

**BNL**

**July 9, 2007**



**tapestry300r<sup>®</sup>**  
storage at the speed of light

**InPhase Technologies**

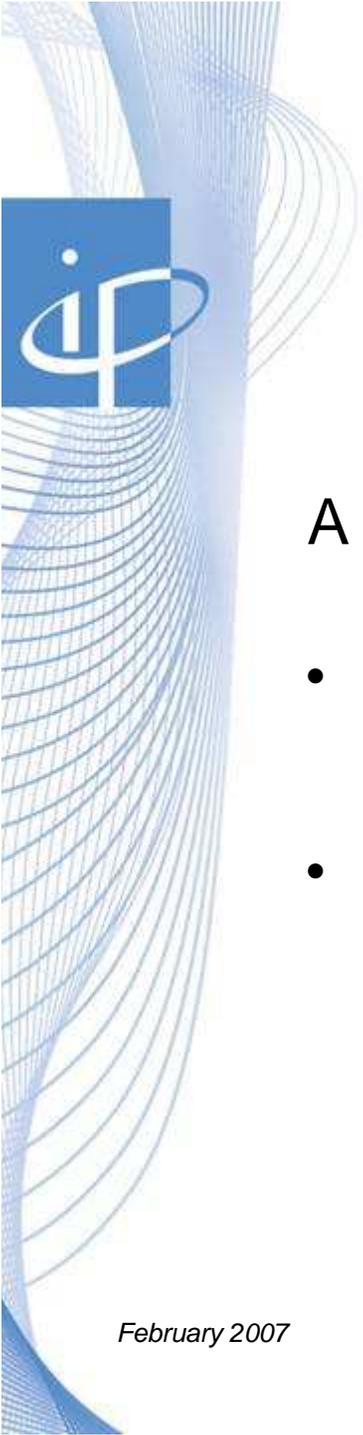
*innovations in holographic storage*

*february 2007*



# World Leader In Holographic Data Storage

- **2007 1st commercial shipments of drive and media**
- Spin off of Lucent's Bell Labs
  - 170+ patents & disclosures in holographic material and recording technology
  - 515 Gb/in<sup>2</sup> aerial density demonstrated in 2006-Q2, highest of any technology
- ~125 employees extensive experience in world-class storage and holography
- Primary supplier of holographic media & test equipment to world-wide optical drive development companies
- Orders in-house from major end-users in storage services, government, broadcast
- Channel development underway
  - Signing OEM and VAR agreements
- Over \$64 million in venture capital funding
  - Corporate investors: Hitachi Maxell, Bayer MaterialScience



# Holographic Data Storage.....

*Unique in **every** way*

A blend of photography and digital recording

- The drive is a digital data-camera that records images of bits
- The media is film-like; but is only sensitive to a particular wavelength – blue laser (405 nm)

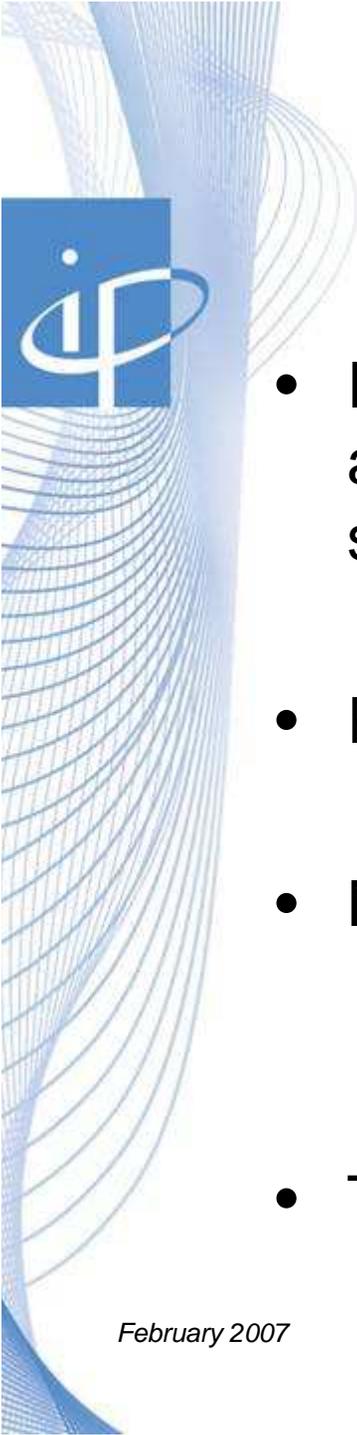
# InPhase Technologies Milestones



## The world's undisputed leader in holographic data storage



- Now a provider of IP, media, and testing equipment to >95% of companies working on holography worldwide.
- World's first broadcast from holographic storage – Turner Broadcast October 2005
- Passed magnetic disk aerial density -515Gb/sq. in., Q1 2006
- 65 patents & 105 applications/disclosures – 170 total



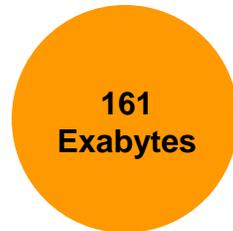
# Holographic storage developers

- Inphase is primary supplier of media, test systems and consulting to other researchers of holographic storage (22 companies)
- Primary focus is on a consumer product
- Major optical companies now investing
  - Daewoo, pioneer, sony, toshiba, fujitsu, JVC, NHK, samsung, sharp, thompson
- Time to market is 3-5 years beyond inphase

# Over 600% data growth 2006 – 2010

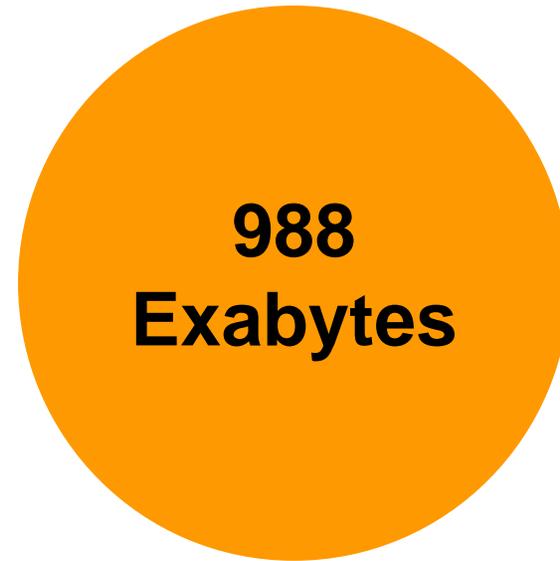
¼ is original – email, transactions, pictures, phone calls

¾ is replicated – emails forwarded, back-ups and archives, movies



**2006**

Stack of books lined up for 1.1 billion miles;  
6 round trips between the Earth & the Sun

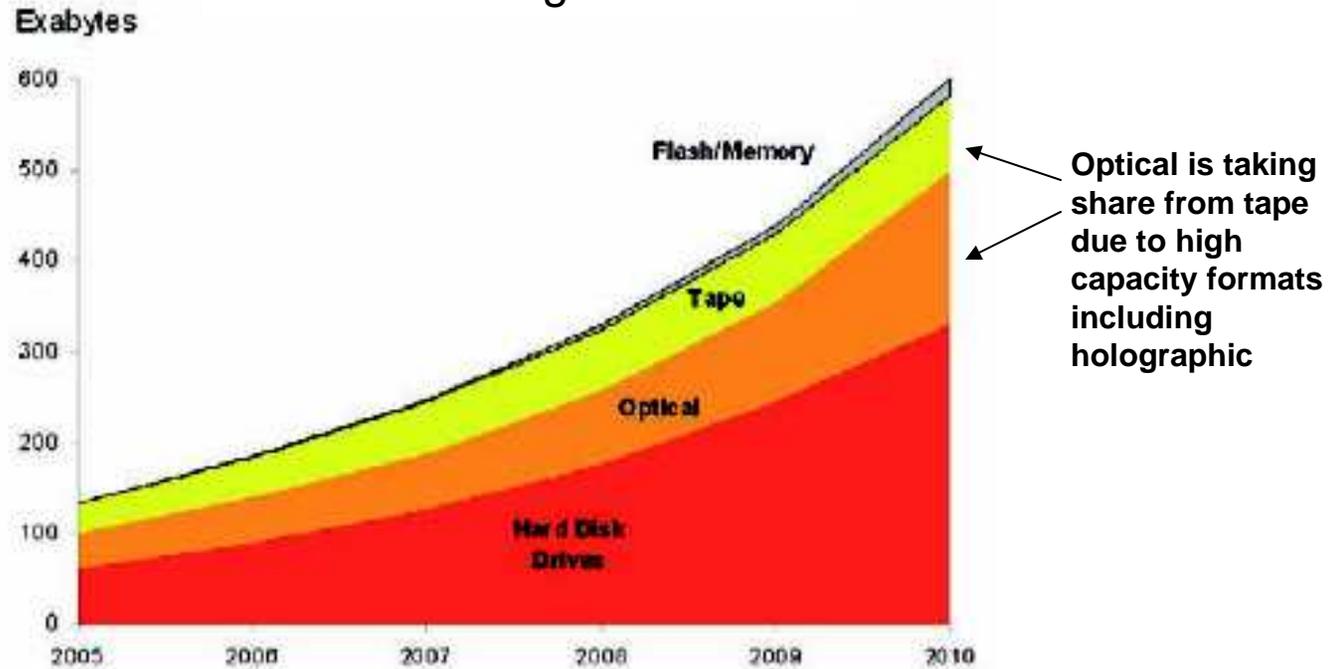


**2010**

Stack of books lined up for 7.4 billion miles;  
round trip from the Sun to Pluto

# Where to put it all?

available storage worldwide



**“One promising next-generation optical storage technology is holographic storage, which promises very stable long term storage in very dense packages. The first commercial holographic products should be available this year.”** IDC

# Archive applications in target markets



**health sciences**

- x-rays, MRIs
- surgical procedures
- pharmaceutical trials
- fixed content

**government**

- national archives
- copyright archives
- space imagery
- surveillance & security
- fixed content

**IT**

- generic archive
- check imaging
- insurance claims
- seismic data
- weather models
- fixed content data

**professional video**

- acquisition
- post production
- digital intermedia
- digital asset management
- deep archive



- SOX
- SEC 17 a-3
- email archives

- HIPAA

- US Patriot Act

# Customer interest



Ford Motor Company



U.S. AIR FORCE



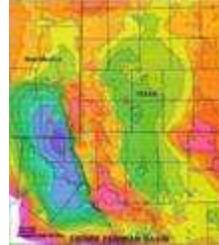
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Over 1200 leads are being qualified

# Characteristics of a holographic storage customer



- Content is the company's asset



**Examples: Geological and seismic data, movies, weather modeling, research data**

- Creation of content is expensive



**Examples: Satellite images, movies, military surveillance, clinical trials**

- Value of content often increases over time

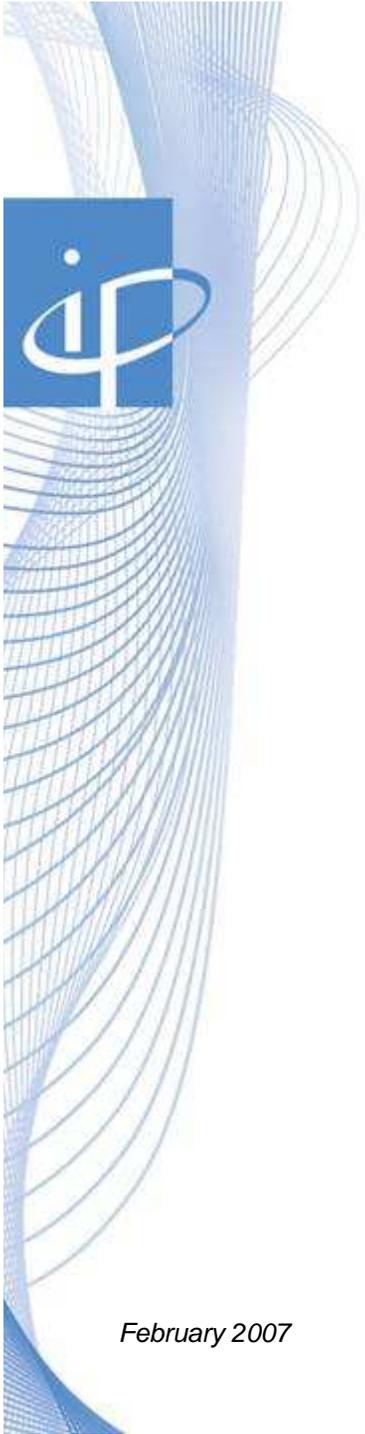


**Examples: Satellite images, movies, medical history, research data**

- Archive expectations are "forever"



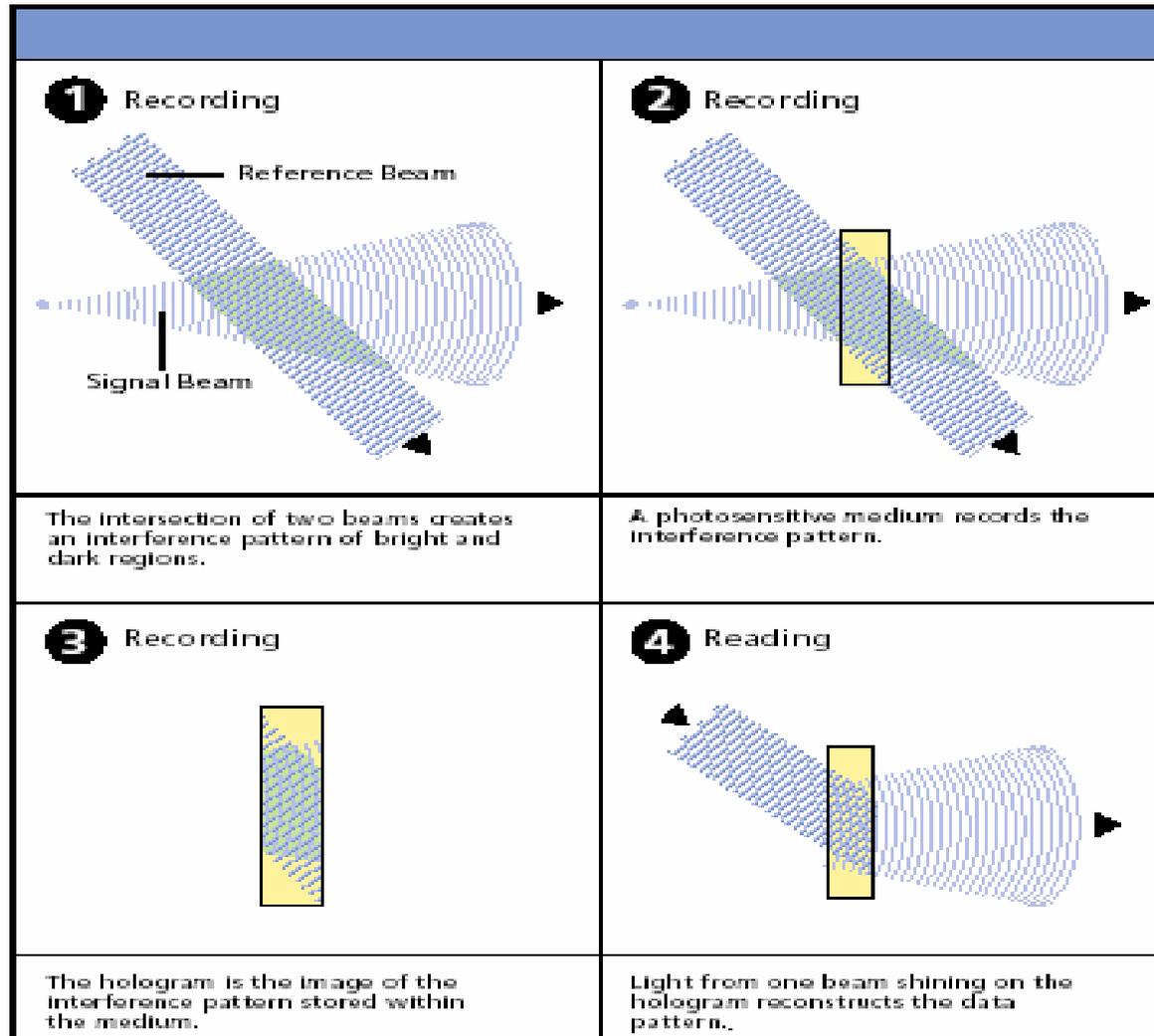
**Examples: Satellite images, movies, news, sports, scientific data**



# Technology/Roadmap

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# Holographic Recording Is Optical Data Storage But In A 3-dimensional Format



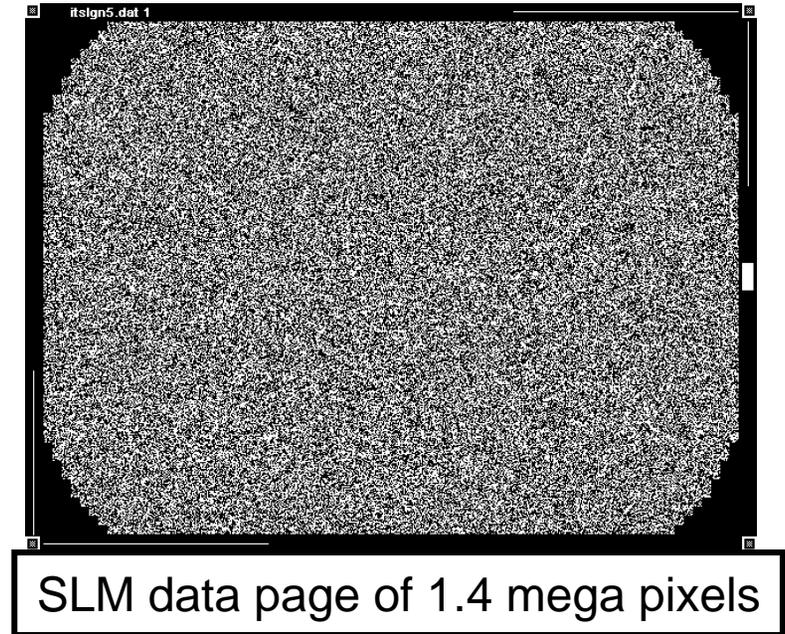
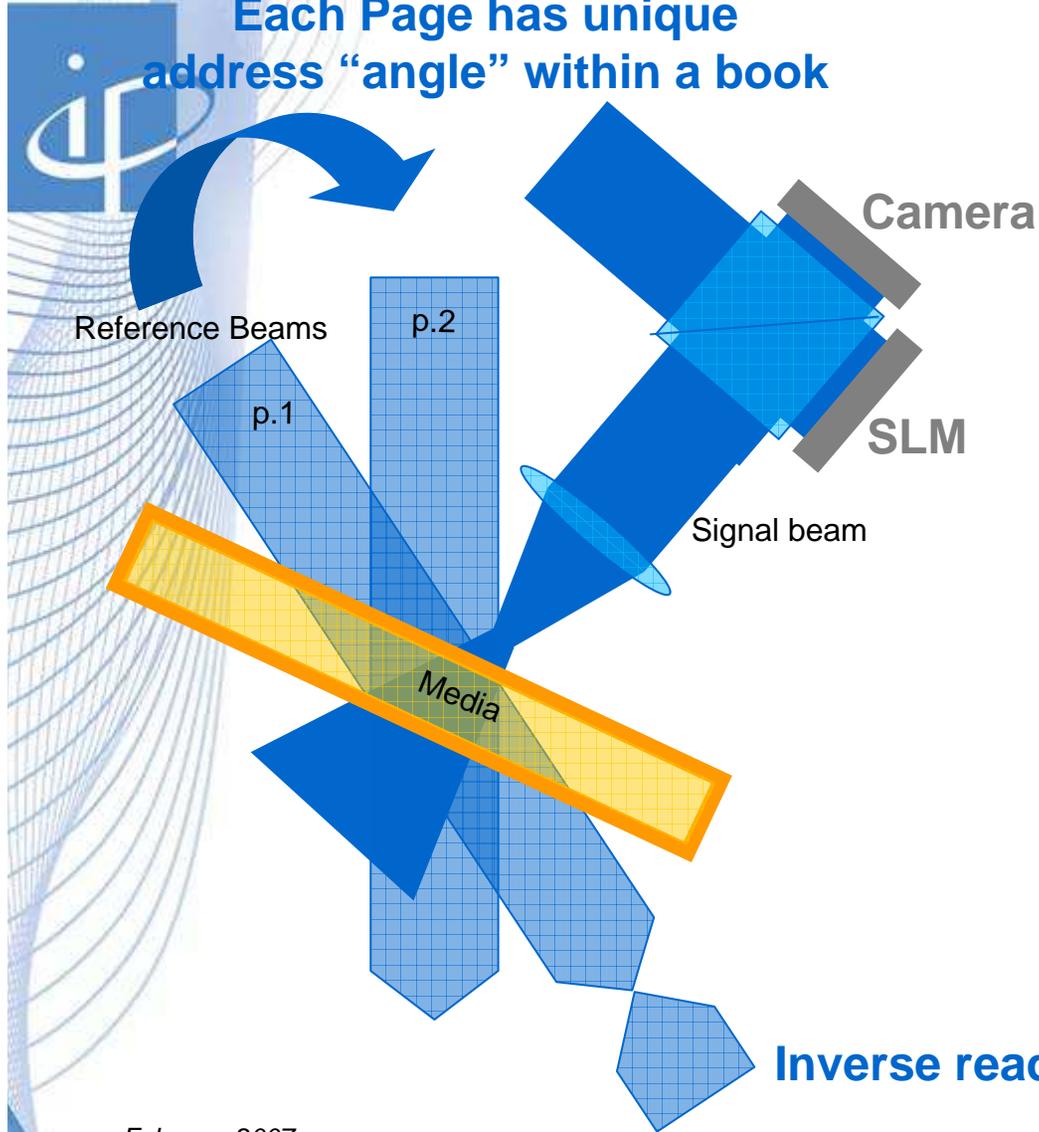
A holographic data page  
(1.4mb) looks like this





# Basic Drive Recording & Recovery Optics

Each Page has unique address "angle" within a book



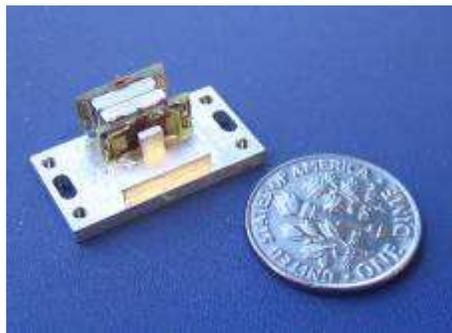
# Key Drive System Components



**Tunable laser 402-408nm**



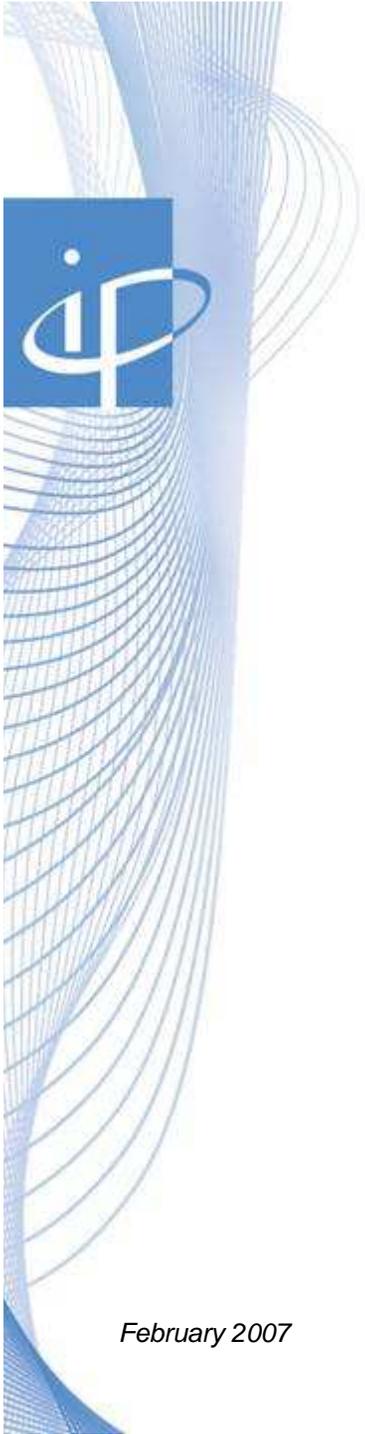
**Custom SLM, 1000 fps**



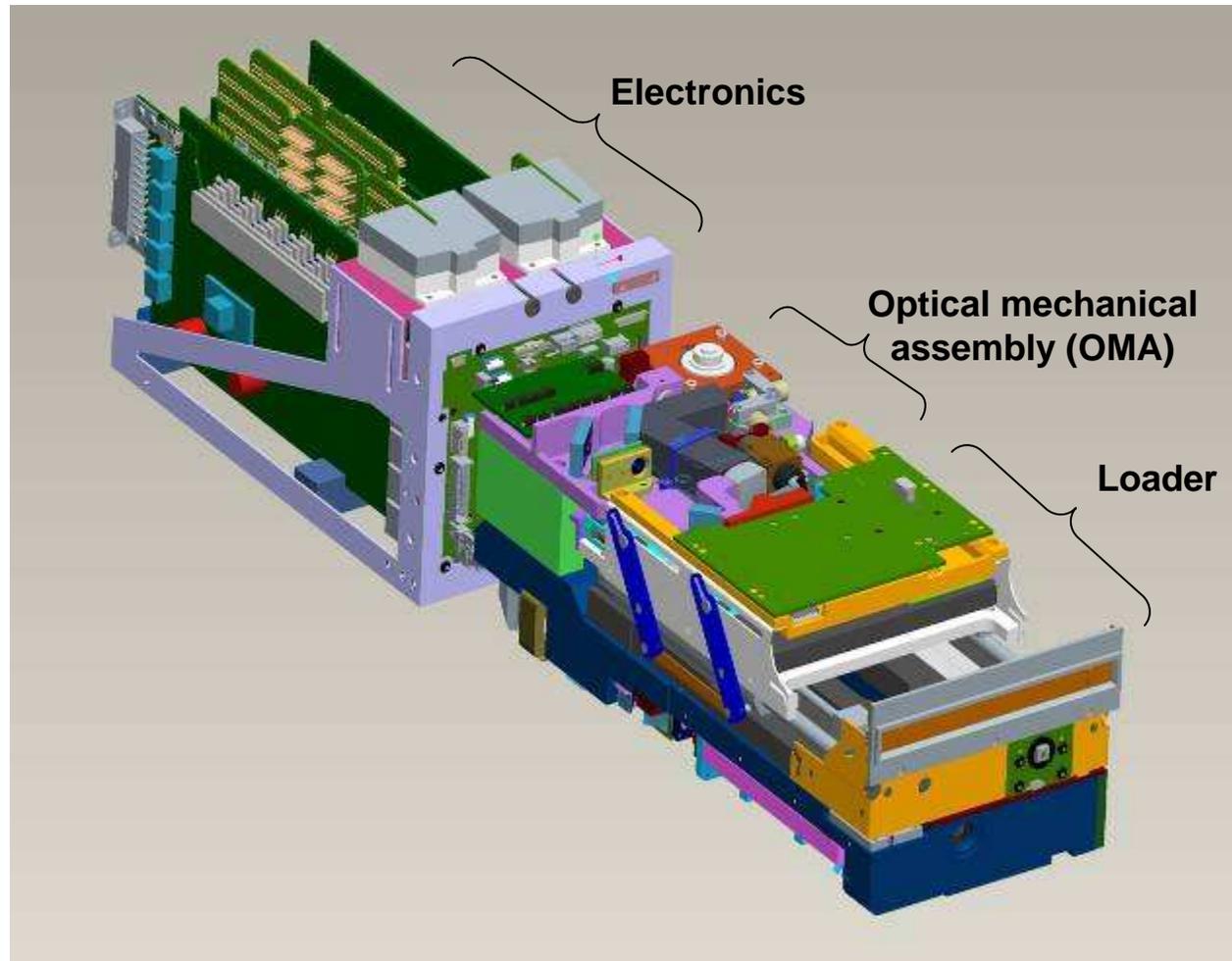
**Custom shutter, 500Hz rep**



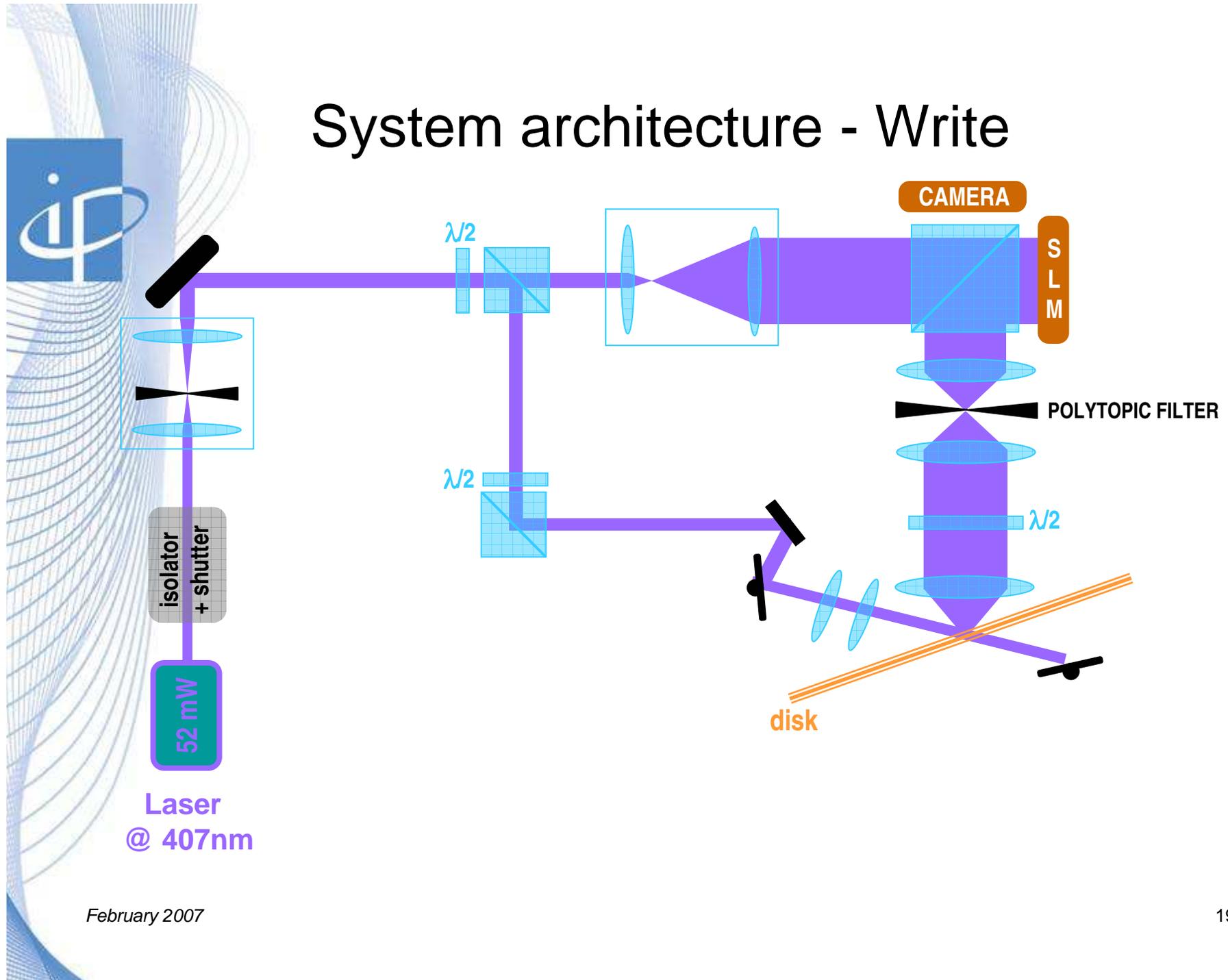
**Custom CMOS camera, 485 fps**



# Drive Overview



# System architecture - Write



# Tapestry™300r

## drive

- capacity - 300GB
- page size - 1.48 millions bits
- book size - 320 pages
- pages per disk - 4.4 million
- laser wave length 405 nm
- transfer rate - 20MBps or 160 Mbps
- avg exposure per page- 1 millisecond
- avg seek time - 250 ms
- bit error rate (BER)  $<10^{-18}$
- form factor: W:5.75", H:4.875", L:27.5"

## media

- write once
- 130 mm disc
- 3 yr shelf life prior to recording
- wave length sensitivity 405 nm
- >50 year archive life
- no special handling required
- 5.31" X 6" X .43"

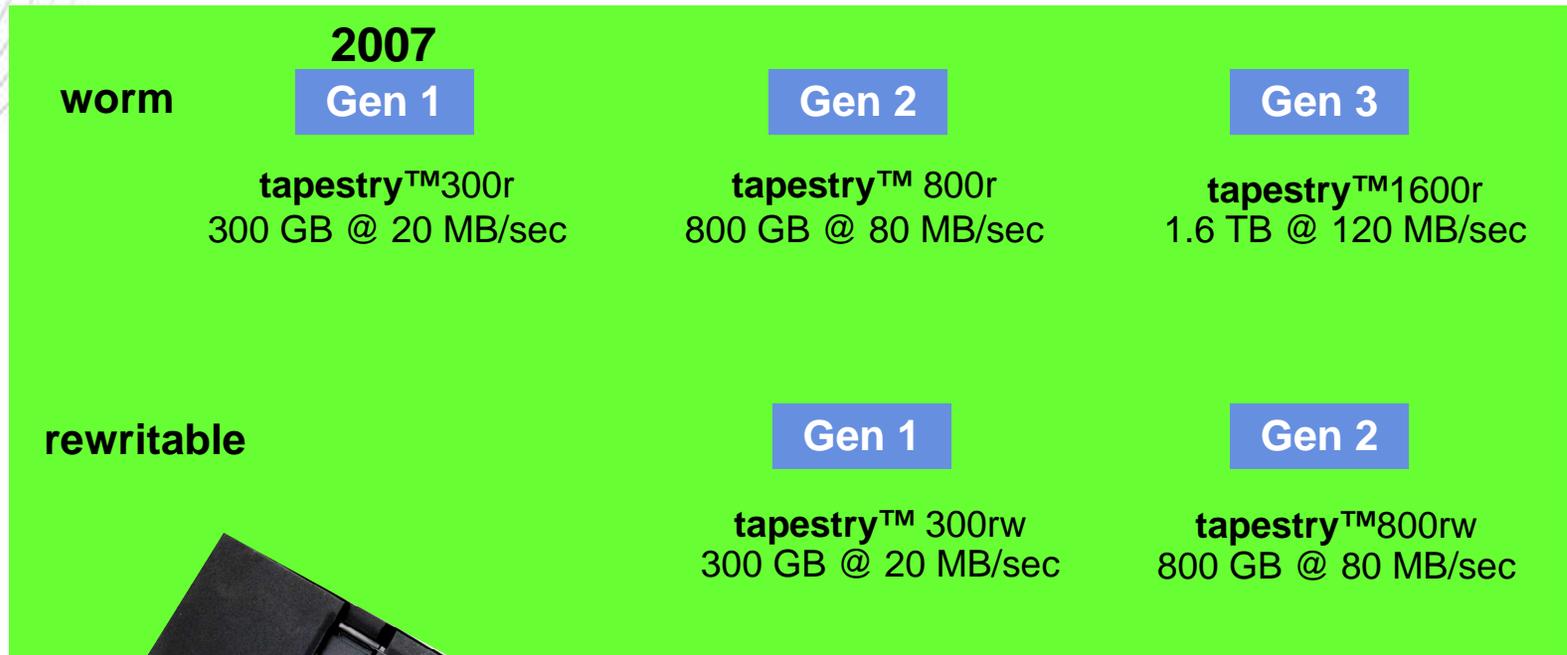
## list prices

drive: \$18,000

media: \$180



# Recordable & rewritable roadmap



rw-drive backward read compatible with r-media  
r-drive backward read compatible for 3 generations  
18 to 24 months between generations  
theoretical maximum of 17 TB

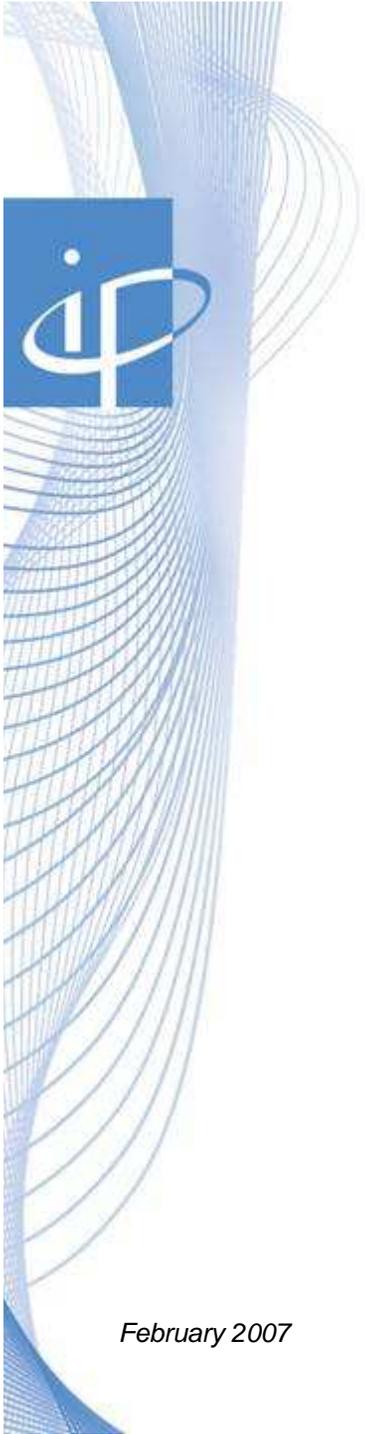


# Customer Interface Solutions

- SCSI Parallel (160/320) – High Density, 68 pin connector
  - HW/SW implemented
- Fibre Channel – 4 Gbps Optical
  - HW implemented
  - SW needs system level qualification
- Gig-E
  - HW implemented
  - SW needs system level qualification
- Serial Attached SCSI (SAS)
  - HW implemented

# ISV Compatibility

- 
- WORM, Magneto Optic
    - Pegasus: Investor4, Windows 2000 Platform, Adaptec HBA
  - LTO
    - CA: BrightStor ARCserve Backup
    - EMC: Retrospect v7.5
    - Oracle: Secure Backup
    - QStar: HSM
    - Software Architects: DataSaver Ver. 2.0.1
    - Veritas: Backup Exec
  - NEXT
    - Bridgehead, Symantec, Masstech, Avalon, SGL Flashnet, Schlumberger, Commvault, Meditech, Chartmaxx and McKesson



# Automation

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up to 675 TB in one  
library

- Focus on the high end professional optical market
- Provide libraries to leading companies worldwide

Credit lyonais, daimler chrysler, development bank singapore,  
deutsche bank, nestle, philips healthcare, siemens medical,  
swissair, t-mobile, and volkswagen

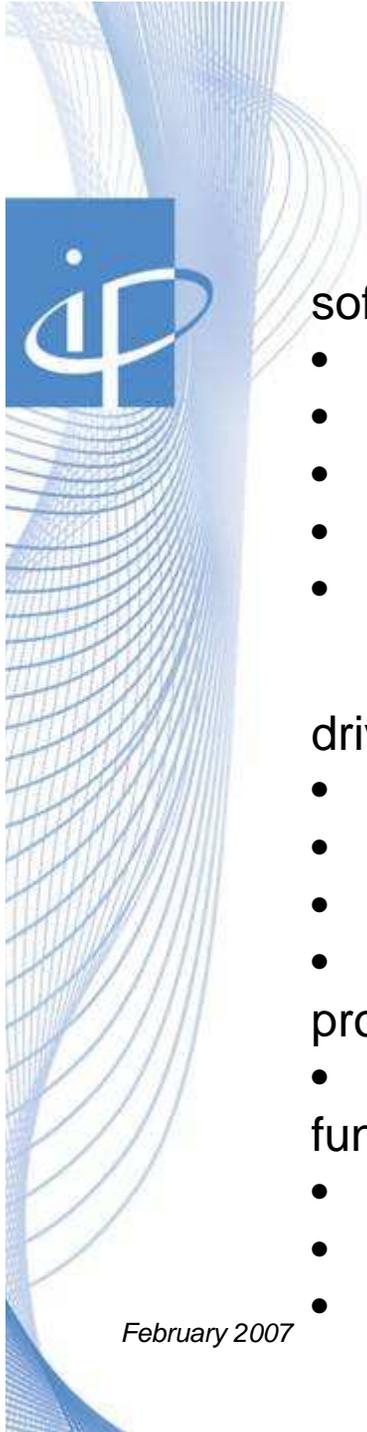
# Disc library



- 200 to 2250 cartridges (675 TB)
- Focus on the high end professional optical market
- Provides libraries to leading companies worldwide

Credit lyonais, daimler chrysler, development bank singapore, deutsche bank, nestle, philips healthcare, siemens medical, swissair, t-mobile, and volkswagen

February 2007 MSRP \$56K to \$208K



# Disc library

## software Support

- Compaq Tru64
- HP-UX
- IBM-AIX
- IBM OS/2
- Linux
- Macintosh
- WinNT/2000/2003
- Novell NetWare
- SGI Irix
- Sun Solaris

## drive management ports

- custom serial port
- usb
- ethernet
- native

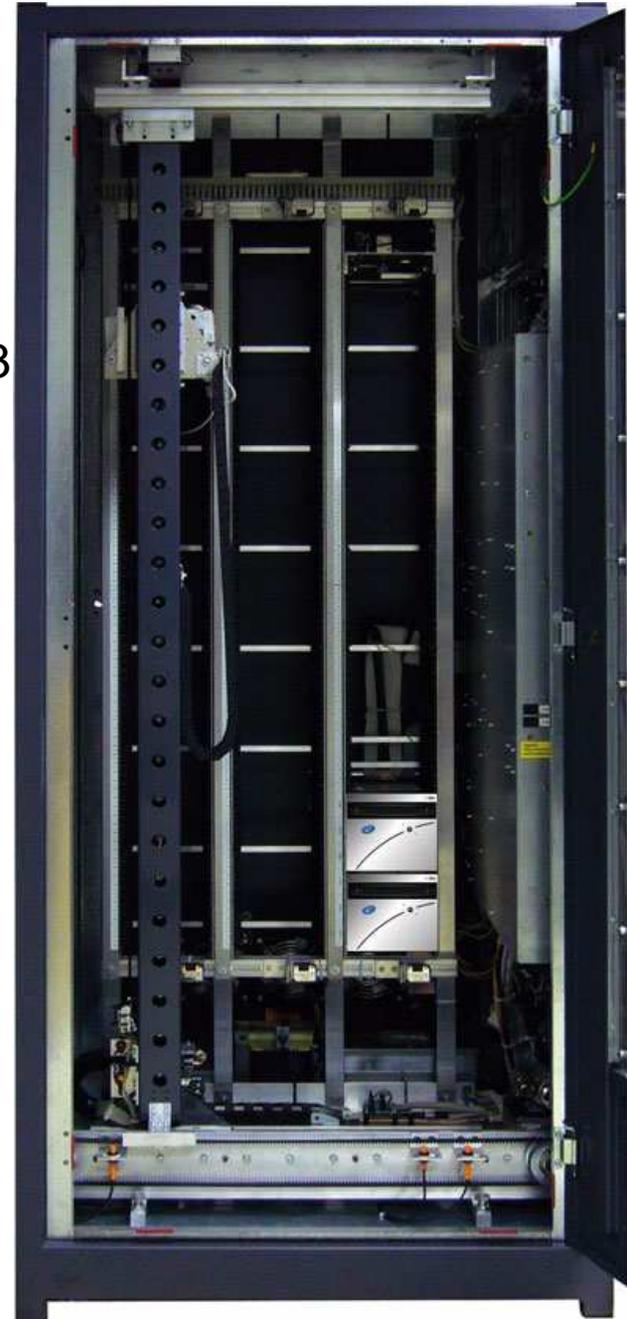
## protocols

- snmp

## functions enabled

- drive/media health checks
- commanded diagnostics
- statistics/error logs

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# Rackmount unit



- 15 slots
- Single drive (1<sup>st</sup> generation)
- Single picker (autoloader operation)
- LVD SCSI Interface

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Q2./2007, HS

InPhase Proprietary

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15.June.2007

# Holographic Library – TERASTORE

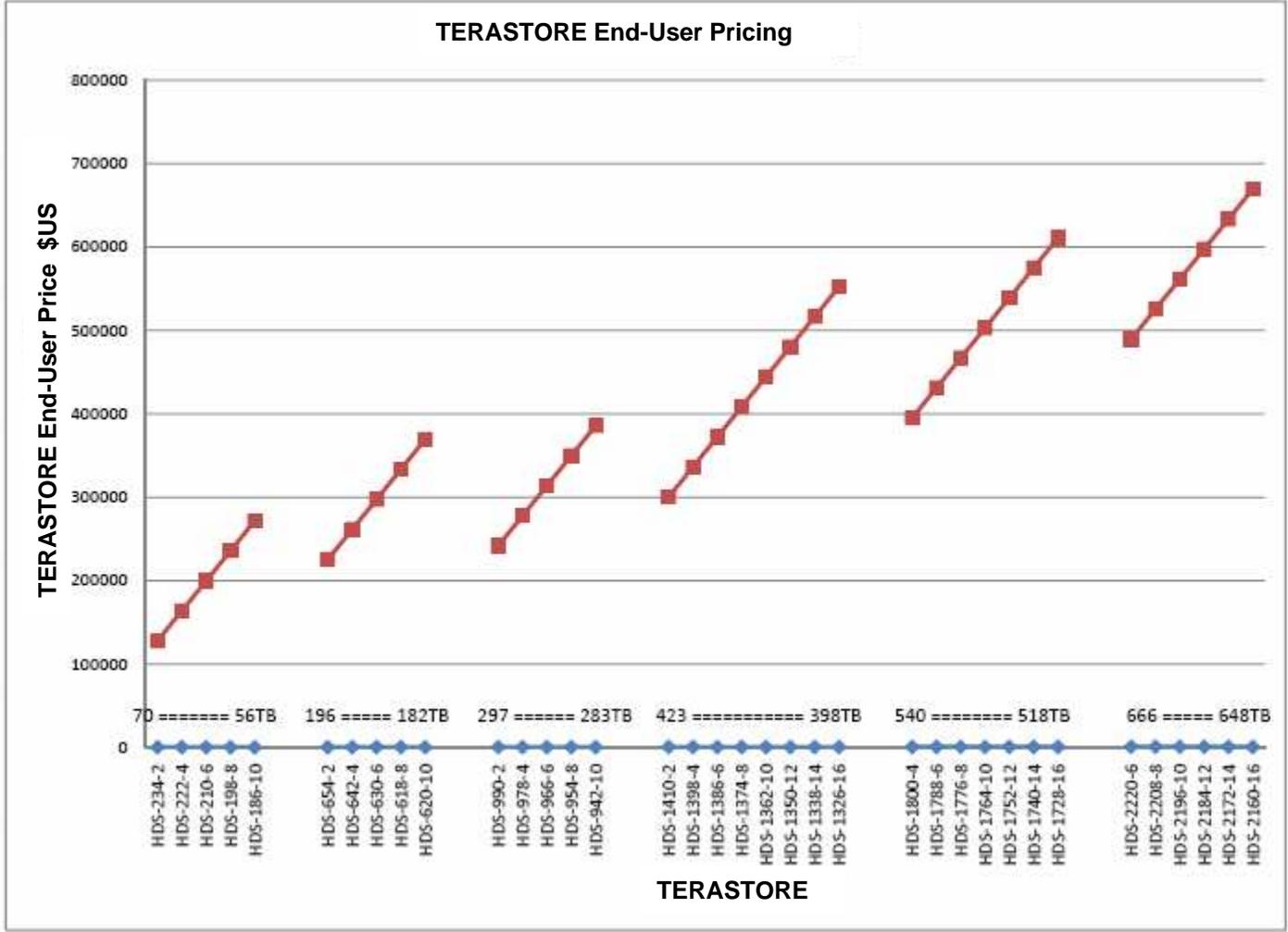


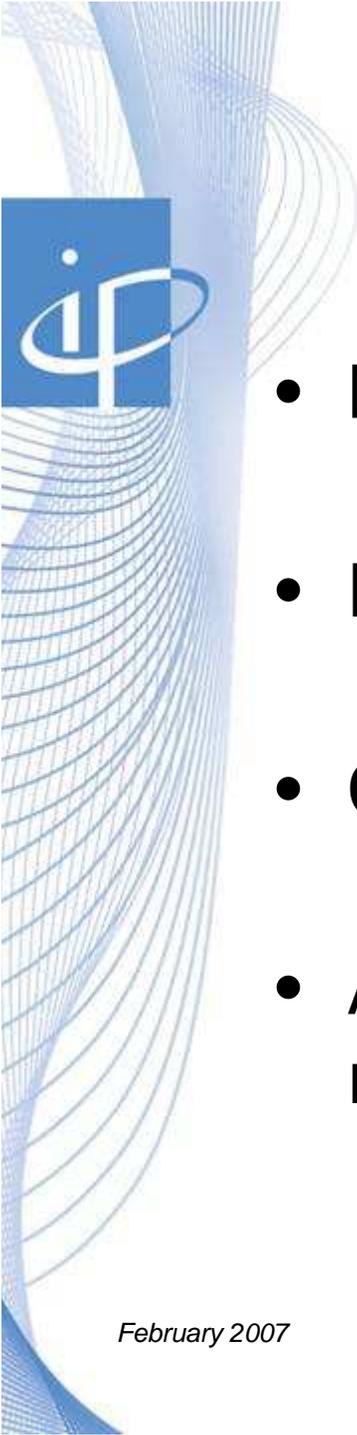
Cartridge type library - InPhase **tapestry300r**<sup>TM</sup> drives

Model	Capacity	Configuration	Layout	\$/GB*
7100	56 – 70TB	2-10 drives		1.8
7200	182 – 196TB	2-10 drives		1.1
7300	283 – 297TB	2-10 drives		0.7
7400	398 – 423TB	2-16 drives		0.7
7500	518 – 540TB	4-16 drives		0.7
7600	648 – 666TB	6-16 drives		0.7

\* \$/GB is calculated using the list price of the library and **tapestry300r** drives – media is not included

# Pricing



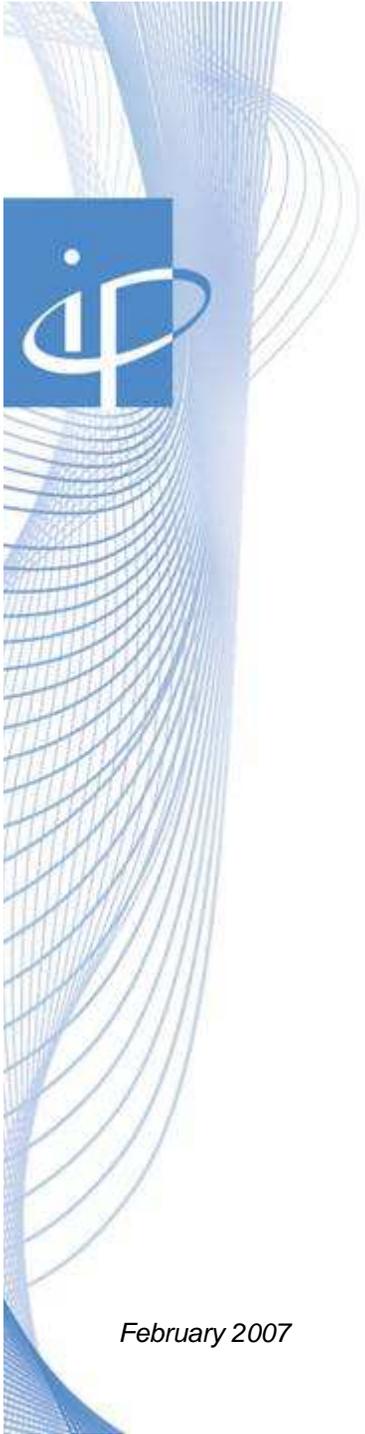


## Frequently asked questions

- MBTF of drive?
  - 100,000 hours
- Drive load/unload cycles?
  - 250,000
- Cartridge loads?
  - 20,000
- Avg. access latency in library (mount request to data access)?
  - 8-11 seconds, dependent on library size

## FAQ continued

- Is access time longer with LTO emulation?
  - No
- Can Gen 2 drives read Gen 1 cartridges at the higher speed of 80 MB/Sec?
  - Yes
- Do you experience tape like “shoe shining” during non-streaming operations?
  - No
- How can you physically destroy the media?
  - CD shredder or incineration



# Competitive Landscape

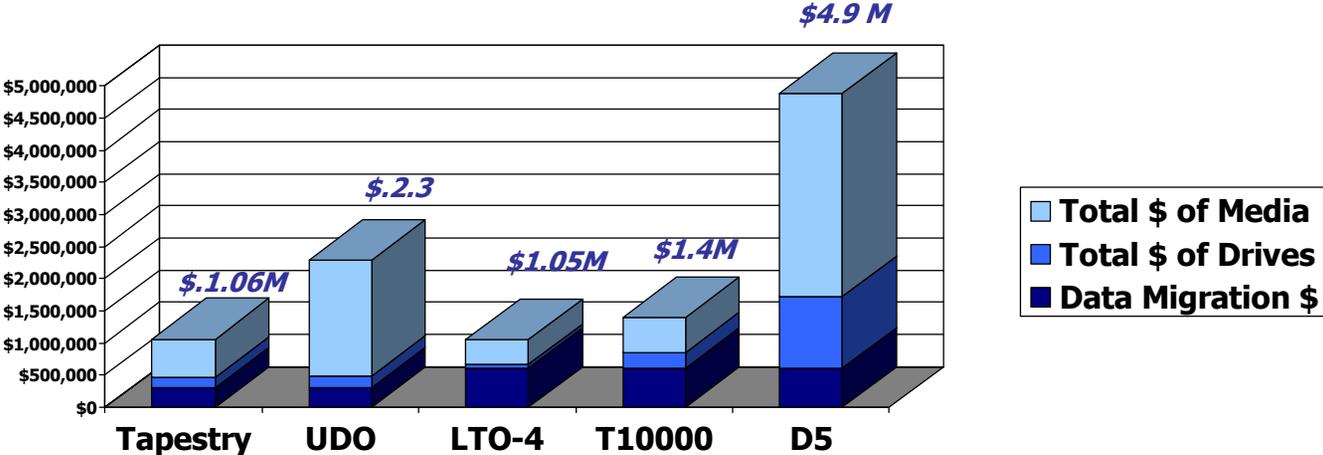
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# Competing technologies

Blue boxes with a ✓ indicate the technology is competitive in archive market

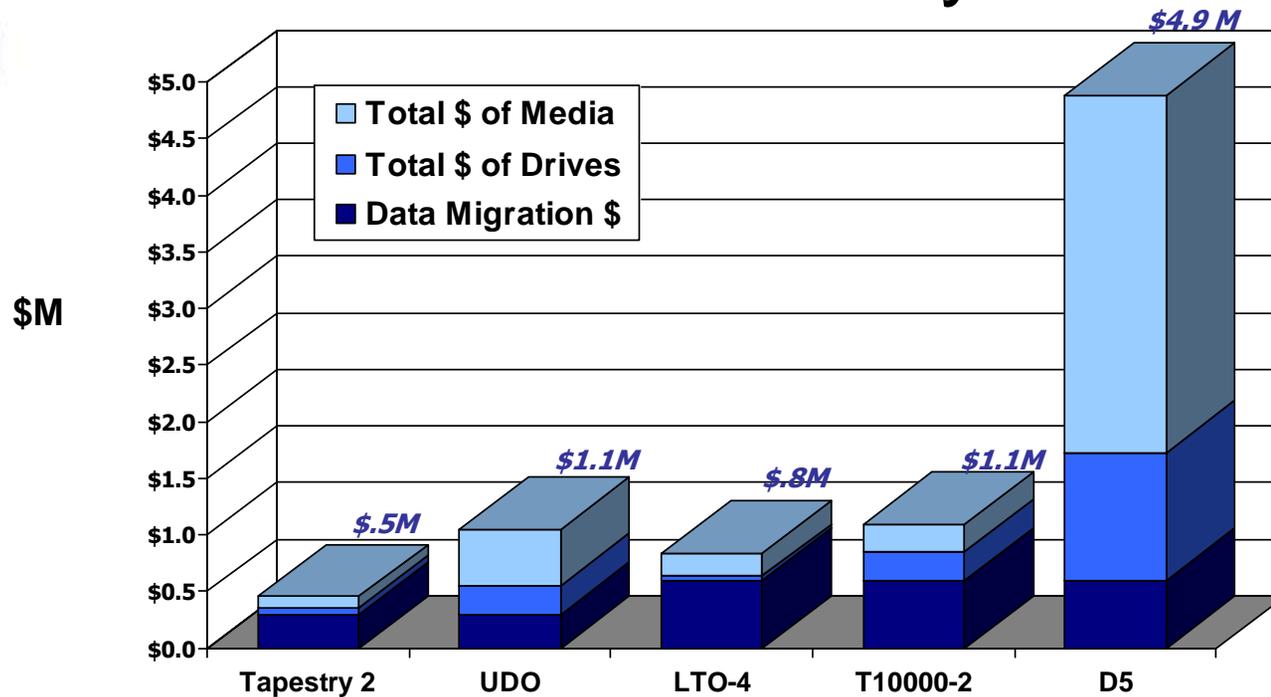
attribute	tapestry	blue laser optical*	data tape	hard disk	video tape
capacity roadmap	✓ 300GB - 1.6 TB	15 – 100 GB	✓ 100GB – 1.6 TB	✓ 18GB ->1.5 TB	1 – 251 GB
transfer rate roadmap	✓ 20 – 120 MB/s	4-12 MB/s	✓ 20 – 120 MB/s	✓ 40-150 MB/s	3 – 25 MB/s
media archive life	✓ 50 yrs	✓ 20 yrs	7-10 yrs	5 yrs	7 yrs
low media price	✓ \$.06-.20/GB	\$1.00/GB	✓ \$.25-1.00/GB	<\$3.00 GB	\$1- 3.00/GB
media handling issues	✓ office environment	✓ office environment	Temp & RH controls	Must spin-up drive periodically	Temp & RH controls
physical WORM	✓ Yes	✓ Yes	no	no	no
random access	✓ Yes	✓ Yes	no	✓ Yes	no
head contact on write/read	✓ no	✓ no	Yes	Yes	Yes
hw security features	✓ optical encryption	none	none	✓ Yes	none

# TCO for 500TB for 25 years



Assumptions	Tapestry	UDO	LTO-4	T10000	D-5 Video Tape
Capacity	300 GB	30 GB	800 GB	500GB	158GB
Media Migration	2 times	2 times	4 times	4 times	4 times
Total Media used	3,333	33,333	2,500	4,000	12,660
Media Price	\$180	\$54	\$150	\$135	\$250
Drives used	9	39	9	9	32
Drive Price	\$18,000	\$2,960	\$8,2930	\$32,000	\$35,000
Data Migration\$	\$300K	\$300K	\$600 K	\$600 K	\$600 K

# TCO for 500tb for 25 years



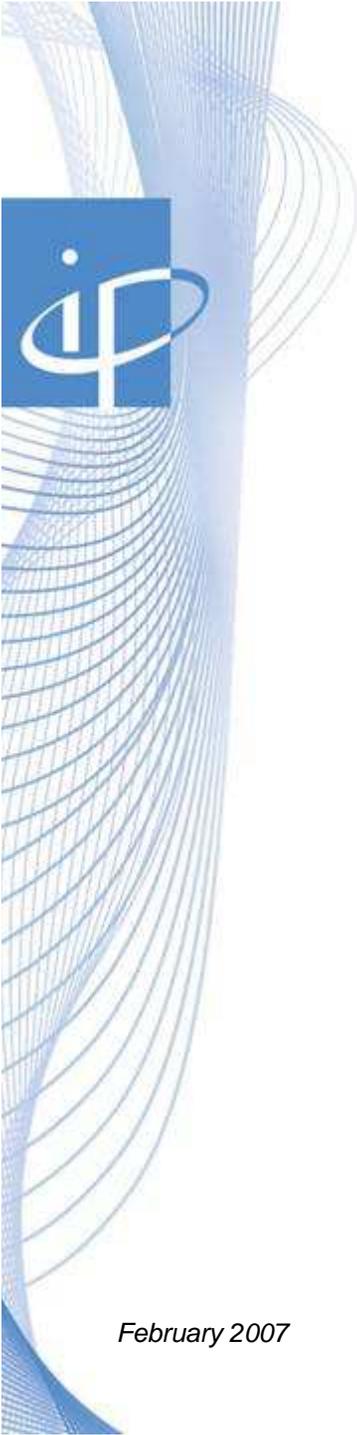
Assumptions	Tapestry 2	UDO-3	LTO-4	T10000 -2	D-5 Video Tape
Capacity	800 GB	120 GB	800 GB	1 TB	158GB
Media Migration	2 times	2 times	4 times	4 times	4 times
Total Media used	1250	8333	2500	2000	12660
Media Price	\$80	\$60	\$80	\$120	\$250
Drives used	9	39	9	9	32
Drive Price	\$6,000	\$4,000	\$4,000	\$32,000	\$35,000
Data Migration\$	\$300K	\$300K	\$600 K	\$600 K	\$600 K

# Media archive & handling characteristics



	video and data tape characteristics	tapestry™ media advantages
<b>archival life</b>	3 – 10 yrs	50 yrs
<b>head/media interaction</b>	media wear out	media has no physical contact with head
<b>special handling</b>	<ol style="list-style-type: none"><li>1) Store at recommended temp</li><li>2) Keep evenly wound</li><li>3) Store upright</li><li>4) Fasten loose end to reel</li><li>5) Rewind every 3 years</li><li>6) Protect from magnetic field</li><li>7) Allow 24 hours for climate change</li></ol>	store at room temperature

Source: Sony, InPhase



# Features meet customer requirements

- **High capacity & performance**
  - Massive data repositories; hundreds of TB to pbs per year; streaming data
- **Long archival life**
  - 50 -100 years
- **Robust content protection & security**
  - Write once read many (WORM) media
  - Drive based optical encryption
- **Random access to data**
  - Millisecond recovery; true near-line capability
- **Excellent total cost of ownership**
  - Low cost media
  - Reduced migration frequency
  - Low power consumption