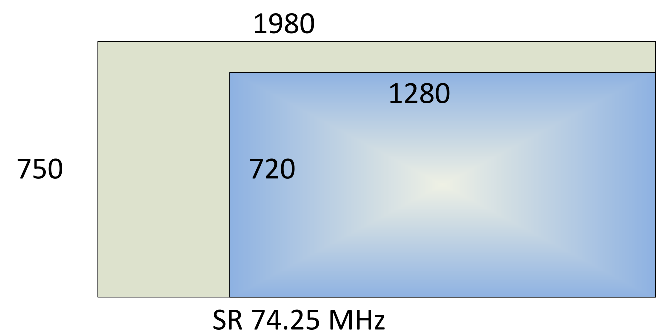
HD formats fall under the ST 292-1:2012 specification and are less complicated than SD. Nomenclature now refers to the active video lines. Sample rates are all fixed at either 74.25 or 74.176. For 720 line images, *SPMTE ST 296 defines the 1280x720 image sample structure*

frame rates are either 60 frames per second or 59.94 frames per second. For 1080 line images, frame rates are ether 30 frames per second or 29.97 frames per second (60 or 59.94 fields per second for interlaced).

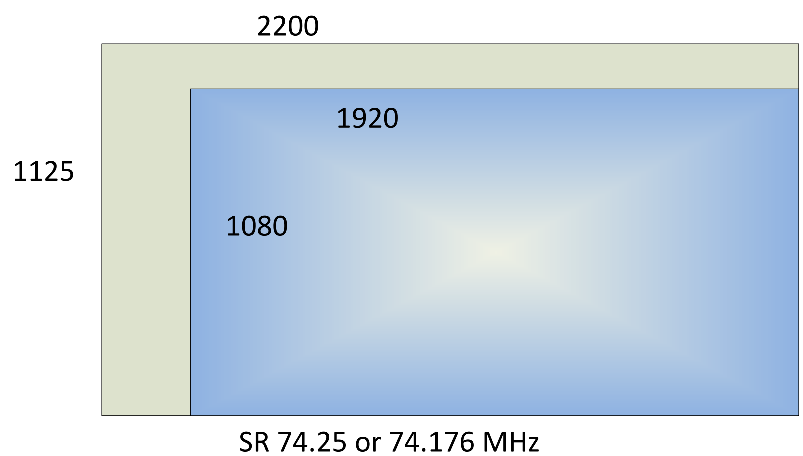
720p60
720p59.94
Component
4:2:2 AR 16:9



720p50
Component
4:2:2 AR 16:9



1080p30
1080i60
1080i59.94
Component
4:2:2 AR 16:9



SPMTE ST 274 defines the 1920x1080 image sample structure

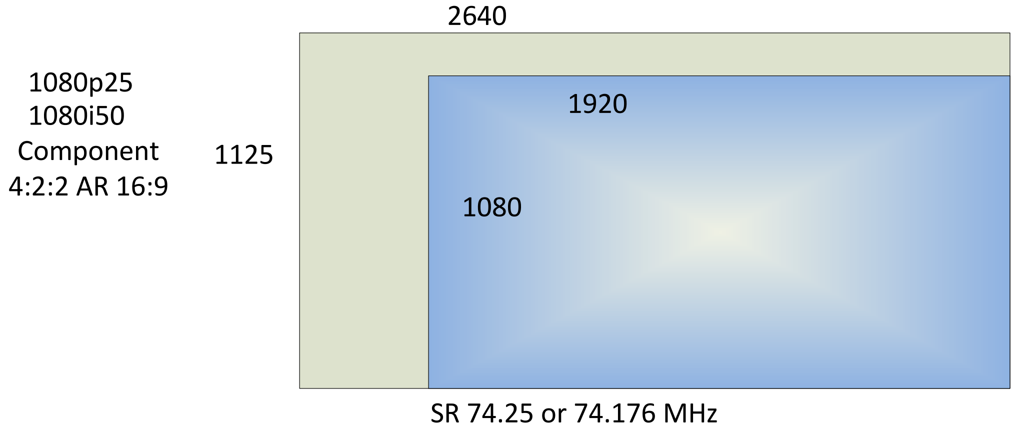


Figure 8 - HD-SDI image formats.

SPMTE ST 296 standardizes 1280x720 image formats while SMPTE ST 274 standardizes 1920x1080 image formats. The output rate equals the 10-bit luma word and 10-bit chroma word, hence 74.25 x 2 X 10 = 1.485 Gb/s. SDI data output rate of 1.485 Gb/s applies to the 30 and 60 frame rate formats. SDI data output rate of 1.483 Gb/s applies to 59.94 frame rate formats. Not all formats are diagramed and SMPTE ST 2048 formats (2048x1080) are not covered in this paper along with stereoscopic formats (ST 292-2).

3G Image Formats

3G formats fall under the ST 425-1:2012 specification. The physical interface is specified in ST 424-1012. ST 425-1 accommodates all of the ST 292-1 formats along with SMPTE-ST-372, which is a dual-link version that operates two 1.5 Gb/s physical coaxial cables for a 3 Gb/s aggregate data rate. It was the predecessor to 3G-SDI and is rarely used in mission systems.

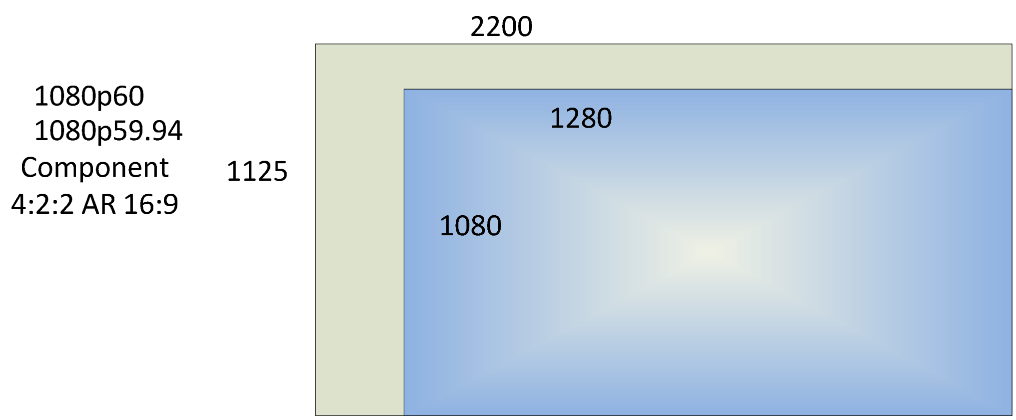


Figure 9 - 3G-SDI image formats.

For ST 425-1, sample rates are doubled from HD and fixed at either 2.970 GHz per second for frame rates of 60 Hz, or 2.96703 GHz for frame rates of 59.94 Hz. All data, no matter the originating SMPTE format, must be mapped to either Level A direct mapping, Level B dual-stream mapping, or Level B dual-link mapping prior to serialization onto the ST 424 3 Gb/s SDI.

SPMTE ST 425 accommodates 10-bit 4:4:4:4, 12-bit 4:4:4 and 4:2:2 encoding.

3G SDI image formats can also accommodate component mapping of 10-bit 4:4:4:4, 12-bit 4:4:4, and 12-bit 4:2:2 for nomenclatures of 720p60 and 1080i60, but is not illustrated here. SMPTE ST 2048 formats (2048x1080) are not covered in this paper along with stereoscopic formats (ST 425-2).

Putting it all Together

The table below summarizes the SMPTE image formats, standards, pixel array size, interface, and data rates. Stereoscopic, 2048 horizontal and ultra-high definition standards and formats are not included in the table. However, it does summarize common formats used in current and existing surveillance mission systems.

System Nomenclature	Image Format Standard	SDI Interface Standard	Active Horiz Pixels	Active Lines	Field Rate Hz	Frame Rate Hz	Aspect Ratio	Signal Type and Structure	Note	SDI Bit Rate Mb/s
SD-SDI										
525i	ST 244	ST 259	768	485	59.94	29.97	4:3	NTSC Composite, 4fsc	Level A	143.18
625i	EBU 3246	ST 259	948	576	50	25	4:3	PAL Composite, 4fsc	Level B	177.344
525i	ST 125	ST 259	720	480	59.94	29.97	4:3	4:2:2 Component, $Y'C_BC_R$	Level C	270
625i	ST 125	ST 259	720	480	50	25	4:3	4:2:2 Component, $Y'C_BC_R$	Level C	270
525i	ST 267	ST 259	960	480	59.94	29.97	16:9	4:2:2 Component, $Y'C_BC_R$	Level D	360
625i	ST 267	ST 259	960	480	50	25	16:9	4:2:2 Component, $Y'C_BC_R$	Level D	360
525p	ST 267	ST 259	960	480		59.94	16:9	4:2:2 Component, $Y'C_BC_R$	Level D	360
HD-SDI										
720p60	ST 296	ST 292-1	1280	720		60	16:9	4:2:2 Component, $Y'C_BC_R$		1485
720p59.94	ST 296	ST 292-1	1280	720		59.94	16:9	4:2:2 Component, $Y'C_BC_R$		1483
720p50	ST 296	ST 292-1	1280	720		50	16:9	4:2:2 Component, $Y'C_BC_R$		1485
720p30	ST 296	ST 292-1	1280	720		60	16:9	4:2:2 Component, $Y'C_BC_R$		1485
720p29.97	ST 296	ST 292-1	1280	720		29.97	16:9	4:2:2 Component, $Y'C_BC_R$		1483
720p25	ST 296	ST 292-1	1280	720		25	16:9	4:2:2 Component, $Y'C_BC_R$		1485
720p24	ST 296	ST 292-1	1280	720		24	16:9	4:2:2 Component, $Y'C_BC_R$		1485
720p23.97	ST 296	ST 292-1	1280	720		23.976	16:9	4:2:2 Component, $Y'C_BC_R$		1483
1080i60	ST 274	ST 292-1	1920	1080	60	30	16:9	4:2:2 Component, $Y'C_BC_R$		1485
1080i59.94	ST 274	ST 292-1	1920	1080	59.94	29.97	16:9	4:2:2 Component, $Y'C_BC_R$		1483
1080i50	ST 274	ST 292-1	1920	1080	50	25	16:9	4:2:2 Component, $Y'C_BC_R$		1485
1080p30	ST 274	ST 292-1	1920	1080		30	16:9	4:2:2 Component, $Y'C_BC_R$		1485
1080p29.97	ST 274	ST 292-1	1920	1080		29.97	16:9	4:2:2 Component, $Y'C_BC_R$		1483
1080p25	ST 274	ST 292-1	1920	1080		25	16:9	4:2:2 Component, $Y'C_BC_R$		1485
1080p24	ST 274	ST 292-1	1920	1080		24	16:9	4:2:2 Component, $Y'C_BC_R$		1485
1080p23.97	ST 274	ST 292-1	1920	1080		23.97	16:9	4:2:2 Component, $Y'C_BC_R$		1483
3G-SDI										
1080p60	ST 425-1	ST 424	1920	1080		60	16:9	4:2:2 Component, $Y'C_BC_R$		2970
1080p59.94	ST 425-1	ST 424	1920	1080		59.94	16:9	4:2:2 Component, $Y'C_BC_R$		2967.03
1080p50	ST 425-1	ST 424	1920	1080		50	16:9	4:2:2 Component, $Y'C_BC_R$		2970
Also includes all HD-SDI formats								4:2:2 Component, $Y'C_BC_R$	2970 or 2967.03	
Also includes all HD-SDI formats								4:4:4 Component, $Y'C_BC_R$	2970 or 2967.03	
Also includes all HD-SDI formats								12-bit 4:4:4 Component, $Y'C_BC_R$	2970 or 2967.03	
Also includes all HD-SDI formats								12-bit 4:4:2 Component, $Y'C_BC_R$	2970 or 2967.03	

Table 2- SMPTE image formats, interface, and standards.

Benefits of SDI Based Systems

There are many benefits in implementing SMPTE SDI based surveillance mission system architectures. As the SMPTE standards evolve and as legacy video standards fade into commercial obsolescence, these benefits will continue to increase:

- Low latency transport
- Uncompressed video
- No image informational loss through compression such as MPEG4
- Superior image quality over longer distances
- Robust digital signal immune to amplitude and noise issues
- Long cable lengths possible from 23 meters to over 800 meters
- Only a single coaxial cable required
- Transport of multiple image formats and resolutions over the same infrastructure
- Evolving standards accommodate existing cable plant
- An Internationally accepted set of video standards
- 3G-SDI is a mature technology
- Interoperability of standards-based SDI equipment
- Large commercial ecosystem of SDI based component suppliers
- Standards for fiber cable exist
- SDI provides transport of ancillary data for audio and other meta data
- Surveillance system components can be easily upgraded without changing the existing cabling plant
- Easily switched for routing purposes
- Accommodates real-time processing and single image manipulation
- Easily looped through from device to device for daisy chained configurations

Conclusion

SMPTE standards for SD-SDI, HD-SDI, and 3G-SDI provide the physical interface, timing, encoding, payload and image formats for digital video. It standardizes the transport of uncompressed low latency video over a wide range of image formats.

When used in state-of-the-art surveillance systems and other military EO/IR applications, SDI provides a cost effective and standards based video transport and display implementation. By setting the foundation for both current and future video technology, the SMPTE standards have resulted in creating a video infrastructure that has many advantages for video surveillance mission system applications.