High Speed Data Recording: Video Recorders Find A New Application

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VTR Track Widths 1956 to Present Day

- Quadruplex: 400µm
- C - Format: 160µm
- Human hair: 100µm
- Betacam: 78µm
- MII
  - D-1: 40µm
  - D-2: 20µm
- D-3: 10µm
- D-5: 10µm
- DVC: 10µm
D-5
1/2” Component Digital Tape Recorder

- Based Upon 1/2” D-3 (composite) Format
- Same Heads & Transport
- Same Cassette (S, M, L)
- Same Track Pitch (20 um)
- Same 8-14 Channel Coding
Serial Digital Interface
SMPTE 259

- Designed to carry Video, Audio & Data on a single COAX
- Permits Simple Interconnection and Routing of Signals
- Interface can handle 10 bit 525 or 625 line, Composite or Component Signals
- Horiz.+Vert. Blanking can be used for Audio and Ancillary Data
First Generation Digital Graphics Workstations

Post Production digital video graphics were processed at D-1 resolution. Performing video image manipulation in real time required dedicated hardware. Images were captured and output from analog component or D-1 video formats.
Second Generation Digital Graphics Workstations

Workstations generate 3-D animation, frame by frame. Each frame is rendered to analog or digital video recorders or higher resolution film.
## Frame Resolution & Data Rate

<table>
<thead>
<tr>
<th></th>
<th>Format</th>
<th>D-1</th>
<th>D-5</th>
<th>Film</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H Res</strong></td>
<td></td>
<td>1440</td>
<td>1440</td>
<td>2048</td>
</tr>
<tr>
<td><strong>V Res</strong></td>
<td></td>
<td>500</td>
<td>500</td>
<td>1536</td>
</tr>
<tr>
<td><strong>Bits/pixel</strong></td>
<td></td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Frame Size</strong></td>
<td></td>
<td>5.76 Mb</td>
<td>7.2 Mb</td>
<td>31.45 Mb</td>
</tr>
<tr>
<td><strong>FPS</strong></td>
<td></td>
<td>30</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td><strong>Mbps</strong></td>
<td></td>
<td>172.8</td>
<td>215.8</td>
<td>754.8</td>
</tr>
</tbody>
</table>
Serial Digital Adaptor formats data from the VME bus into a data compatible with serial digital devices. This allows either data or video to be recorded by the digital VTR.
Viewgraphics Dataview SDA Applications

- Dedicated Fast archival for Onyx graphics
- Networked in Challenge server environment
- Integrated in serial digital video system
Third Generation Digital Graphics Workstations

Processing images at different resolutions allows equipment, facility and personnel flexibility. Facilities can alternate video and film jobs on an hour by hour basis.
Dataview SDA Blocks

- VME Host Interface
- Interface Buffer
- FIFO Buffer
- FIFO Buffer
- Secondary Error Correction
- Read after Write Correction
- Serial Digital I/O
- Controller
- RS-422 Control
- Genlock/Timing Gen
Dataview SDA Features

- Up to 256 MB onboard RAM
- Full control of VTRs
- Read after Write data validation
- On-tape directory in table of contents
- Full bandwidth video capture to VME bus
- Data interchange media
  - High capacity (up to 127 GB/cassette)
  - High speed (up to 17.5 MB/sec)
Serial Digital Interface

Physical 75 ohm Co-axial
Clock Rate 270 MHz
Coding Scrambled NRZ
Data Start Flag SAV (Start Active Video)
Data End Flag EAV (End Active Video)

Viewgraphics Transfer Rate
D-1 14 MB/s
D-5 17.5 MB/s (10 bit mode)
Comparison (average)
DLT 1.2 MB/sec 8 mm .5 MB/s

Maximum File Size
UNIX 4 GB
SGI XFS 127 GB (D-5 Large Tape)
Error Correction Systems

- Error Correction Systems can provide very powerful correction
- D-3 & D-5 EC Systems have about a $1,000,000 : 1$ correction range
- They provide almost perfect correction until the EC range is exceeded
- Once overloaded ECC systems tend to collapse abruptly
Bit Error Rate vs ECC Headroom

RAW BER

1x10⁻¹

Beyond concealment capability

1x10⁻²

Concealment

1x10⁻³

Correction

1x10⁻⁴

Burst errors (dropouts)

1x10⁻⁵

1x10⁻⁶

time
## Dataview Data vs. Video Mode Recording

<table>
<thead>
<tr>
<th></th>
<th>Data Mode 525 D-5 VTR</th>
<th>Video Mode 525 D-5 VTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bytes/Line</td>
<td>1260</td>
<td>1800</td>
</tr>
<tr>
<td>Lines/Frame</td>
<td>486</td>
<td>486</td>
</tr>
<tr>
<td>Frames/Sec.</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>X-Fer Rate MB/sec</td>
<td>17.52</td>
<td>25.03</td>
</tr>
<tr>
<td>Additional ECC</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Corrected BER</td>
<td>$10^{-10}$ to $10^{-13}$</td>
<td>$10^{-12}$</td>
</tr>
</tbody>
</table>

## Tape Capacity of D-5 Standard Cassettes
(Gigabytes)

<table>
<thead>
<tr>
<th></th>
<th>525 VTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>23.61</td>
</tr>
<tr>
<td>Medium</td>
<td>64.67</td>
</tr>
<tr>
<td>Large</td>
<td>127.29</td>
</tr>
</tbody>
</table>

DOD5 Backup Time is approximately
1 minute per Gigabyte
D-5 & HDTV

- D-5 is a 300.6 Mbs Digital Recorder
- D-5 Does Not Use Compression Internal to the VTR
- D-5 can thus accept "non-video" Data signals
- D-5 Uses an External 4:1 HDTV Compressor to Provide Superb Quality HDTV Today
- D-5 plays D-3 tapes, Records D-5 in 13.5/18MHz and accepts Compressed HDTV.
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