Present and Future Directions for Ampex DCRsi™ and DD-2 Format Products

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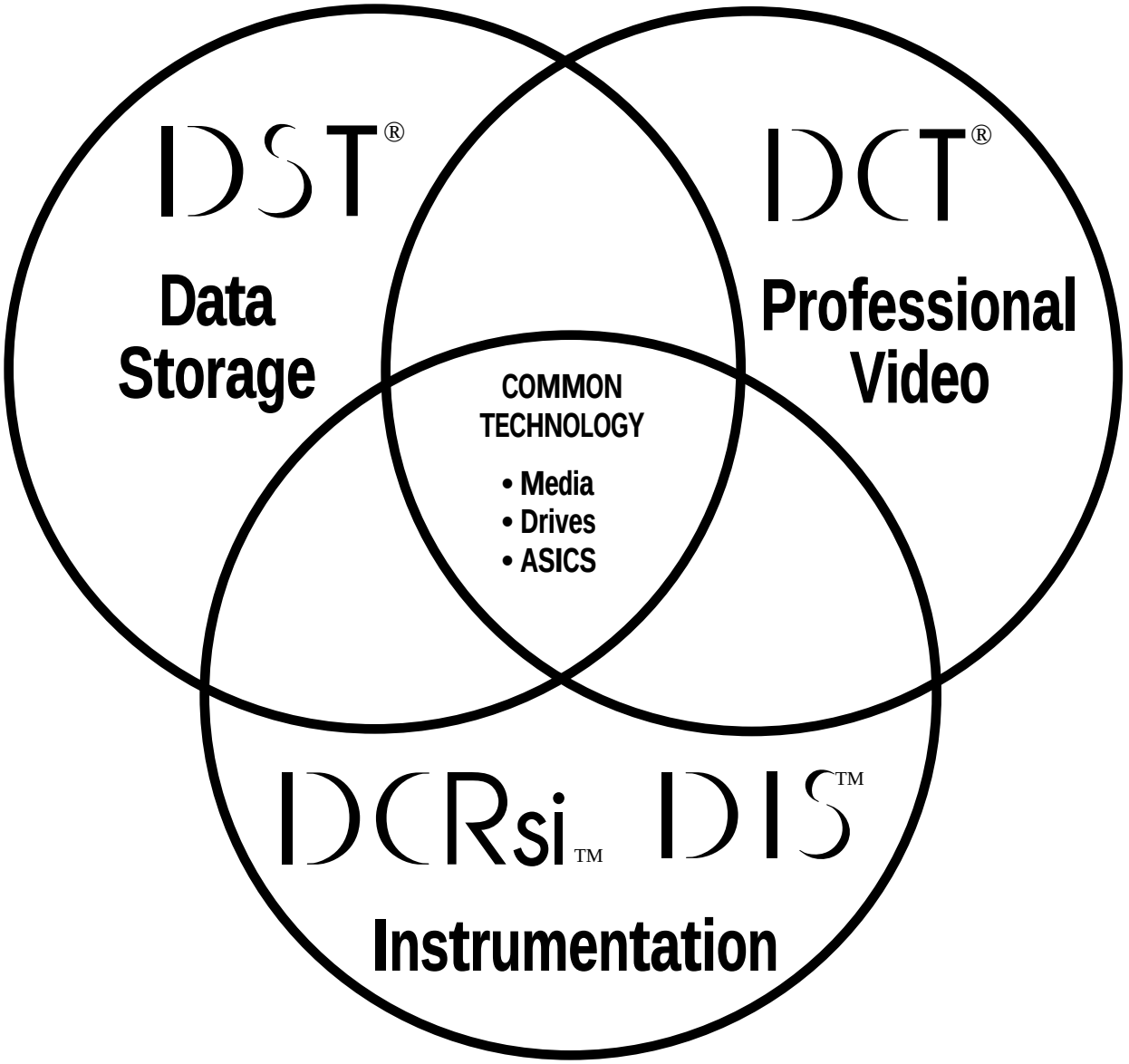
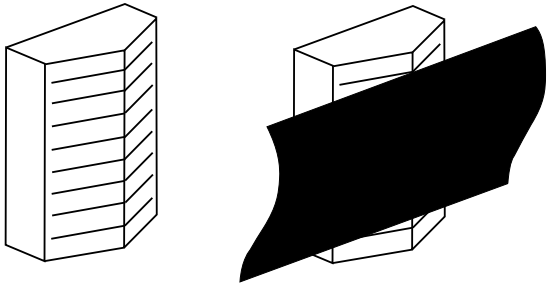
AMPEX

High Performance Recording Technology



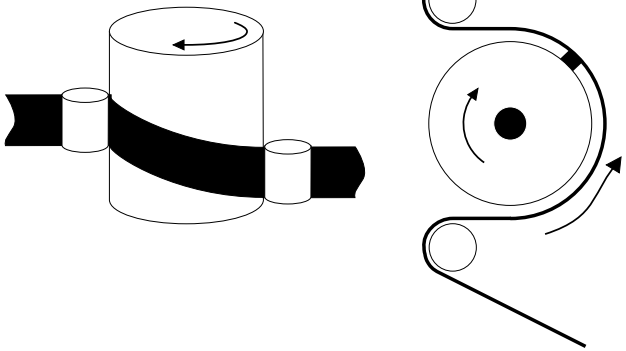
AMPEX

Overview of Recording Techniques

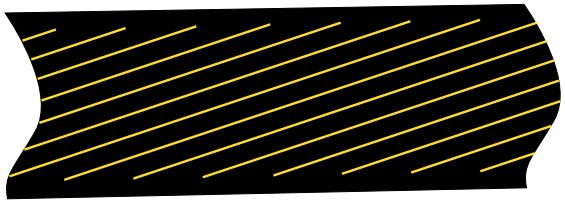


Longitudinal (Linear)

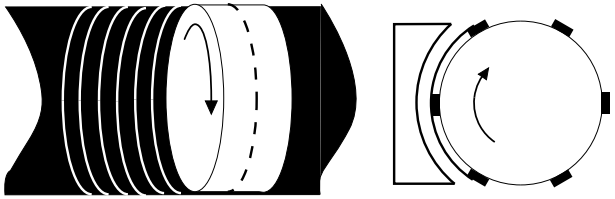
DD-2



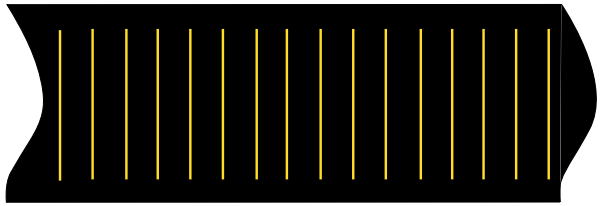
Helical



DCRsi



Transverse



Ampex Solutions

Ampex 19mm tape technology offers high performance,high capacity and high reliability!

DST™ and DIS™ Update

- DST is strictly for computer data storage and retrieval applications
  - 25 (50)[1], 75 (150)[1], 165 (330)[1] GB cartridges
  - 15 MB/sec (dual SCSI-2 ports)
- DIS has dual usage capability
  - Computer mode thru first port (SCSI-2)
  - DST/ER-90 tape format compatible
  - Instrumentation mode thru a second port
    - 8-bit Parallel & Clock
    - BIT Serial
    - IRIG-B Timecode
    - RS-232 Control
  - Supports tape-tape copy for DCRsi
  - 160 Mb/sec version available
- Technology updates to be first shown on DIS product
  - Double density in beta site testing
  - 240 Mb/sec version due in 1997

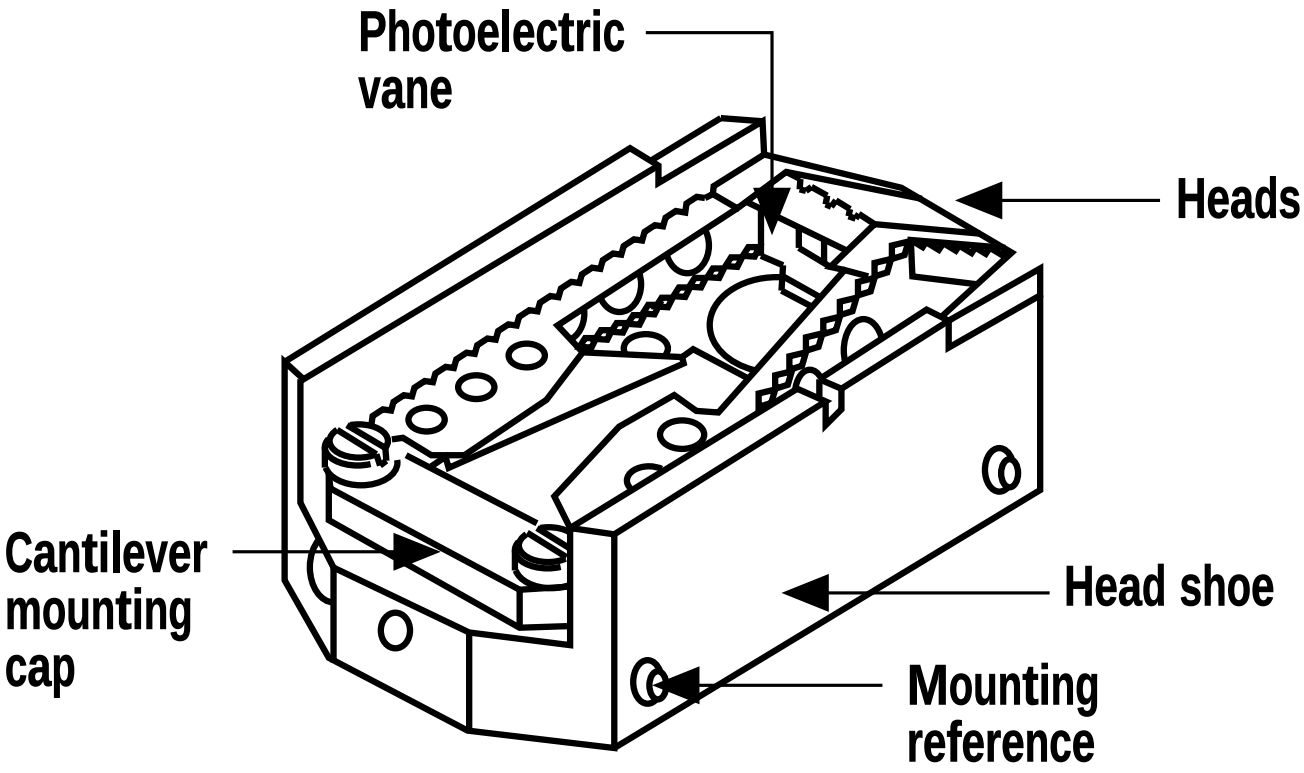
A M P E X

[1] Double density configuration

DD-2 Technology

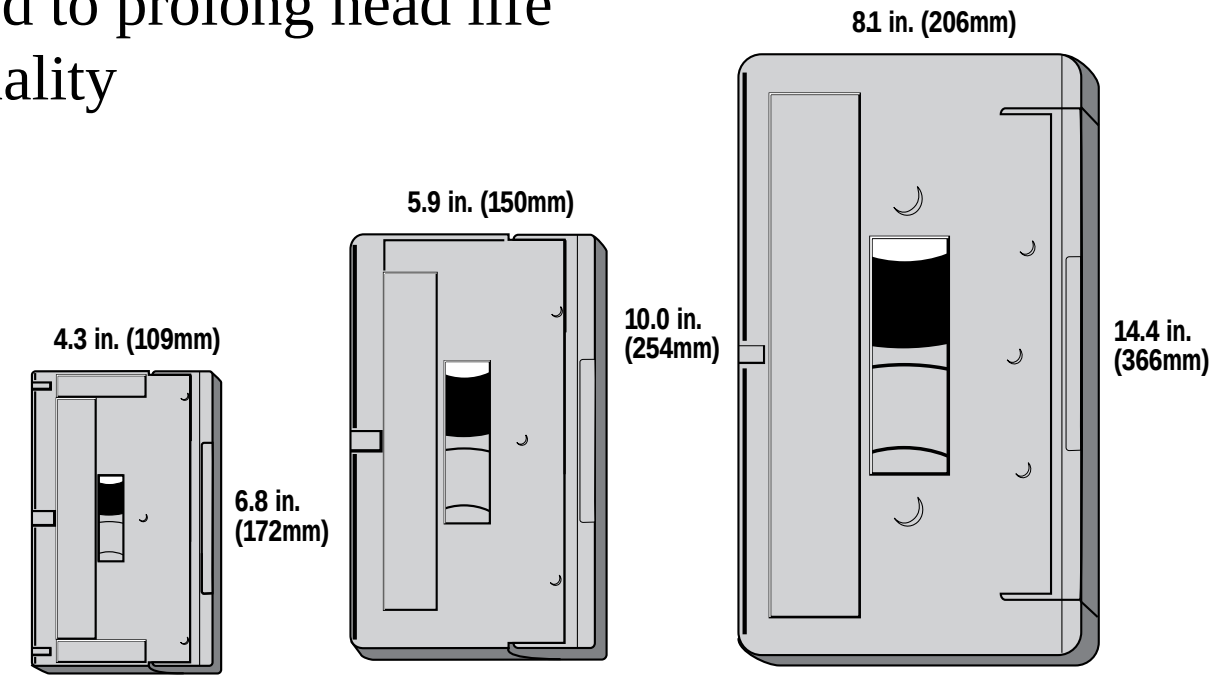
Features	Benefits
• Automatic Scan Tracking (AST™)	- Tape Interchange
• Metal particle (MP) tape	- Higher packing density/multiple vendor support
• Field replaceable head modules	- Reduction MTTR-simple alignment required
• Air lubricated tape guides	- High speed tape handling
• Powerful error correction system	- 3-level Reed-Solomon coding - Read-After-Write with automatic rewrite - Multi-track (3-1/3) burst correction capability/block - Less than one permanent error in 10^{14} bytes read using qualified media
• Advanced read/write heads	- Azimuth heads - Long-life configuration

AST™ Playback Head Assembly



DST™ Data Cartridges

- 19mm metal particle media
- Fully certified for data
- Conditioned to prolong head life
- Archive quality



	Small	Medium	Large
Standard Density	25 GB	75 GB	165 GB
Double Density	50 GB	150 GB	330 GB

DIS 160i Tape Drive Subsystem

- Supports 3 cartridge sizes:
  - 25(50)[1], 75(150)[1], 165(330)[1] Gigabytes
  - Instrumentation interface
    - 0 - 160 Mb/sec variable
    - DCRsi tape-tape copy
    - RS-232 control
    - IRIG-B time code
  - Search speed
    - 800 MB/sec (1500 MB/sec)[1] logical, physical, time code
  - Tape format
    - DD-2 format compliant
    - DST/ER-90 compatible
  - SCSI-2 interface (16 bit fast &wide)
    - <20 MB/sec sustained
    - 20 MB/sec burst
  - Error rate
    - 1 in 10^{14} bytes read

[1] Double density configuration

DIS 220i Automated Cartridge Library

- Up to 1.15 (2.3)[1] terabyte capacity in less than eight square feet (0.7m^2) of floor space
- Supports three cartridge sizes, with capacities of 25(50)[1], 75(150)[1], 165(330)[1] GB
- Uses DIS drive with one instrumentation interface and one SCSI-2 interface
- Transfer rate of 0 -120 MB/sec or 0 - 160 Mb/sec instrumentation data

[1] Double density configuration

DIS 820i Automated Library

- 6.4 (12.8)[1] TB on-line capacity
- 256, 25 (50)[1] GB cartridges
- One to four DIS tape drives
- 21 sq. ft. ($2m^2$) floor space
- Average cartridge cycle time <7 seconds
- Average data access time <30 seconds
- Aggregate transfer rate of up to 640 Mb/sec

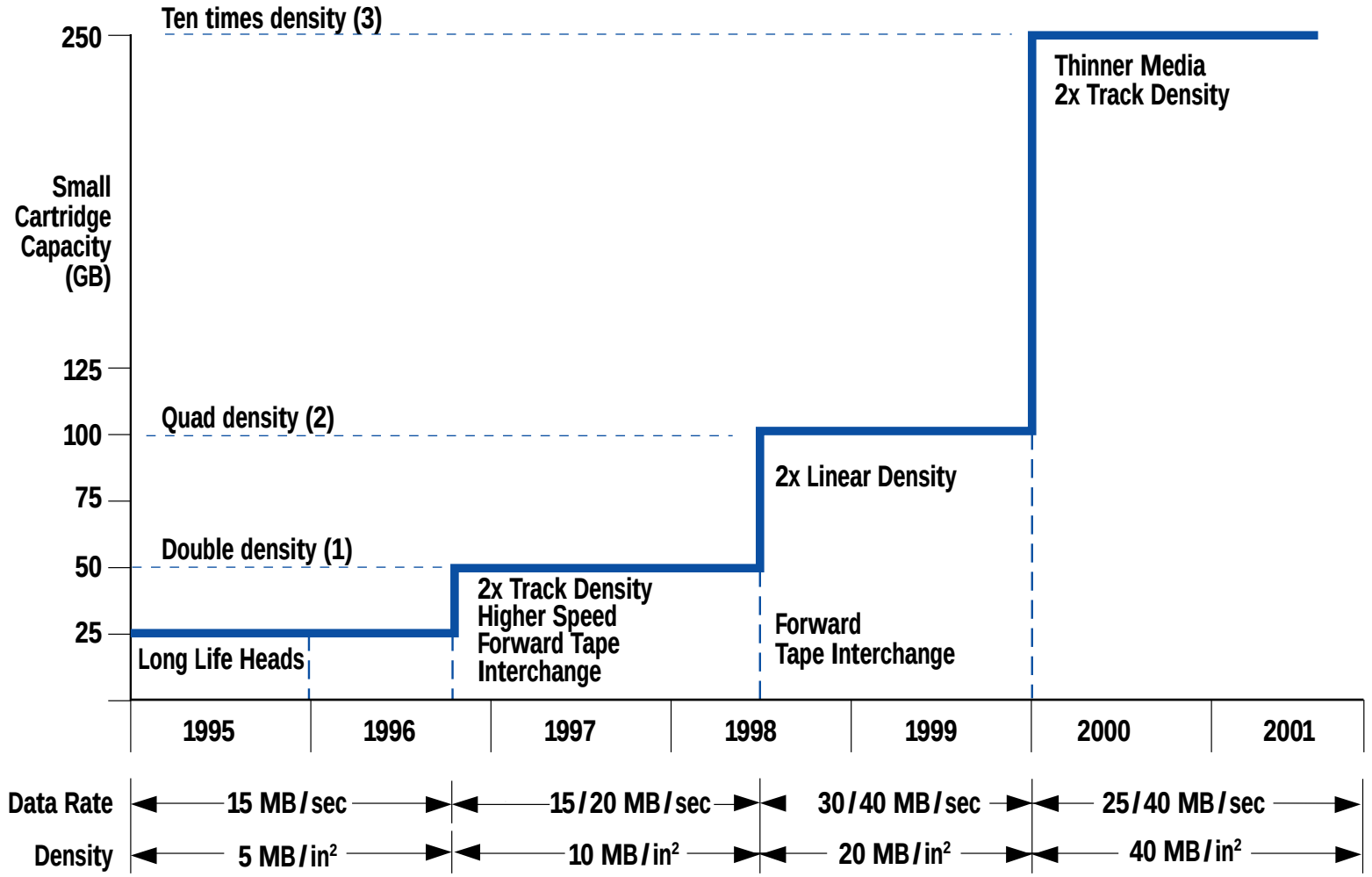
AMPEX

[1] Double density configuration

Ampex Software

- Hardware device support:
  - Tape drives
  - Automated tape libraries
- Unix environments:
  - Sun-Solaris (Cray Super Server)
  - SGI-IRIX
  - IBM-AIX
  - DEC-Alpha
  - HP-800 - HP/UX
- Third party integration:
  - Spectra Logic Alexandria™
  - Legent/CA - OSM™
  - Legato Networker 4.2
- Future
  - NT device driver
  - LSC - HSM

Ampex DD-2 Technology Roadway



Status: (1) Product Development; (2) Technology Development; (3) Projected

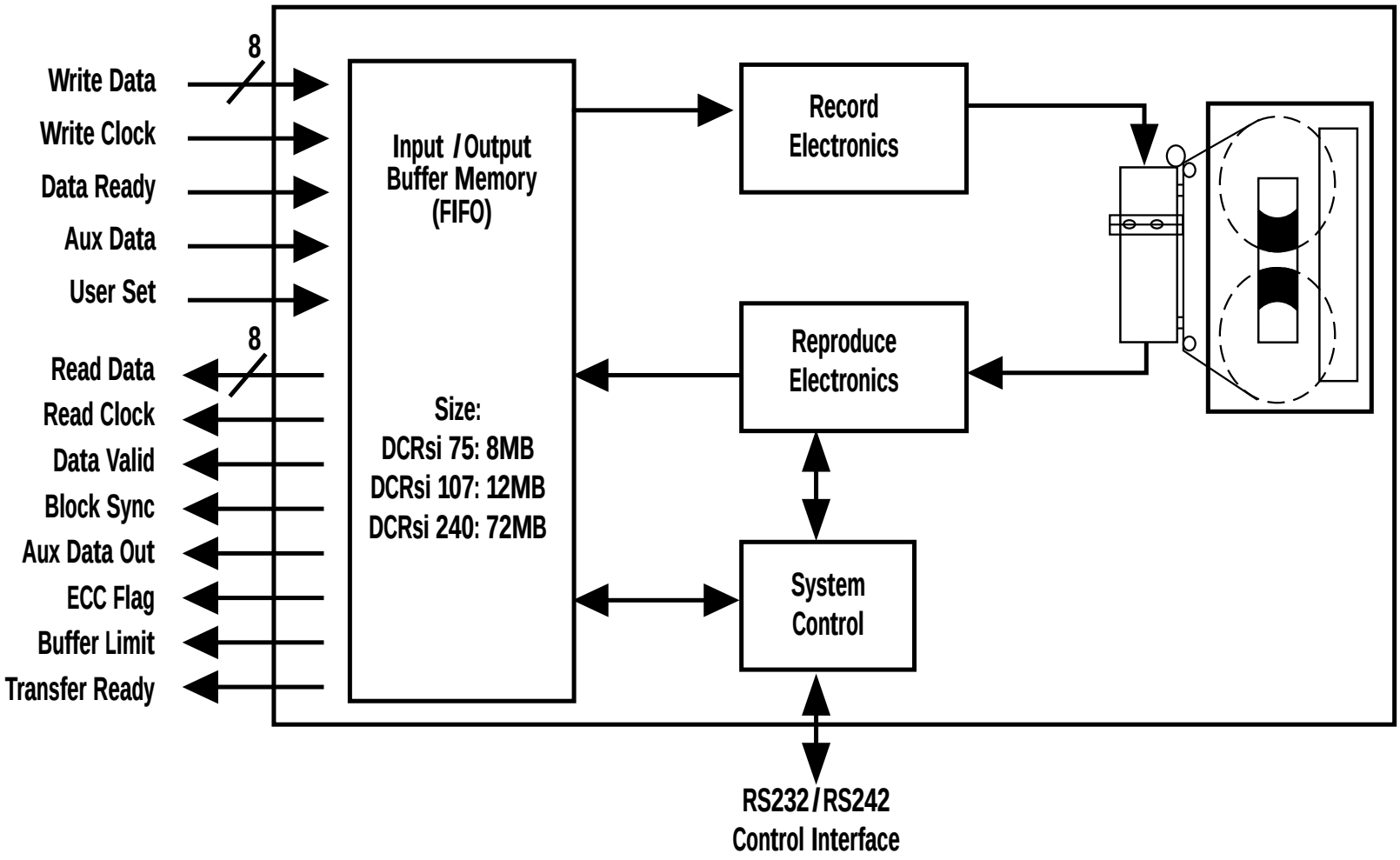
DCRsi Product Overview

- Data transfer rate:
  - DCRsi 75 0 to 8.37 MB/sec
  - DCRsi 107 0 to 13.4 MB/sec
  - DCRsi 240 0 to 30 MB/sec
- Buffered data I/O eliminates data transfer restriction
  - Data transfer can be continuous or in bursts
  - No adjustments are required to compensate for data rate changes
  - DCRsi is a “slave” to user interface equipment
  - 100% tape utilization at all data rates

DCRsi Specification Overview (continued)

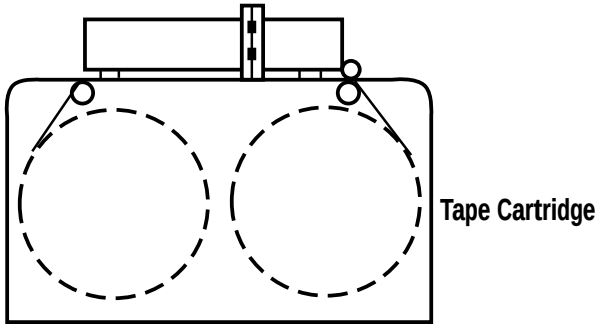
- Highly interleaved Reed-Solomon error correction code
  - Bit error rate better than $1x10^{-9}$ under ALL interchange conditions
- Built-in data tagging
  - Each data block is time tagged upon arrival at input to DCRsi
- Transverse scanning transport topology
  - Simple and compact tape path
  - Superior performance in hostile environments
  - “Azimuth” recording
  - >3,000 hour head life - typical

DCRsi I/O and Buffer Architecture

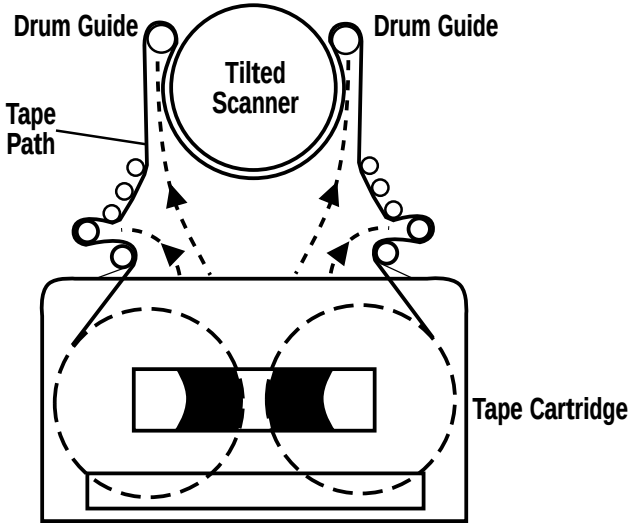


Tape Path Comparisons

Tape Transport Relative Sizes



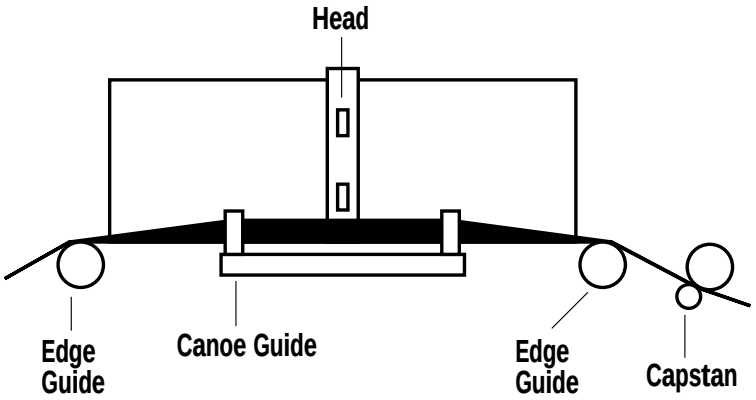
Transverse (DCRsi)



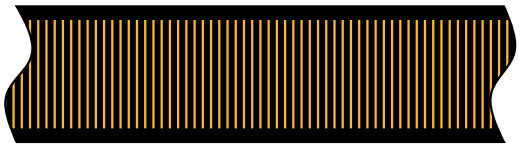
Helical (ID-1)

Environmental Performance

Transverse

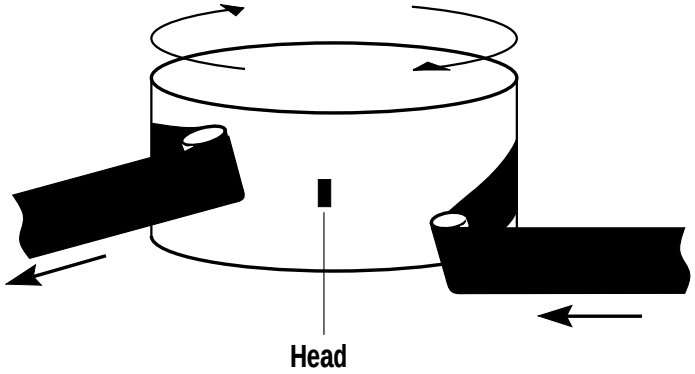


Vertical digital tracks are NOT sensitive to vertical tracking errors

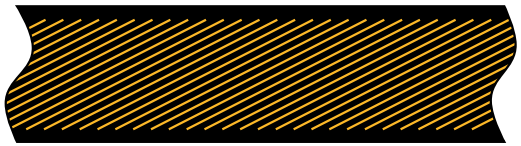


- Short distance between guides and head
- Pilot tone servo control provides “active” tracking

Helical

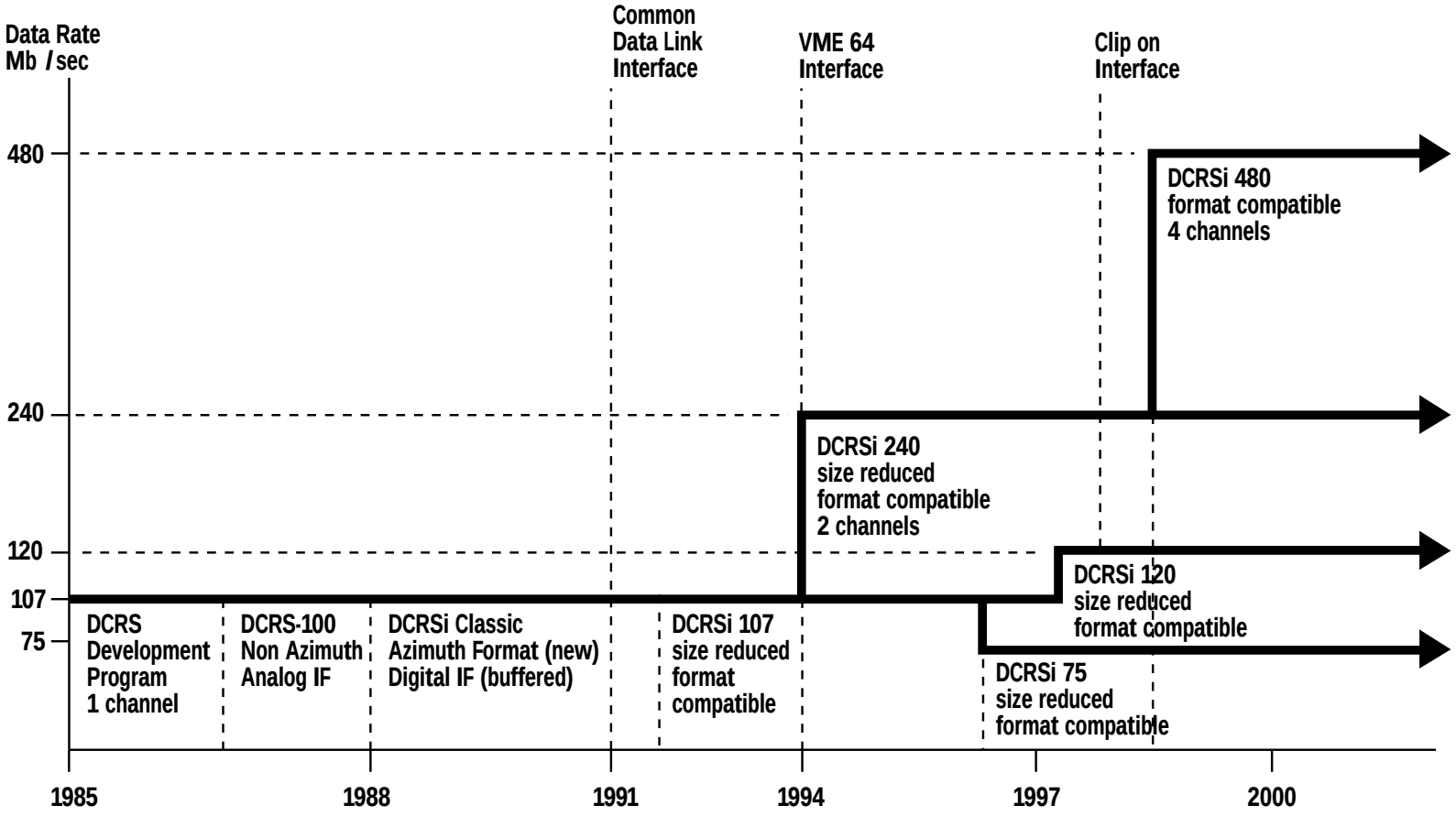


Helical tracks are sensitive to vertical tracking errors



- Long distance between guides and head
- Format sensitive to humidity and temperature

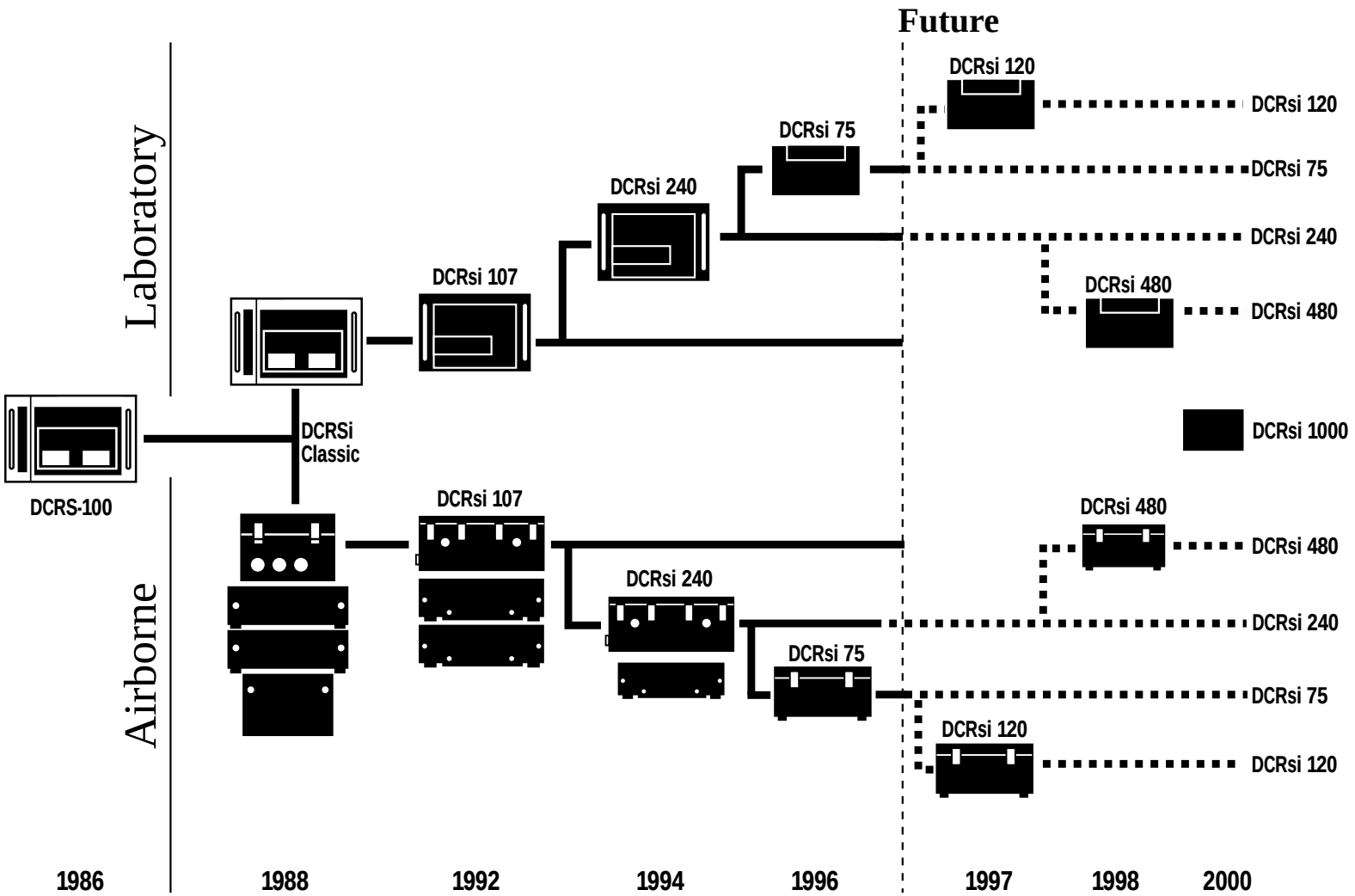
DCRsi Technology Roadmap



DCRsi “Clip-On” Interface Plans

- Provide a fast/high capacity solid state front end for DCRsi - aimed initially at tactical RECCE imagery applications
  - Expandable from 2 to 10 GB of solid state FIFO memory
  - Burst data rate up to 100 MB/sec
  - Integral cache memory of up to 500 MB for “instant access” to selected frames
  - Automatic backup to DCRsi tape
- Availability in 1997

DCRsi Product Evolution



Standards Efforts

- DD-2 - ANSI - X3B.5 Project
  - Efforts underway to update revision 3 to include double density considerations and instrumentation unique considerations
- DCRsi - NATO standards and CIGSS
  - STANAG 4283: Annex C is being updated to include DCRsi as a fully compliant high density digital recorder (HDDR) for use on marine patrol aircraft (MPA) for acousitc data recording
  - STANAG 7024: a new annex to STANAG 7024 is being considered which would incorporate the DCRsi transversal format for imagery recording on NATO reconaissance systems
  - CIGSS: DCRsi is CIGSS compliant

Digital Data Recorders Comparison

Item	ID-1	DD-2	DCRsi
Capacity per cassette (GB)	small: 13 medium: 42 large: 96	small: 25 (50)[1] medium: 75 (150)[1] large: 165 (330)[1]	one only: 48
Data rate	8 MB/sec; 16 MB/sec; 32 MB/sec; 50 MB/sec	15 MB/sec 20 MB/sec	13.375 MB/sec 30 MB/sec
Tape type	Gamma ferric oxide	Metal Particle	Gamma ferric oxide
Head tracking	fixed or auto tracking	AST™ (active)	Auto Tracking
Supports multiple platforms?	No	Yes	No
Supports file marks?	No	Yes	No
SER	10^{-10} (w/exceptions)	10^{-14} (no exceptions)	10^{9} (no exceptions)
Archival media stability	15+ years	15+ years	15+ years
Standards status	ANSI standard	X3B.5 Project underway	STANAG 4283 and STANAG 7024 in progress

[1] Double density configuration