Pro Video Formats for IEEE 1722a

Status & Next Steps

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Today's Pro Video Infrastructure

(for Live Streams, not file-based workflows)

- SDI (Serial Digital Interface) carries video, audio, and meta data
  - SMPTE standards
  - 75-ohm coax links
  - Uncompressed frame encoding (4:4:4, 4:2:2, 4:2:0)
  - Audio may be embedded or carried separately

Standard	Name	Bitrates	Example Video Formats
SMPTE 259M	SD-SDI	270 Mbit/s, 360 Mbit/s, 143 Mbit/s, and 177 Mbit/s	480i, 576i
SMPTE 344M	ED-SDI	540 Mbit/s	
SMPTE 292M	HD-SDI	1.485 Gbit/s, and 1.485/1.001 Gbit/s	
SMPTE 372M	Dual Link HD-SDI	2.970 Gbit/s, and 2.970/1.001 Gbit/s	
SMPTE 424M	3G-SDI	2.970 Gbit/s, and 2.970/1.001 Gbit/s	

Define a suitable packetization format

- House Sync carried on separate links
  - 75-ohm coax
  - Video frame rates
    - Film rates (24 fps, other?)
    - NTSC rates (29.97, 30, 59.94, 60 fps)
    - PAL rates (25, 50 fps)s

=> Derive sync from 802.1AS Network Time, rather than piping "genlock" and timecode signals around the facility

Objectives for Pro Video Streaming

- Trivial mapping between SDI and Ethernet
  - Easy for manufacturers to migrate
  - Easy to bridge between the two
  - Minimize buffering requirements and latency at the endpoints
  - Long term desire: Ethernet Switches should be able to switch streams on frame boundaries (already in discussion within Gen 2 AVB in 802.1, e.g. “multiple talker SRP”)
- Fit the entire SDI signal into a single AVB stream
- Preserve all Ancillary Data and its location within the video raster.
  - Audio, HANC, VANC, other (defined by SMPTE 291)
- Layer-2 solution
  - Devices can Sync using common 802.1AS timebase
  - Confined to subnet – avoid complex schemes for error protection
  - Desire: easy bridge to L3 (SMPTE 2022-6 “SDI over IP networks”)

Example of Line Sizes / Formats : 3G-SDI

Picture format	Signal format	Progressive frame rate	Interlaced field rate
1920 × 1080	10-bit 4:2:2 (Y'C'BC'R)	60, 59.94, 50	
	10-bit* 4:4:4 (R'G'B') 4:4:4:4 (R'G'B' + A) 4:4:4 (Y'C'BC'R) 4:4:4:4 (Y'C'BC'R + A)	30, 29.97, 25, 24, 23.98	60, 59.94, 50
	12-bit 4:4:4 (R'G'B') 4:4:4 (Y'C'BC'R) 4:2:2 (Y'C'BC'R)*		
1280 × 720	10-bit 4:4:4 (Y'C'BC'R) 4:4:4:4 (Y'C'BC'R + A) 4:4:4 (R'G'B') 4:4:4:4 (R'G'B' + A)	60, 59.94, 50, 30, 29.97, 25, 24, 23.98	
2048 × 1080 (D-Cinema)	12-bit 4:4:4 (X'Y'Z')*	24	

** Includes PsF (Progressive segmented Frame) format*

20-bit pixels

30-bit pixels

40-bit pixels

36-bit pixels

24-bit pixels

Table 1. 3Gig-SDI supported video formats, per SMPTE-425M

From Broadcast Engineering May 1, 2009

Ancillary Data in SDI

- Defined by SMPTE 291
- Inserted during H and V blanking intervals
- Used for many different purposes
  - Embedded Audio
  - Error Detection and Handling
  - Time Code
  - Camera Position info
  - Captioning / Subtitles
  - Other / TBD
- Keep it transparent to 1722

Line Encoding

- Many different line formats must be supported
  - SD-SDI: NTSC, PAL, Component, 8-bit or 10-bit data
  - HD-SDI: 720p, 1080i, 10 bit data
  - 3G-SDI: 720p, 1080p, Dual HD-SDI, 4:2:2, 4:4:4, 10-bit or 12-bit data
  - SMPTE 485 mapping defines a 4125-word line size
- Each line includes Active Video, Line Number, CRC, and space for Ancillary data.
- Need as many as 13 packets per line assuming 1500 byte MTU
  - ⇒ Mid-frame recovery (in the event of a lost 1722 frame) is desirable
  - ⇒ Use Marker Bits as “continuation characters”
  - ⇒ Need more marker bits than AVTP-Video proposal defines (Dave O suggests a separate field as mid-line sequence number)
- 32-bit alignment seems impractical
  - ⇒ Agreed. Don’t even try!

Pro Video Stream Packetization
To be resolved for next F2F

- Packet format suitable for SD-SDI, HD-SDI, and 3G-SDI
- Each new line (or group of N lines?) starts on a new packet boundary
  - 1722 frame size depends on format? (yes, that seems fine)
- Agree to forego attempts at 32-bit alignment? (Yes agreed)
- Add support for 4k frame sizes (beyond 3G-SDI)?
- Harmonize with SMPTE 2022-6 ?

Objectives for Video Sync

- Nodes derive “genlock” sync from gPTP time
  - ***PROBLEM: PTP time has discontinuities***
- Nodes may derive time code from gPTP time, or receive as ANC data embedded in a stream
- Convey Sync events using 1722 Control Packets?
  - Q to committee: Is there a precedent to follow for this?
  - 1722 Committee recommends using Media Clock Negotiation as the solution (currently an Annex in 1722a draft). This would define a low-bandwidth stream (essentially a periodic control message)

Recent work in NAB

(April 2012)

The New Genlock Generation of Broadcast Signals from Precision Time

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Abstract - *Traditional genlock circuitry relies on a streaming broadcast signal to operate. Whether color black (blackburst), tri-level sync, timecode or DARS, we distribute these signals to all of our locked devices where they are used to generate deterministic output timing. The next generation of genlock will not be based on legacy analog TV waveforms or digital bitstreams, but instead will use network-distributed precision time to synthesize their output signals. While in many ways this represents a quantum shift in how device synchronization is accomplished, particularly at the system level, many things under the hood don't change that much.*

House Sync Distribution
To be resolved for next F2F

- Consider MCN (Media Clock Negotiation) proposal
- Identify all “event types” to be conveyed
- Define a 1722 ~~Control~~ Packet format
  - Instead, use a stream with low bandwidth and regular periodicity
  - Ref MCN spec (Annex in 1722a current draft)
- Prove / agree that 802.1AS meets timing precision requirements

Other Issues

- Liaison with SMPTE ? Yes, we should try
  - Bob Edge, Al Kovalick, Paul Briscoe, possible players
  - Rob Silfvast to attempt to establish Liaison relationship and serve as conduit into IEEE 1722 group
  - Working group on 2022-x is dubbed 32NF-60
- What else?
  - Target schedule for 1722a going to sponsor ballot is “early 2013”
  - Need to make fast progress to get this format completed in time

Thank You