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THIC Inc.

The Premier Advanced Recording Technology Forum

**Professional Optical Data Storage - As Viewed From A
Consumer Electronics Perspective.**

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**Presented at the THIC Meeting at the STK Bldg 8
Auditorium, 1 Storage Tek Dr, Louisville CO 80027-
9451**

July 22 - 23, 2003

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22/07/2003 THIC Meeting, Louisville, CO, USA.

Consumer & Professional Applications.

Static	Optical libraries (5¼"). HDTV editing.	A/V recorders. PC drives.
	HDTV camcorders. Data logging.	Cameras/camcorders. PDAs/Laptops.
Portable	Professional	Consumer

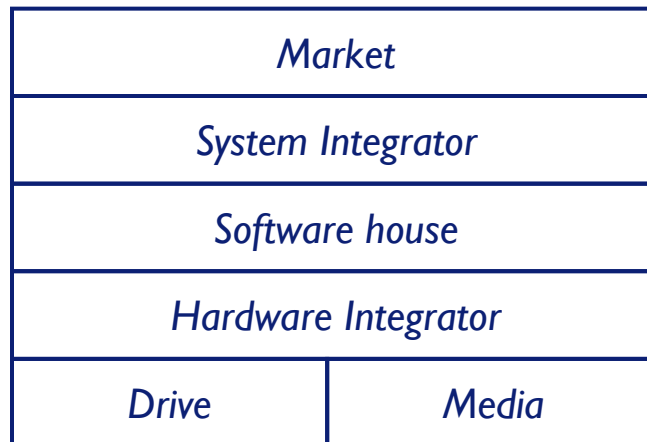
The Data Storage Pyramid.

Classification	Capacity	Access time	Category
Primary memory	Up to 4GB	RAM	2.5-10ns
	40GB-TB's	HDD RAID	8-10ms
Secondary memory	2.6GB-9.1GB	MO/WORM	30-45ms
	650MB-8.56GB	CD/DVD	80-300ms
	50GB-TB's	MO/CD/DVD Optical libraries	2.5-30s
	TB's	Tape libraries	15s-15m
	>200 GB	External exchange media	>5m
			Offline memory

Professional Mass Data Storage Landscape.

- *Systems usually have to be transparent to users.*
- *Regulatory approval sometimes required.*
- *Reliability.*
- *Robustness.*
- *Long data retrieval lifetimes.*
- *Backwards compatibility.*

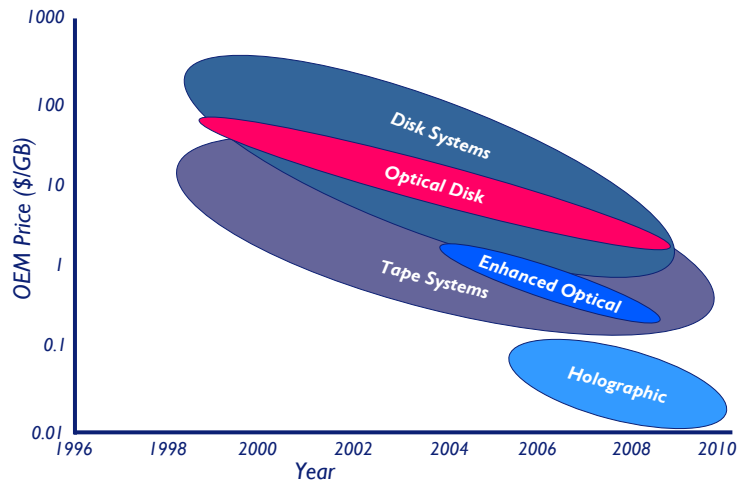
The Professional Mass Storage System Model.



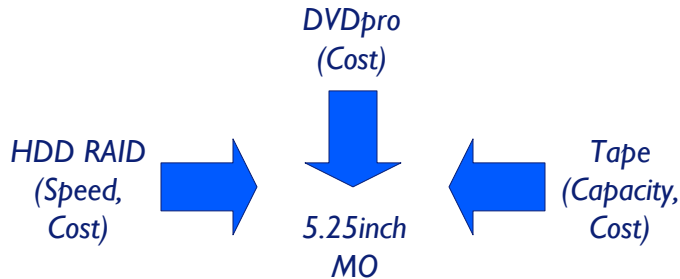
Professional Mass Data Storage Technology.

- **HDD RAID systems.**
 - Enterprise mirrors, high-medium cost/GB, fast data rates, faulty disks hot swappable, organically expandable (EMC Centera is eWORM, 4.8-153TB).
- **Automated optical libraries (-5.8TB).**
 - Enterprise back-up, high-medium cost/GB, medium capacities, slow data rates, faster media transport & seek times.
- **Automated tape libraries (1-50TB).**
 - Enterprise back-up, low-medium cost/GB, respectable data rates, slower media transport & seek times, media maintenance.

Storage System Price Trends.



Pressure on 5.25inch Optical Libraries.



- Higher density (increased capacity) required to compete with DVDpro and tape on cost/GB.
- Higher data rates (>200Mb/s) required to compete with HDD and tape.

Go Blue*: UDO and V-disk.

- | | |
|---|---|
| <ul style="list-style-type: none"> • UDO (Plasmon). • 5.25inch disk in cartridge. • 30GB per disk, 60GB & 120GB on road map. • 8MB/s (64Mb/s) read, 4MB/s (32Mb/s) write. • 80MB/s ultrawide SCSI interface. | <ul style="list-style-type: none"> • V-disk (Sony). • 12cm disk in cartridge. • 23.3GB per disk, 50GB & 100GB on road map. • 11MB/s (88Mb/s) read, 9MB/s (72Mb/s) write. • 160MB/s ultrawide SCSI interface. |
|---|---|

*Blu-Ray
associated
technology.

Other Technologies.

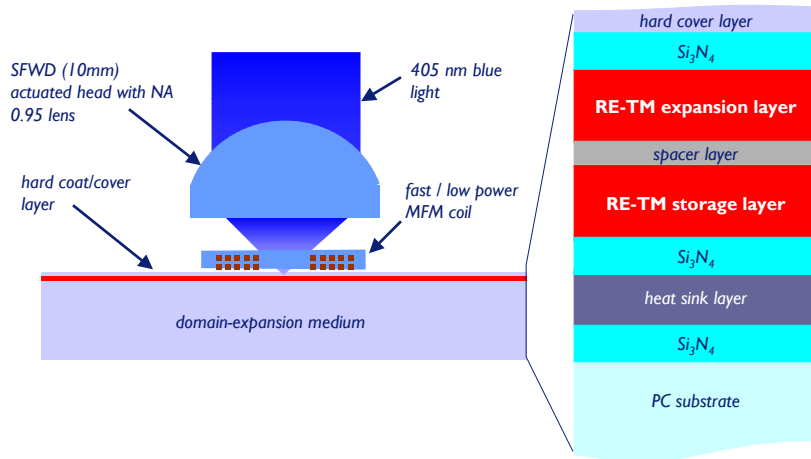
- *Multi-level.*
- *Multi-layer.*
- *2DOS.*
- *SuperRENS.*
- **DomEx (MAMMOS, DWDD).**
- *Holography.*

Applying DomEx to 5.25inch MO.

- **5.25inch MO technology delivers:**
 - “14x” 9.1GB disk capacity.
 - 50Mb/s data rate.
- **DomEx technology could deliver:**
 - Up to 150 GB* per disk (32days full body MR).
 - >200Mb/s* data rates.

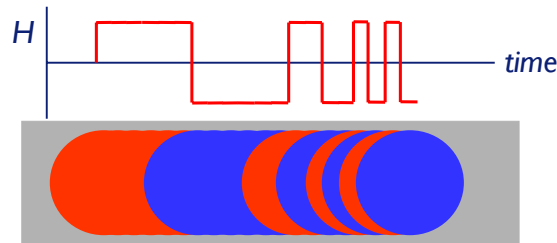
**Demonstrated experimentally.*

Blue First-surface MAMMOS* Recording.



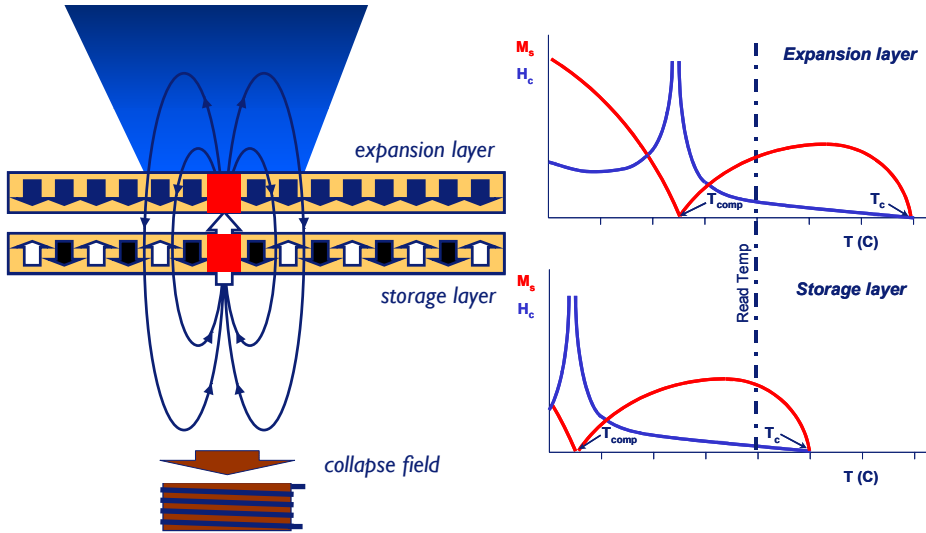
*Magnetically AMplified MO System.

Writing at High Density with MO.

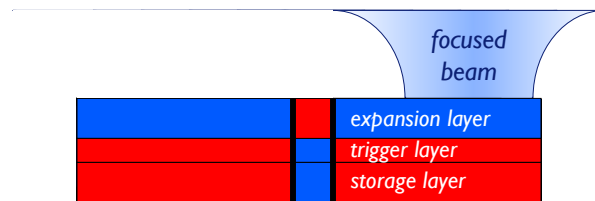


- LP-MFM: laser pumped – magnetic field modulation.
- Marks (much) smaller than given by the diffraction limit.
- Crescent-shaped domains written when laser pump rate increased.
- DomEx read-out schemes used for reading marks small marks.

RF-MAMMOS – Mark.

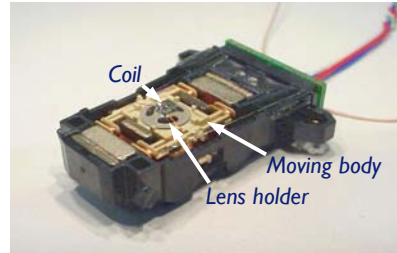
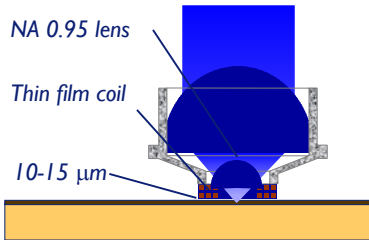


ZF-MAMMOS read-back mechanism.



- External magnetic field NOT required.
- Bit copied through exchange coupled trigger layer.
- Heat decouples trigger layer from storage & expansion layers.
- Expansion driven by balance of stray fields from neighbouring bits and demagnetising field from expanded domain.
- Collapse driven by stray field from current bit.

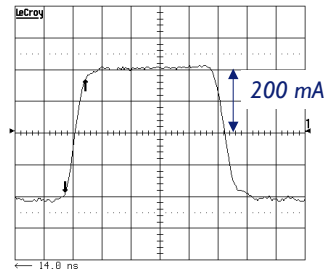
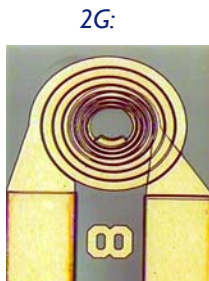
Small Free Working Distance Actuated Head.



- High bandwidth DVD actuator.
- Red NA 0.65 lens replaced with blue ($\lambda=405\text{nm}$) NA 0.95 lens.
- Thin film coil placed between lens and media.
- Lens wave-front aberration $< 30\text{m}\lambda$ rms.



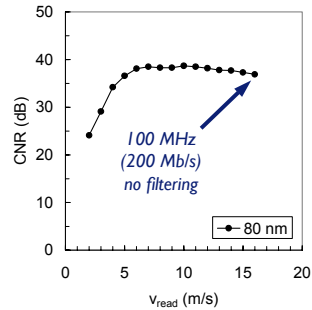
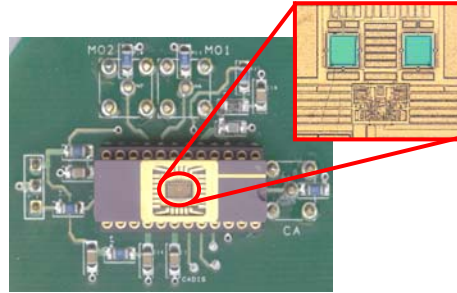
High Data Rate Integrated MFM Coil.



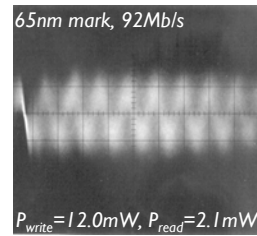
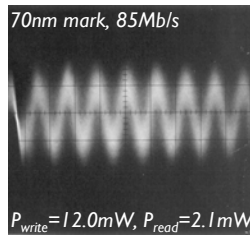
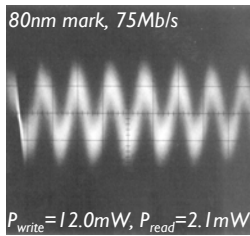
- Optimal for $0.7 < \text{NA} < 0.95$ lenses.
- Low inductance, good heat transport design.
- Magnetic field rise time 3.5 ns with coil driver.

MO-PDIC.

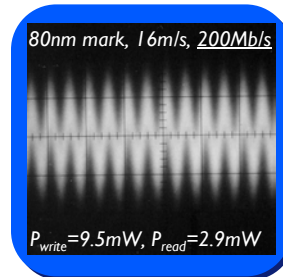
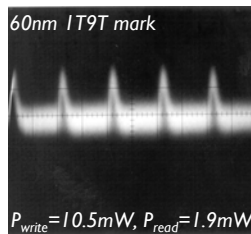
- Photo detectors integrated with pre-amplifier.
- 200MHz or 300 MHz bandwidths, 68 dB gain.
- 1.7ns expansion rise times measured.
- 100MHz (200Mb/s) read-back performed with 80nm carrier (200MHz b/w).



ZF-MAMMOS Carrier Signals.



- $NA=0.95, \lambda=405nm.$
- $V_{write}=2.5m/s,$
 $V_{read}=6.0m/s.$
- Signals low-pass filtered with 80 MHz BW.



Benefit of DomEx MO 5.25inch.

- *Competitive cost/GB with DVDpro.*
 - *Due to >10Gb/in² density.*
- *Quadrupled data rates (>200Mb/s).*
- *Maintain:*
 - *Overwriteability.*
 - *Long term data stability.*
 - *Media access & file seek times.*
 - *Robustness*
 - *Cartridge compatibility.*
 - *Cartridge selling price.*

Summary.

- *Many alternatives exist for professional mass data storage.*
- *The 5.25inch optical library market is under pressure.*
- *DomEx MO could complement other technologies for future 5.25inch drives.*

<http://www.research.philips.com/technologies>

