The Redwood Project: An Overview

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OVERVIEW

• REDWOOD IS A NEW GENERATION TAPE SUBSYSTEM NOW UNDER DEVELOPMENT AT STORAGETEK USING HELICAL SCAN TECHNOLOGY.

• THIS LIBRARY BASED STORAGE SUBSYSTEM IS DESIGNED FOR THE HIGH PERFORMANCE, DEEP ARCHIVAL MARKET.
RedWood is the outgrowth of a series of internal strategic planning and customer advisory board meetings.

The RedWood Project, combined with the StorageTek Library Systems, is StorageTek's strategy in satisfying our customer requirements.

RedWood consists of combination of:

- High-performance 36-track StorageTek tape subsystem
- State-of-the-art digital video system as used in broadcast studios

The architecture of the RedWood tape subsystem takes best advantage of the formats and operational parameters defined for video 'D3' devices.

Capacity per meter of as much as 50 times more information than 3490E cartridges.

State-of-the-art media formulation integral factor in deck's design.
REDWOOD SUBSYSTEMS OVERVIEW

MEDIA

- This current generation of MP media is an ideal candidate for reliable data storage.
- Significant improvements have been achieved in durability and stability over earlier generations.
- The RedWood MP media along with its improved cartridge will meet or exceed 3480-class media lifetimes.
- MP media technology will continue to benefit from extensive R & D expenditures in the commercial broadcasting sector and from work now in process within the data storage sector.

MEDIA STANDARDS

3rd Draft

PROPOSED
AMERICAN NATIONAL STANDARD
HELICAL-SCAN DIGITAL COMPUTER TAPE CARTRIDGE
12.65 mm (0.50 in)
FOR INFORMATION INTERCHANGE

13 May 1992

(ASC X3 Project No. 850-D)

Prepared by
Technical Committee X3B5
of Accredited Standards Committee X3

Revision History
1st Draft: X3B5/91-228 14 August 1991
1st Draft: X3B5/91-228A 14 November 1991
2nd Draft: X3B5/91-466 12 February 1992
3rd Draft: X3B5/92-068 13 May 1992
Using a ferromagnetic fluid, the magnetic domains of a recorded tape can be viewed under magnification to show track alignment, transition spacing, defects, and data format.

Scale factor is 125X or about 2mm of the 12.65mm tape width is represented by this slide.

Bottom transitions are the longitudinal time code track, which are used for high speed searching and location verification.

Middle transitions are servo sync pulse used to align the reel motors, capstan, and scanner motors for precise positioning of the tape.

Helical tracks in the upper area are written at opposing 20° azimuth angles to reduce cross talk and allow gapless recording. The tracks are written at an helix angle of 4.92° with a track spacing of 20 μM (1270 TPI).
REDWOOD CARTRIDGE

- Same media as D3 with video format extended for data.
- Storage reel only - permanent take-up reel; in drive.
- Packaged in a 3480 form-factor cartridge.
- Accommodates same range of tape length as 3480.
- Meets or exceeds 3480-class media lifetimes.
- ANSI format includes data compression.

REDWOOD CARTRIDGE FEATURES

- Tape pulled from opposite corner to 3480
  - Straighter path for loading arm
- Improved leader block design over 3480
  - Field-replaceable without special tools
  - More reliable latching mechanism
- Notch to ensure no damage if inserted into 3480 drive
- Design ensures no damage if 3480 cartridge inserted in helical scan device
REDWOOD CARTRIDGE FEATURES

- Improved write-protect switch, length and machine type recognition scheme
  - Separate cartridge/media identification block for ease of manufacturing
- Same label areas as 3480 cartridge
  - Additional area on trailing-edge
REDWOOD SUBSYSTEM OVERVIEW

- Head and tape wear characteristics differ from linear tape devices since the relative head-to-tape speed for RedWood is quite high, on the order of 1000 ips, in support of available data rates.

- Life expectations for media and heads will far exceed those currently thought possible in all modes of use.

- StorageTek has defined a means to keep track of customer tape and head usage facilitating preventive maintenance, timeliness and convenience to the customer.
REDWOOD 1 FEATURES

- CAPACITY PER METER OF AS MUCH AS 50 TIMES MORE INFORMATION THAN 3490E CARTRIDGES
- DEVICE DATA RATES COMPLEMENTARY TO CAPACITY
- 18 MB/S CHANNEL DATA RATE/ESCON
- 10 MB/S CHANNEL DATA RATE/SCSI II
- FIBER CHANNEL
- BIT ERROR RATE OF $10^{-13}$

REDWOOD 1 FEATURES

- High speed search: 60 to 100 times
  - Position of key records retained by for future searches
- File Safe™
  - Allows tape to be written once and only once
  - Information can be appended, but existing records cannot be overwritten
  - Emulates optical Write Once Read Mostly (WORM)
Higher device data rate requires fresh approach

- Original ESCON announcement by IBM barely fast enough
- Need ESCON performing at limit (approx. 18 megabytes/s)

Given the push towards open-systems and standards

- New versions of SCSI (SCSI-2 fast and wide) will see use for workstation market with RedWood
- HIPPI established in supercomputer systems, and thus is addressed in RedWood architecture
- Fiber Channel expected to become interface of choice for medium and high-performance RedWood systems users

Helical has longer mechanical latencies

- Not a problem - uses large buffers
- Very short records may lead to non-optimal performance and capacity utilization

Helical has lower inherent BER than longitudinal

- Add 3rd Level ECC to achieve $10^{-15}$
- Both 3rd Level ECC and write retry can be disabled by system
All RedWood products will operate in a library environment. The architecture also allows the customer to use stand-alone drives with or without stacker-loaders.

All StorageTek libraries are capable of storage and management of the new helical scan cartridge.

General availability features will include mixed media in the StorageTek library family (both helical and 3480 type media).

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<table>
<thead>
<tr>
<th>LIBRARY</th>
<th>TIMBERWOLF</th>
<th>WOLFCREEK</th>
<th>4400/PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Floor space (sq ft)</td>
<td>23</td>
<td>33</td>
<td>100</td>
</tr>
<tr>
<td>3490E (36 track) Capacity</td>
<td>0.2</td>
<td>0.4</td>
<td>2.4</td>
</tr>
<tr>
<td>RedWood 1 (terabytes)</td>
<td>10</td>
<td>20</td>
<td>120</td>
</tr>
</tbody>
</table>

Capacity comparison does not include compression

Floor space does not include access for manual loading, servicing.
HOST SOFTWARE FOR REDWOOD LIBRARIES

- IBM ARENA
  - MIXED MEDIA SUPPORT AT GA

- OPEN SYSTEMS
  - CUSTOMER REQUIREMENTS WILL BE USED TO REFINE HOST SOFTWARE AND DEVICE CONNECTIVITY FOR EACH SPECIFIC CASE.

PRODUCT EMPHASIS

IBM ARENA
OPEN SYSTEMS
FEDERAL AGENCIES
MID RANGE PRODUCTS
MARKET OPPORTUNITIES

- Continued steep growth in capacity requirements
- Driven by new applications
  - Imaging, seismic
  - High-definition full-color video stored digitally
  - Archives formerly on fiche, etc.

- Only 1% of business data stored in digital form in 1990, growing to 3-5% by year 2000 (source AIM report)

- Every company will have a true "mass storage" problem as percentage grows

PRODUCT AVAILABILITY

1994
SUMMARY

- RedWood allows investment in current-generation Nearline technology to be preserved in defining next-generation mass-storage systems.

- Helical scan technology offers order-of-magnitude improvement in capacity and density, cost/GB for all Libraries.

- Use of existing broadcast technology in RedWood significantly lowers risk.

Extensive R&D expenditures in the commercial broadcast sector will facilitate future generations of StorageTek helical-scan products.
SUMMARY

- Proposed standards-based helical-scan cartridge
  - Allows existing Nearline products to be upgraded by mixing new media with the existing cartridge set
  - Provides improvement in data rate over existing Nearline products in archival applications

- New helical-scan features, e.g., high-speed search, File Safe will be application enablers.

- RedWood facilitates use of Nearline technology in next generation mass-storage systems.