SMPTE 346M
Time Division Multiplexing (TDM) Video and Data Streams Into a 1.5Gb/s HDTV Stream

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Definition: SMPTE 246M

• TDM (time division multiplexing) of various SD (standard definition) digital video and generic 8-bit data signals over a HD (high definition) serial digital interface (ANSI/SMPTE 292M)

• Single link to transmit, distribute, route and switch a complete family of existing 10-bit video formats and various data formats
Definition continued

- Active video and vertical blanking areas in the HD SDI stream are time divided into 19 interleaved channels.
- The word in the first channel indicates the data validation of the 18 remaining channels.
- Single video or data stream is muxed into one or multiple channels of the total 18 channels.
Definition continued

- Control packet is muxed into HANC after switching point
- Control packet indicates how and which channels are used for video or data stream
- Also contains a stream clock reference for clock recovery of the original clock signal
Definition continued

- Multiple SD video or data could be muxed/demuxed from a single HD SDI stream with a total delay in a fraction of a line (<4us)
- Dynamic re-configuration of the number and type of streams
- Compatible with 1.5Gb/s SMPTE 292M routing and processing infrastructure
Definition continued

- 32 20bit-word of stream header for each video/data stream with minimized use of HANC space in HD signal leaving the space available for other signals to be embedded
- Easy identification of type and number of steams that have been embedded
- Payload header similar to SDTI standard including source and destination address for intelligent router
Definition continued

- Synchronous operation allow synchronized switching of embedded signal
- Asynchronous operation is permitted for applications requiring low latency, low cost and simplicity
EAV/SAV/ADF (Ancillary Data Flag) MAPPING

When 19 20 bit-words are packed to an 18 channel packet, we have 21 bits per channel. What a luxury!

The extra bit can tell us

Data is valid          1 + Data
Data is not valid      0 + 040&200 (hex)

-remap “illegal” codes during active video

Data contain EAV/SAV/ADF
0 + Data with toggled 19, 18, 9 and 8bits
# Packet Header

<table>
<thead>
<tr>
<th>Word</th>
<th>Name</th>
<th>Data (Y/C)</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ADF</td>
<td>000h</td>
<td>Ancillary data flag</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>3FFh</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3FFh</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>DID</td>
<td>143h</td>
<td>Data ID</td>
</tr>
<tr>
<td>4</td>
<td>SDID</td>
<td>113h</td>
<td>Secondary DID</td>
</tr>
<tr>
<td>5</td>
<td>DC</td>
<td>110h</td>
<td>Data count</td>
</tr>
<tr>
<td>6-32</td>
<td>HD</td>
<td>Data</td>
<td>Header Data</td>
</tr>
<tr>
<td>33</td>
<td>RD0</td>
<td>040h</td>
<td>Reserved data 1</td>
</tr>
<tr>
<td>34</td>
<td>RD1</td>
<td>040h</td>
<td>Reserved data 2</td>
</tr>
<tr>
<td>35</td>
<td>CS</td>
<td>Cs</td>
<td>Check sum</td>
</tr>
<tr>
<td>6</td>
<td>SID</td>
<td></td>
<td>Steam ID</td>
</tr>
<tr>
<td>7</td>
<td>STP</td>
<td></td>
<td>Stream type</td>
</tr>
<tr>
<td>8-9</td>
<td>CUS</td>
<td></td>
<td>Channel usage</td>
</tr>
<tr>
<td>10-13</td>
<td>SCR</td>
<td></td>
<td>Stream clock reference</td>
</tr>
<tr>
<td>14</td>
<td>AAI</td>
<td></td>
<td>Format of the Address</td>
</tr>
<tr>
<td>15-22</td>
<td>DA</td>
<td></td>
<td>Destination address</td>
</tr>
<tr>
<td>23-30</td>
<td>SA</td>
<td></td>
<td>Source address</td>
</tr>
<tr>
<td>21-22</td>
<td>CRC</td>
<td></td>
<td>Header data CRC</td>
</tr>
</tbody>
</table>
CH0: 270Mb/s; CH1 360Mb/s; CH2 540Mb/s;
Summary of Formats

• A single infrastructure for all video formats

• A single HDI link to carry
  1x 1080i, 720p at 1.5Gb/s, or
  2x 480p60 at 540Mb/s, or
  3x 480p60 4:2:0 at 360Mb/s, or
  4x 480p30, 480i60 at 270Mb/s, or
  6x NTSC/PAL at 143/177Mb/s, or
  8x 13.5MHz sampled composite video
  9x 10bit 4:0:0 sampling at 13.5MHz, or
  18x MPEG stream <68Mb/s, or
Combination of above, total bit rate <1.22Gb/s
## Summary of SD Video Formats

<table>
<thead>
<tr>
<th>SD System/Sampling Structure</th>
<th>525x60 or 625x50 4x3 13.5MHz</th>
<th>525x59.94 or 625x50 16x9 18MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:0:0i</td>
<td>135 Mb/s</td>
<td>180 Mb/s</td>
</tr>
<tr>
<td>4:2:2i</td>
<td>270 Mb/s SMPTE 267M</td>
<td>360 Mb/s SMPTE 267M</td>
</tr>
<tr>
<td>4:2:2:4i</td>
<td>360 Mb/s</td>
<td>540 Mb/s</td>
</tr>
<tr>
<td>4:2:0p</td>
<td>360 Mb/s</td>
<td>540 Mb/s</td>
</tr>
<tr>
<td>4:4:4:4i</td>
<td>540 Mb/s SMPTE RP174</td>
<td>720 Mb/s</td>
</tr>
<tr>
<td>8:4:4i</td>
<td>540 Mb/s</td>
<td>720 Mb/s</td>
</tr>
<tr>
<td>4:2:2p</td>
<td>540 Mb/s SMPTE 293M</td>
<td>720 Mb/s</td>
</tr>
</tbody>
</table>
### Why Not SDTI?

<table>
<thead>
<tr>
<th>Feature</th>
<th>TDM</th>
<th>STDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>10bit video</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Latency</td>
<td>Fraction of line</td>
<td>Field</td>
</tr>
<tr>
<td>HANC space used</td>
<td>Small</td>
<td>Every line</td>
</tr>
<tr>
<td>Clock recover</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Embed format</td>
<td>TDM</td>
<td>Packets</td>
</tr>
</tbody>
</table>
## Why Not Multi-Rate SDI?

<table>
<thead>
<tr>
<th></th>
<th>TDM</th>
<th>MR SDI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple stream</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Sets of frequencies</strong></td>
<td>Unlimited</td>
<td>Unlimited</td>
</tr>
<tr>
<td><strong>Silicon cost &amp; complexity</strong></td>
<td>Digital + HD SDI</td>
<td>Less digital, more analog, circuitry required for each rate</td>
</tr>
<tr>
<td><strong>Support video formats</strong></td>
<td>Unlimited</td>
<td>Limited sets</td>
</tr>
</tbody>
</table>
### SDTI Mezzanine Summary

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>➤ Reuses existing 270/360 Mb/s SDI infrastructure</td>
<td>➤ Availability</td>
</tr>
<tr>
<td>➤ Proven and reliable</td>
<td>➤ Cost of mezzanine encode/decode</td>
</tr>
<tr>
<td>➤ Economical for large scale routing</td>
<td>➤ Higher bit rate (&gt;250 Mb/s)</td>
</tr>
<tr>
<td></td>
<td>➤ video server availability</td>
</tr>
<tr>
<td></td>
<td>➤ Concatenation issues</td>
</tr>
</tbody>
</table>
TDM Summary

• Single co-ax or fiber for any standard
• TDM is more cost effective than WDM
• Supports all sampling formats
  – 4:0:0, 4:2:2i/p, 4:2:2:4, 4:4:4, 8:4:4, 8:8:8
• Uncompressed and compressed at the same time
Example

- SD_V
  - Audio
  - Data
- HD_V
  - Audio
  - Data

HD_V
Audio
Data

270 Mb/s
270 Mb/s
270 Mb/s
<68 Mb/s
68 Mb/s

up to 64ch audio (32 AES)

aux Data

Embedded in HANC

Co-ax to Fiber

TDM

1.5 G

Co-ax to Fiber

HDM

WDM
HD Multiplex Interface in HD SDI Infrastructure

- Multi-format Server
- DS3 receiver
- MPEG Decoder
- D1 Video Server
- Multi-sync Monitor
- Multi-Format Server
- Multi-Format VSM
- Multi-Format VSM
- Multi-Format MPEG Encoder
- Multi-Format MPEG Encoder
- Satellite dish
- Workstation

HD SDI Router

- 1.5G
- 540M
- 270M
- 270M
- <68M
- <68M
- 540M
- 270M
- 360M
- 270M
- 1.5G
- 540M
- 360M
- 270M
- 1.5G
- 540M
- 540M
- 540M
- 540M
- 540M
Example: Drop, Add, Pass

1.5Gb/s

Pass

Drop

Add (insert)
Example: Long Haul Applications

- Within a large facility
- Or from facility-to-facility
- Full bandwidth and compressed signals
Example: Large Video Networks

- Campus
- Military bases
- Hospitals
- Broadcast Facilities
Example: Stereovision 3D TV

- 2 (left/right) 270Mb/s for 3D-TV
- Telemedicine, sports, movies
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