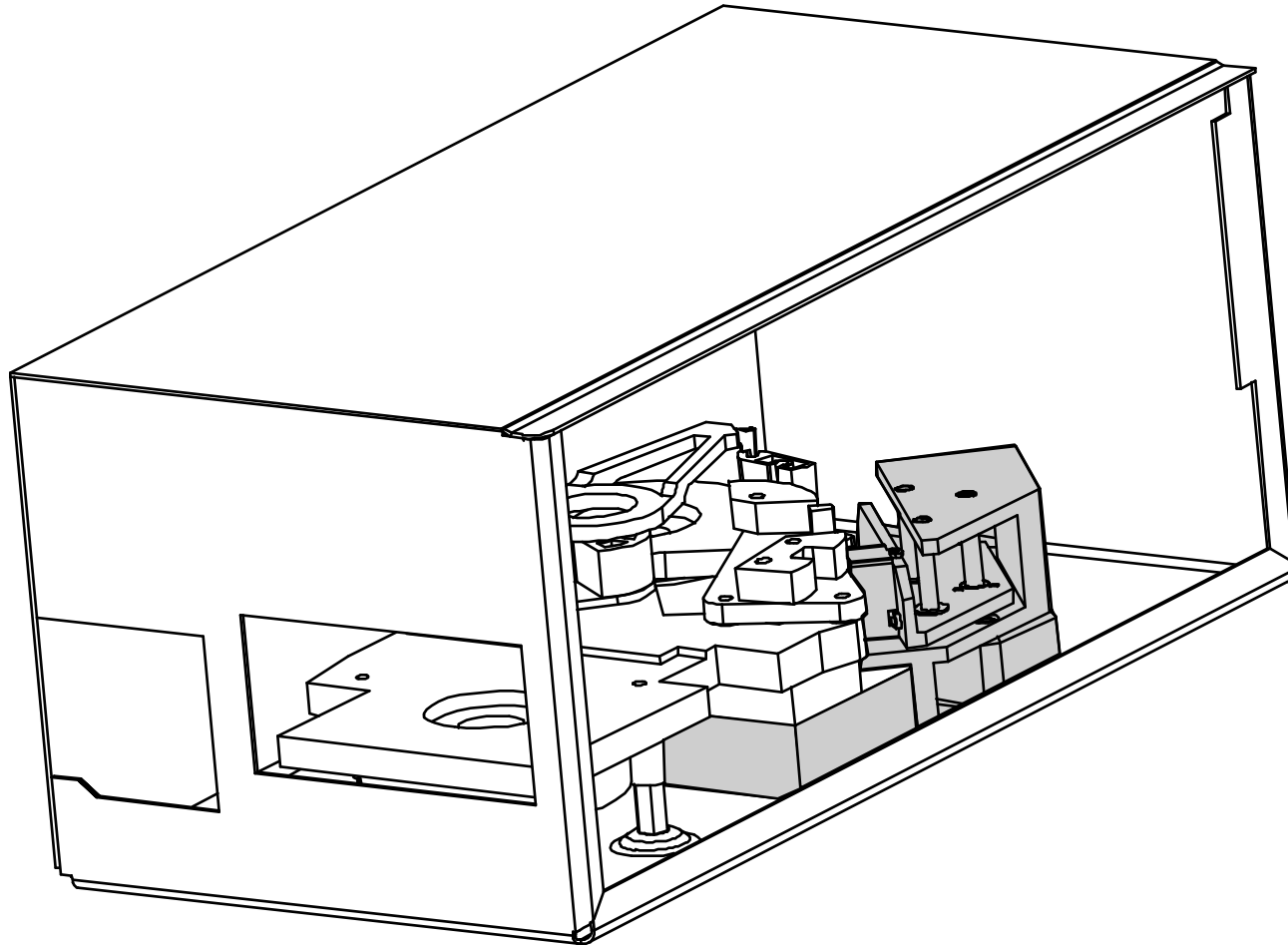


*Optical Tape Storage
Presentation at
THIC
Del Mar, CA
January 23rd, 1996
John Chu
EMASS Inc.
Englewood, CO*

EMASS Raptor Family of Optical Tape Products



Harrier Optical Tape Product



WHY Optical Tape ?

- ★ **Low Cost**
- ★ **High Capacity**
- ★ **High Data Transfer Rate**
- ★ **Long Archival Media Life**
- ★ **Preserving Investment in Libraries**

WORM Optical Tape Applications

★ Data acquisition environments :

- Original data is priceless**
- In very large quantities**

★ Permanent data storage environments

★ Growth Environments :

- Cost effective conversion from paper/films**
- New applications**

Implementation Strategy

- ★ **Moderate Risk Design Point**
- ★ **Starting with existing building blocks**
 - **Philips/LMS TD3600 Series Tape Deck & CSL**
 - **CREO Optical Technology**
- ★ **1/2-inch cartridge form factor**
 - **Library applications & Industry standard**
- ★ **Work with different types of Media**
- ★ **Applying for ANSI standard**
- ★ **WORM -> Rewritable**

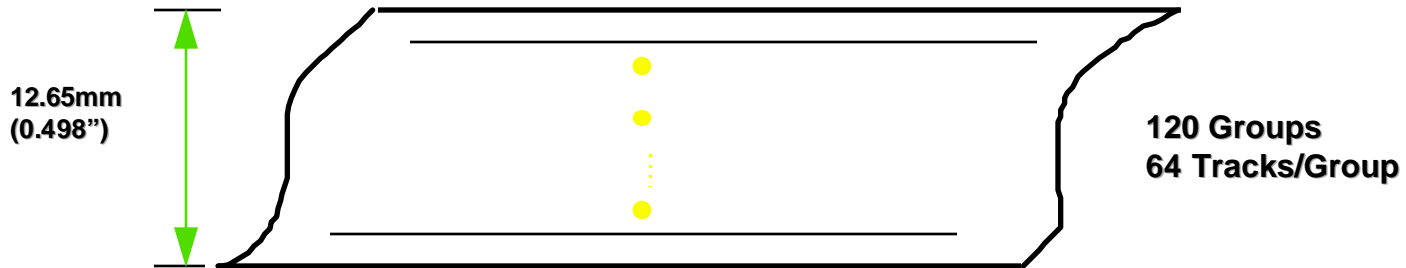
Attributes

- ★ **8-inch Form Factor (3490E Tape Path)**
- ★ **1/2-inch Tape Cartridge**
- ★ **200 GB Native Capacity**
- ★ **12.5 MB/s Data Rate**
- ★ **WORM - Archive**
- ★ **SCSI-III Fast & Wide**
- ★ **Average Access Time 50 sec**
 - **Includes Load time**

Attributes (Con't)

- ★ **3 m/s Tape Read/Write Speed**
- ★ **6 m/s Tape Search Speed**
- ★ **Serpentine Recording (120 Track Groups)**
- ★ **Reed-Solomon ECC**
- ★ **Library Model w/o CSL**
- ★ **Tower or Rack Mount Model w/ CSL**
- ★ **FCC Class B**

Tape Format



Tape Width	12,650 μm
120 Groups @ 97μm each	11,640 μm
Guardband	1,010 μm
	(505 μm Top & Bottom)

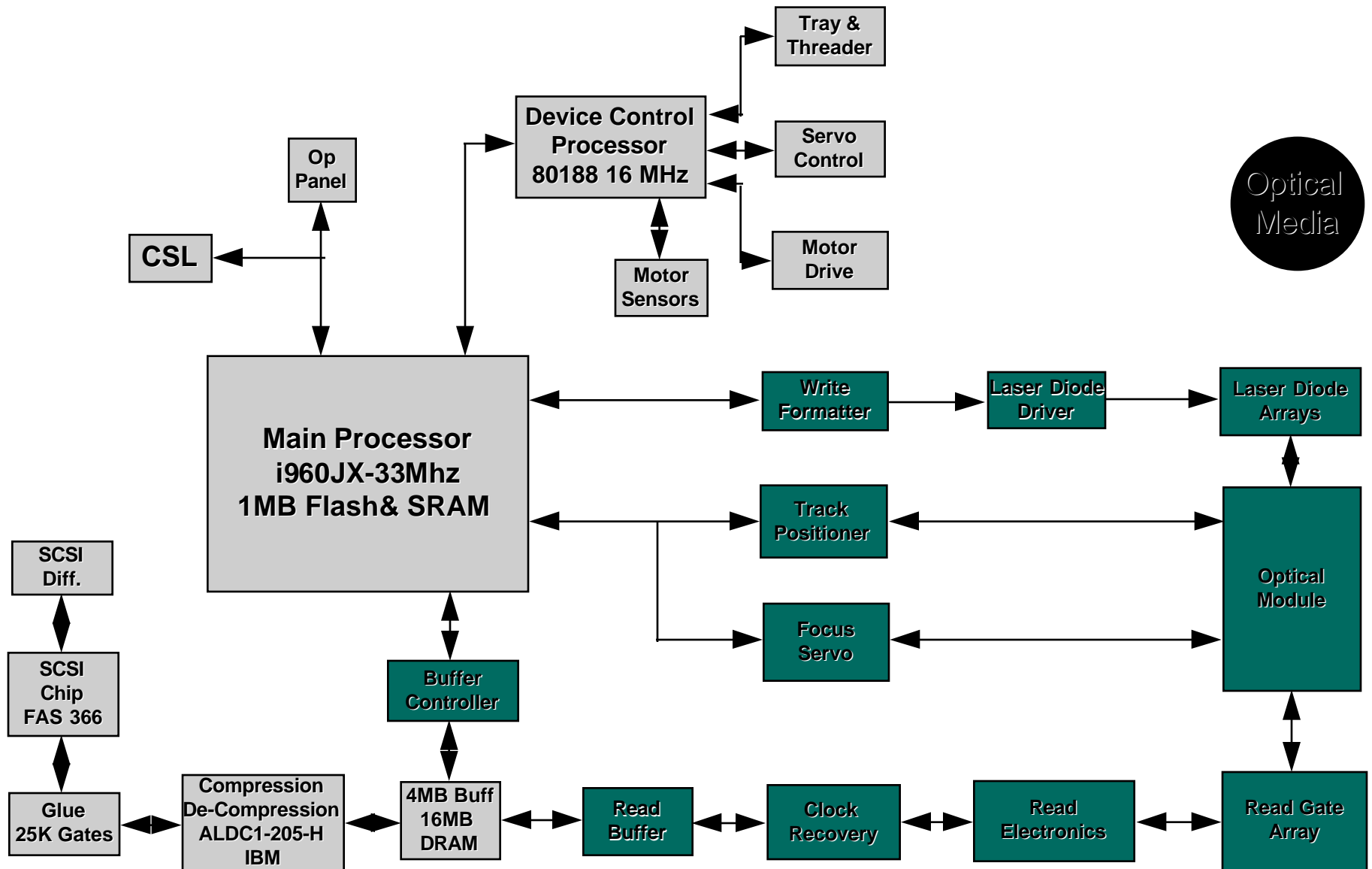
64 Tracks @ 1.2μm	76.8 μm	} Group-Group Spacing 20.2 μm
Write Magnification Error	2.5 μm	
Lateral Tape Motion	6.0 μm	
Thermal Expansion Tape	2.0 μm	
Track Positioner Absolute Error	3.2 μm	
Guaranteed Void	4.5 μm	
Write Laser to Read Array Spacing	2.0 μm	

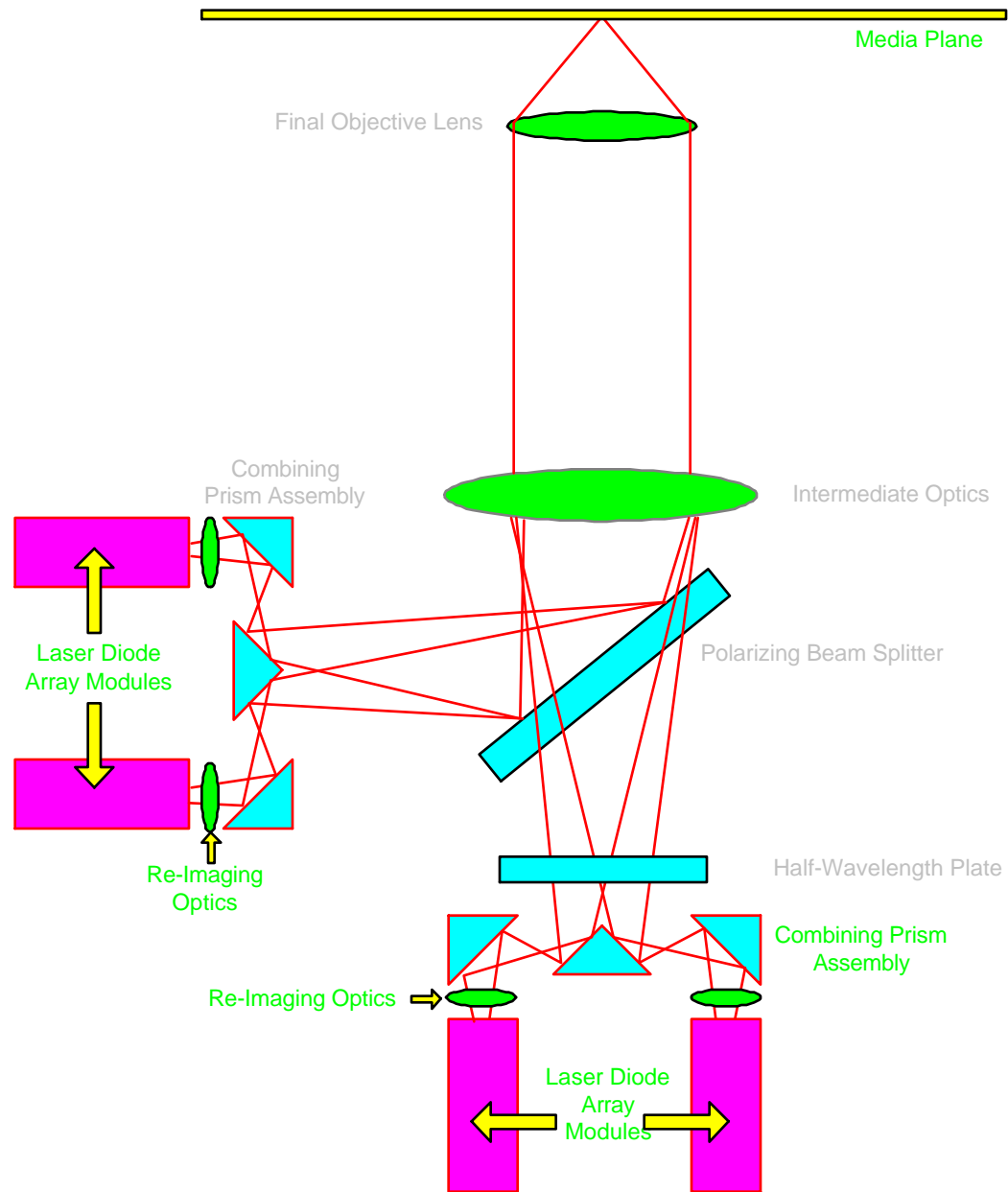
	97.0 μm	

Capacity & Data Rate

- ★ Capacity
 - 200 GB (430 m length tape with 0.5 mil thickness)
- ★ Data Rate (830 nm laser, 66% Code Efficiency)
 - 12.5 MB/s (with 3 m/s tape speed)
- ★ Opportunity
 - 230 GB & 14.3 MB/s (Laser spot 1 μm x 1.2 μm)
 - 16.6 MB/s (with 4 m/s tape speed)
 - RLL Data Encoding (+35% improvement to Capacity and Data Rate)
 - 4X Capacity (Blue Laser or Near Field Optics)

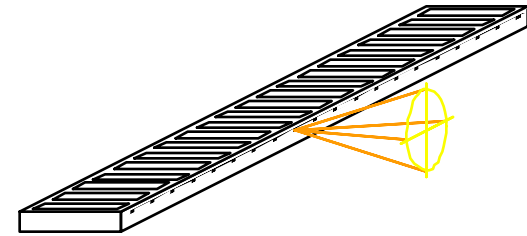
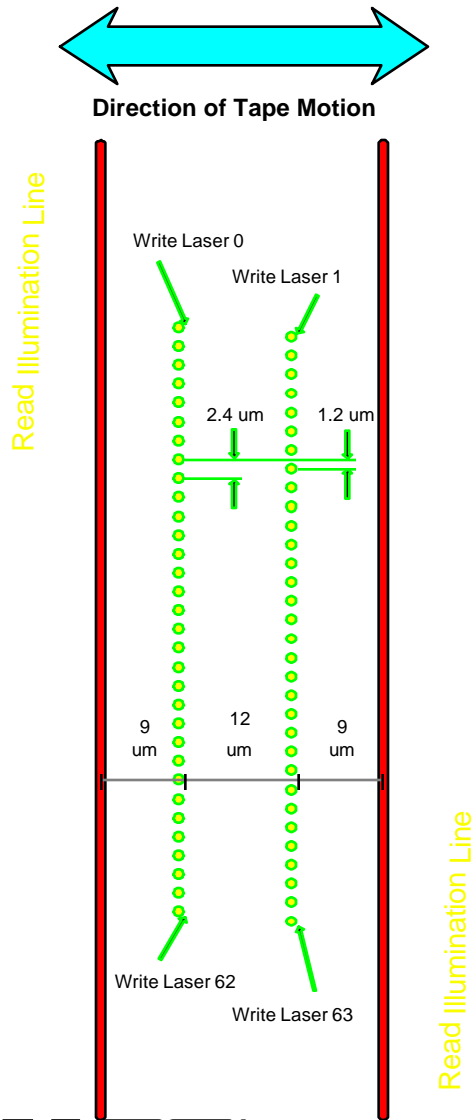
Harrier Optical Tape Functional Diagram





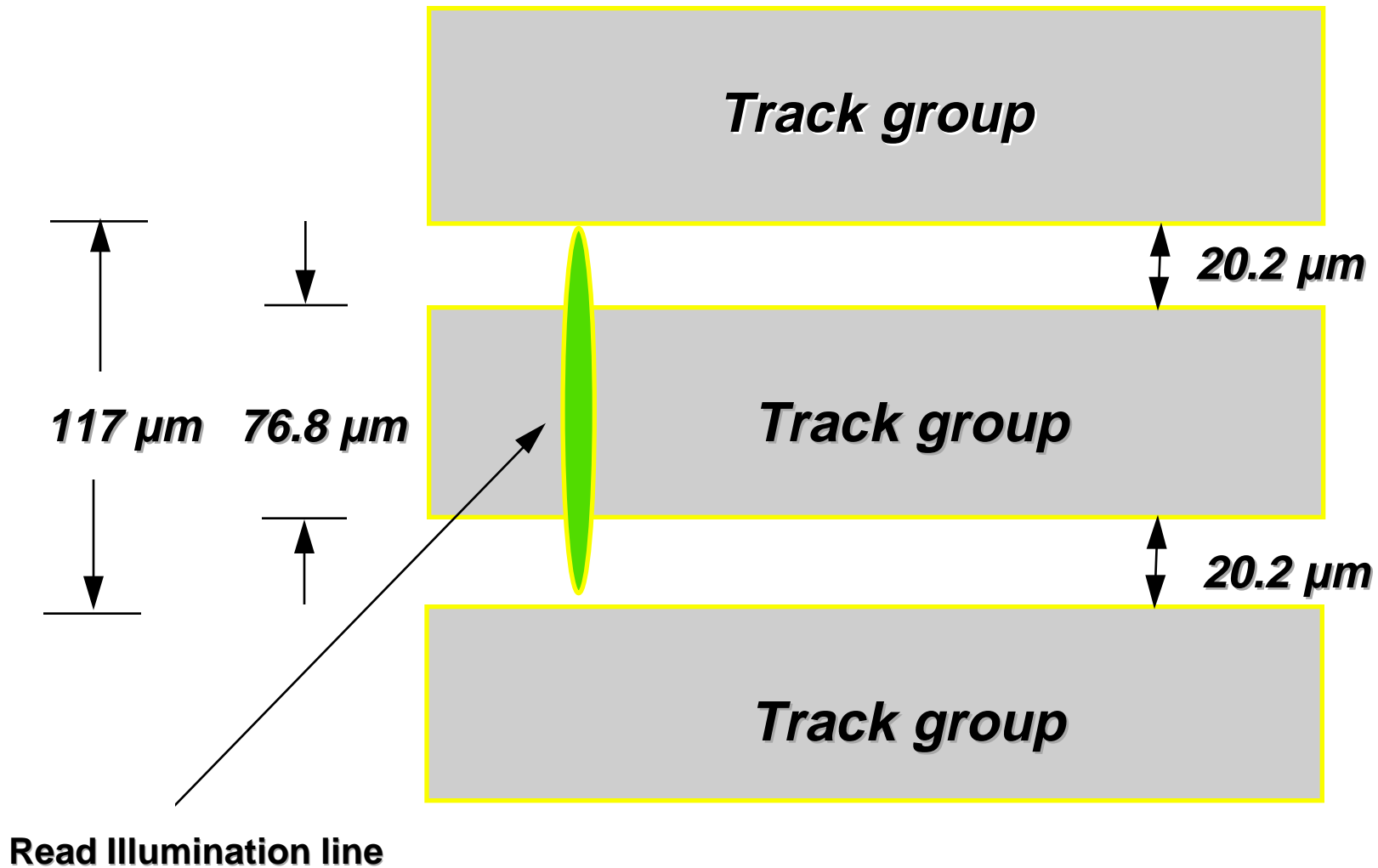
Write Optics System

Laser Image at Tape Plane

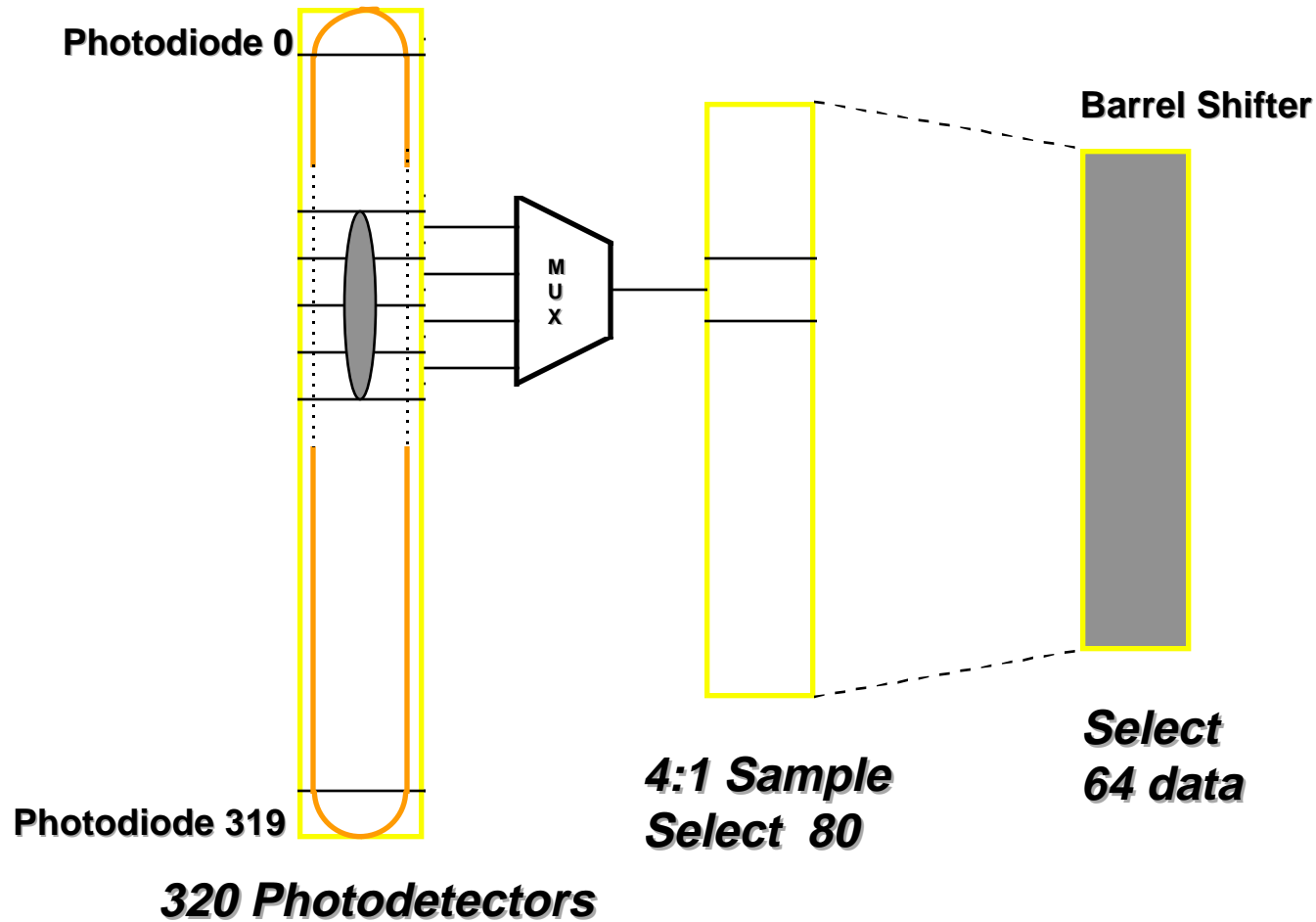


Monolithic Laser Write Array

Read Illumination

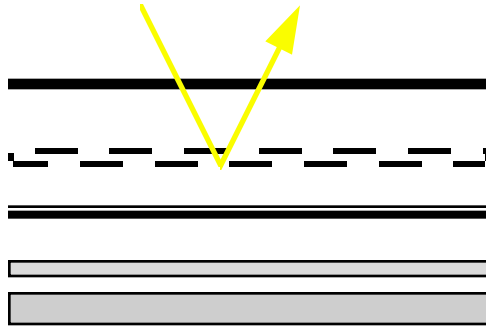


Read Sensor & Inertialess Tracking Servo



Optical Media Comparison

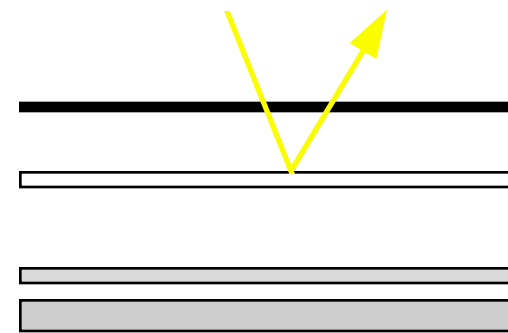
35mm
75 μm
880 m
Polyester
Proprietary
20.9 MB/square in.
1 TB
None
No
20+ years, 100K passes



Width
Thickness
Length
Base Material
Coating Material
Recording Density
Total Storage Capacity
Pre-format
Erasable
Life

Read/Write
Anti-abrasion layer
Recording Layer
Reflecting Metallic Coat
Smoothing Layer
Substrate

12.65mm
13 μm
450 m
Polyester
Proprietary
28.3 MB/square in.
200 GB
None
No
30 years, 100K passes

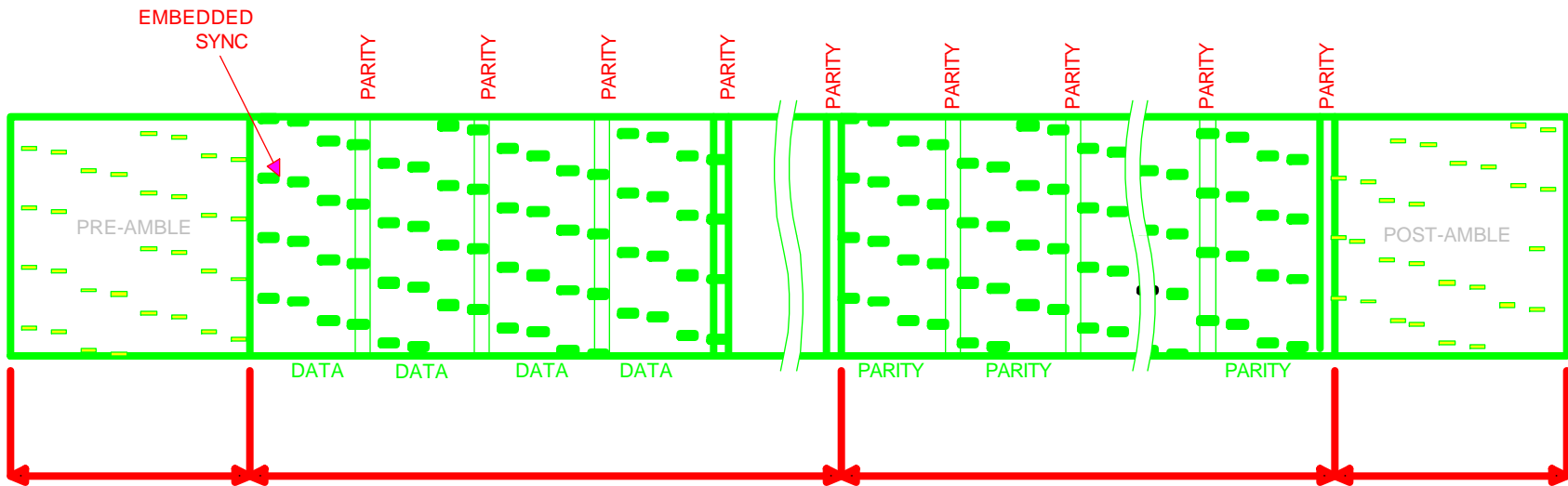


Phase Change

Optical Tape Cartridge

- ★ 3M Magstar cartridge shell
- ★ Different Leaderblock prevents load in 3480/3490 products
- ★ Tabs allow for cartridge type identification
- ★ Increases 3M cartridge shell volumes
- ★ 3M sells/licenses shells to other Optical Tape Media vendors

Record Format



Concerns

★ **Dust**

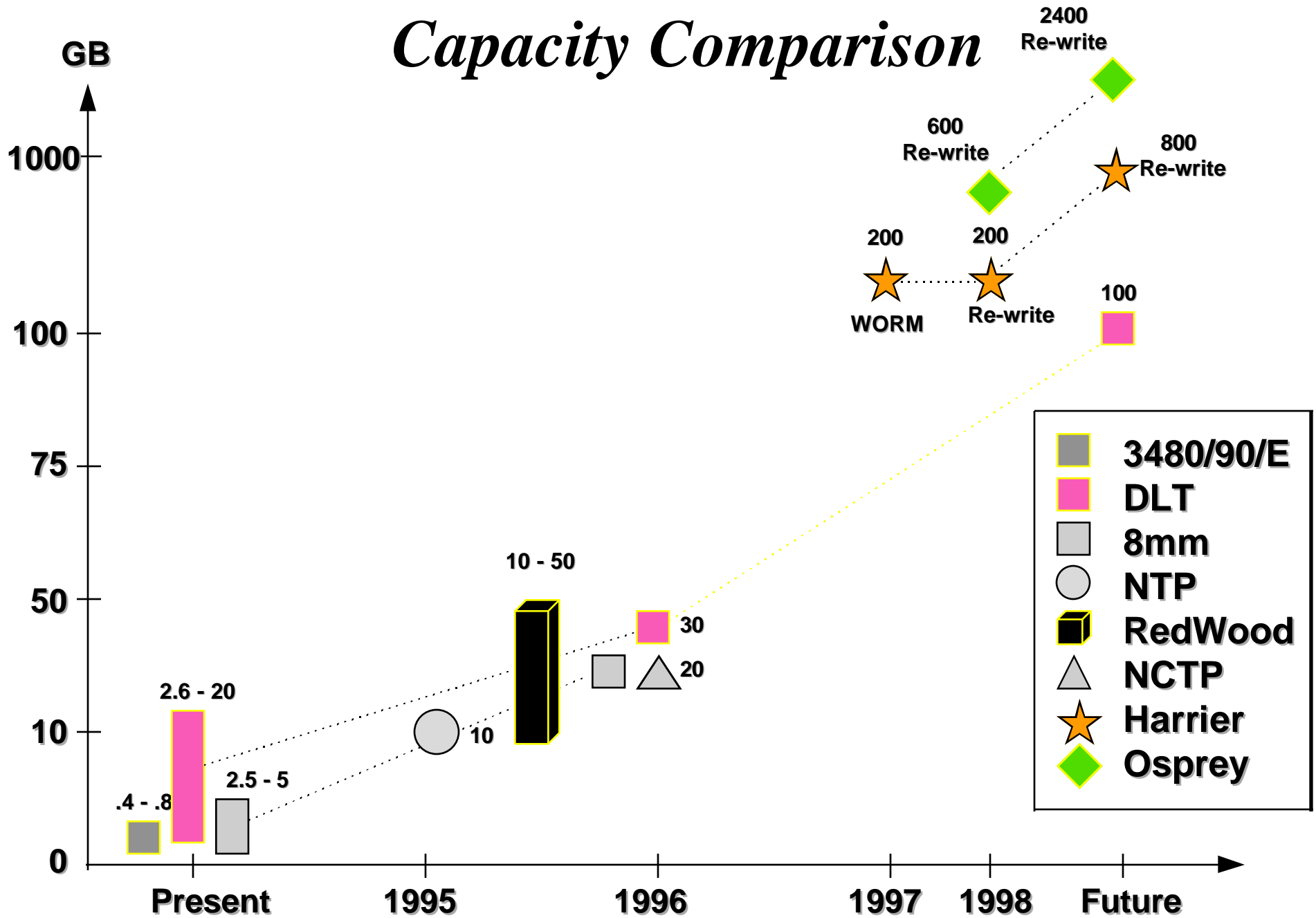
★ **Laser Diode Array**

– **Packaging**

– **Yield**

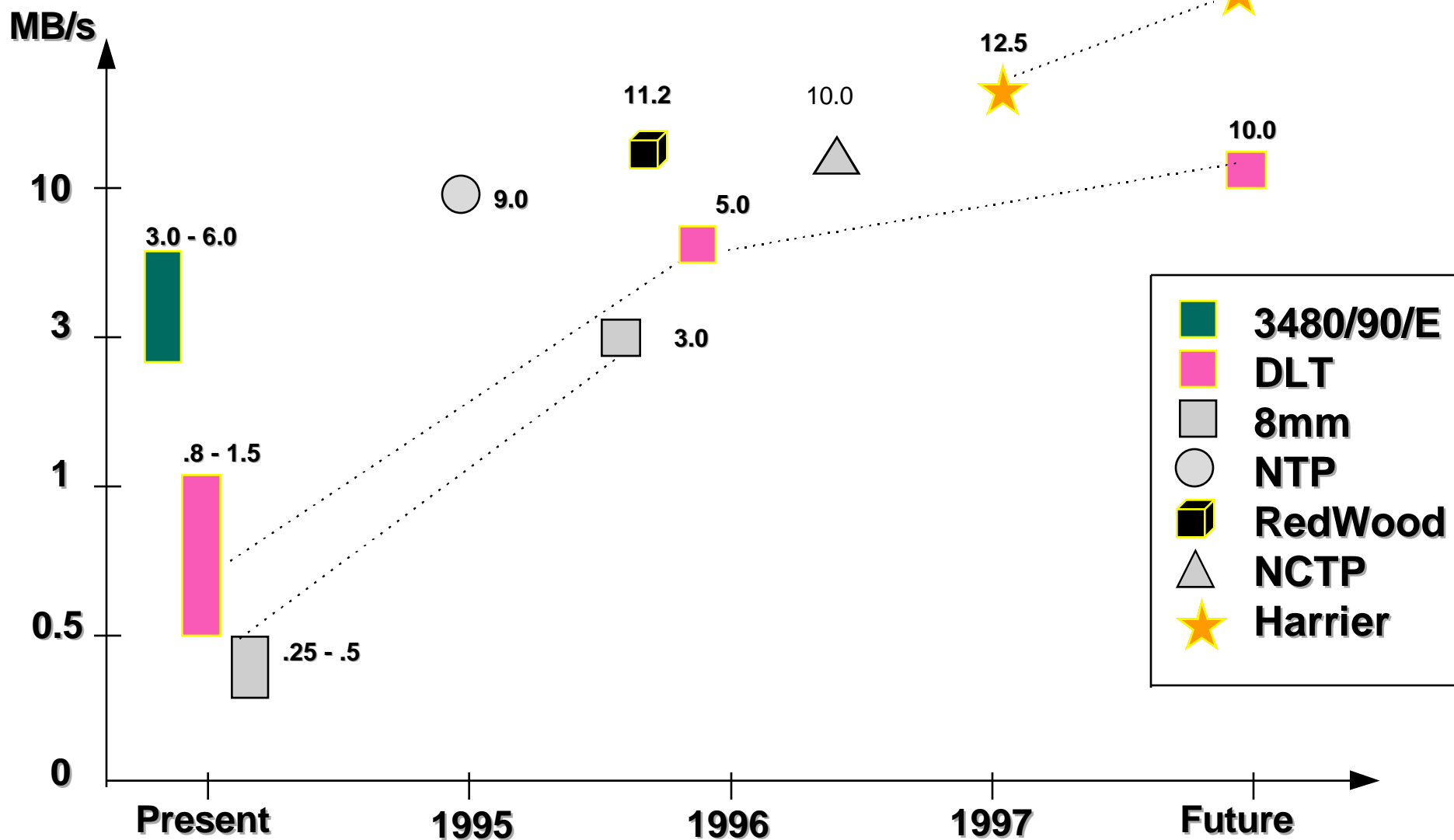
– **Second Source**

Capacity Comparison

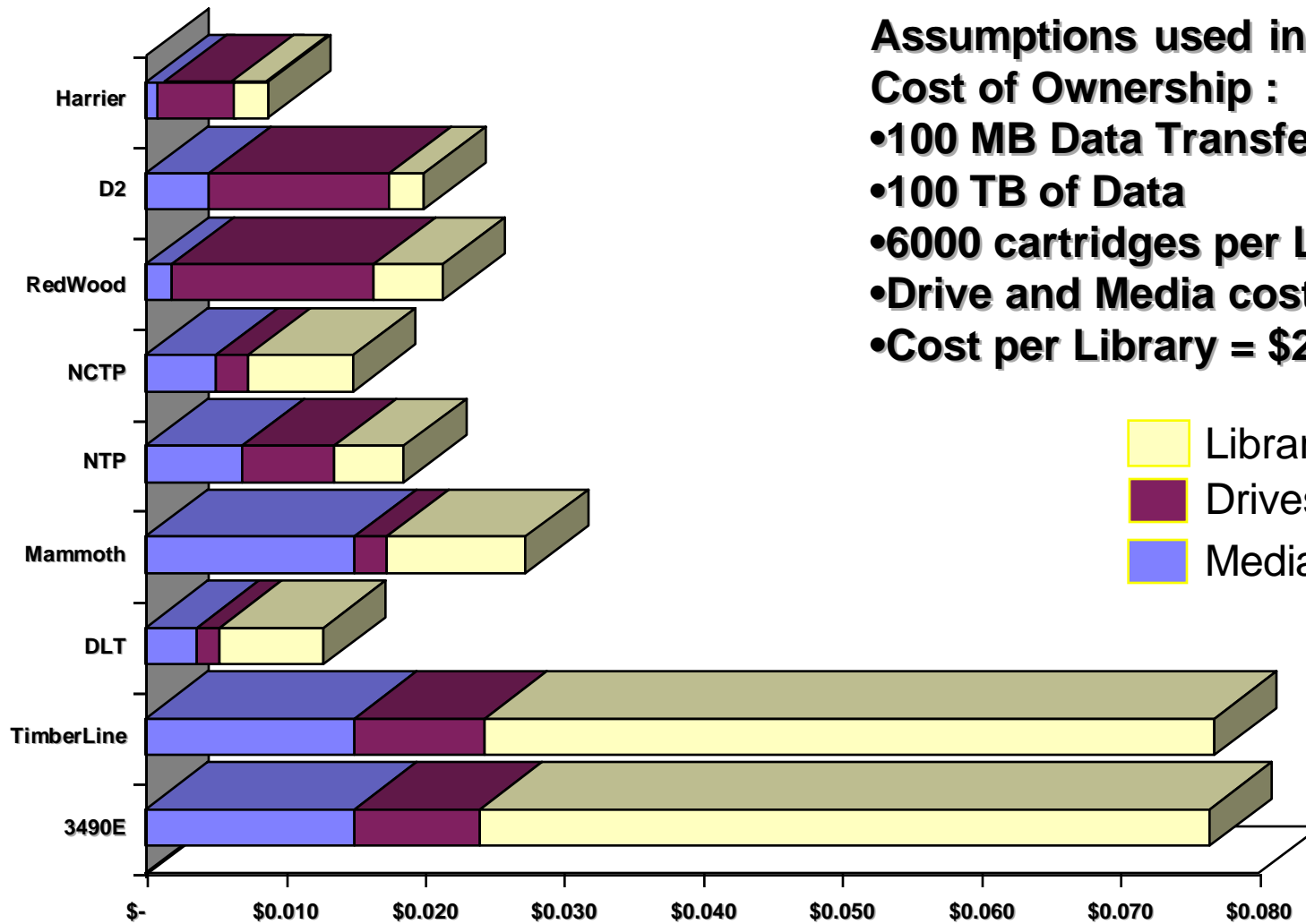


- 3480/90/E
- DLT
- 8mm
- NTP
- RedWood
- NCTP
- Harrier
- Osprey

Data Rate Comparison



User Cost per Megabyte



Assumptions used in calculating Cost of Ownership :

- 100 MB Data Transfer Rate
- 100 TB of Data
- 6000 cartridges per Library
- Drive and Media cost
- Cost per Library = \$250K

Libraries
Drives
Media

Summary

- ★ **Demonstrated Technology**
- ★ **Development & Manufacturing**
- ★ **Complete Storage Solution (Software and Automation)**
- ★ **Support Structure**
- ★ **Marketing Channels**