



# Disc Drive Technology Update

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# Topics

HDD areal density

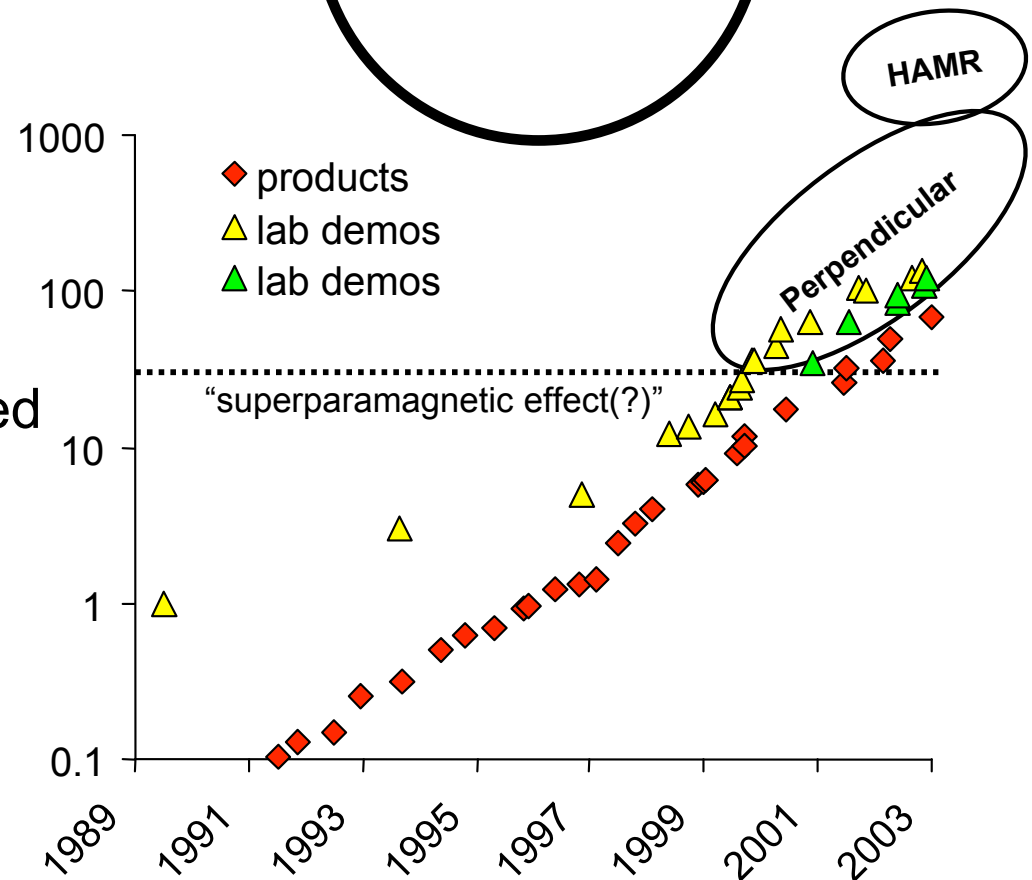
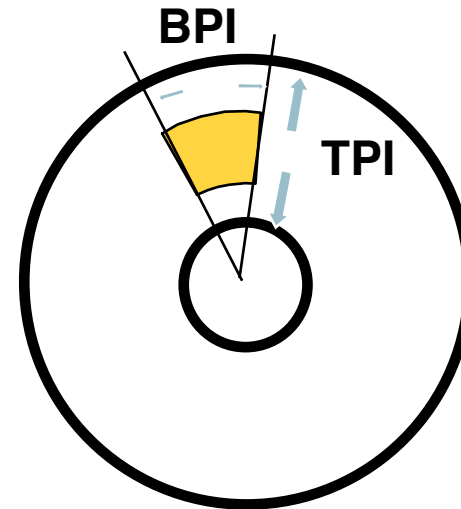
Intelligence in HDD Storage

- Protection
- OSD



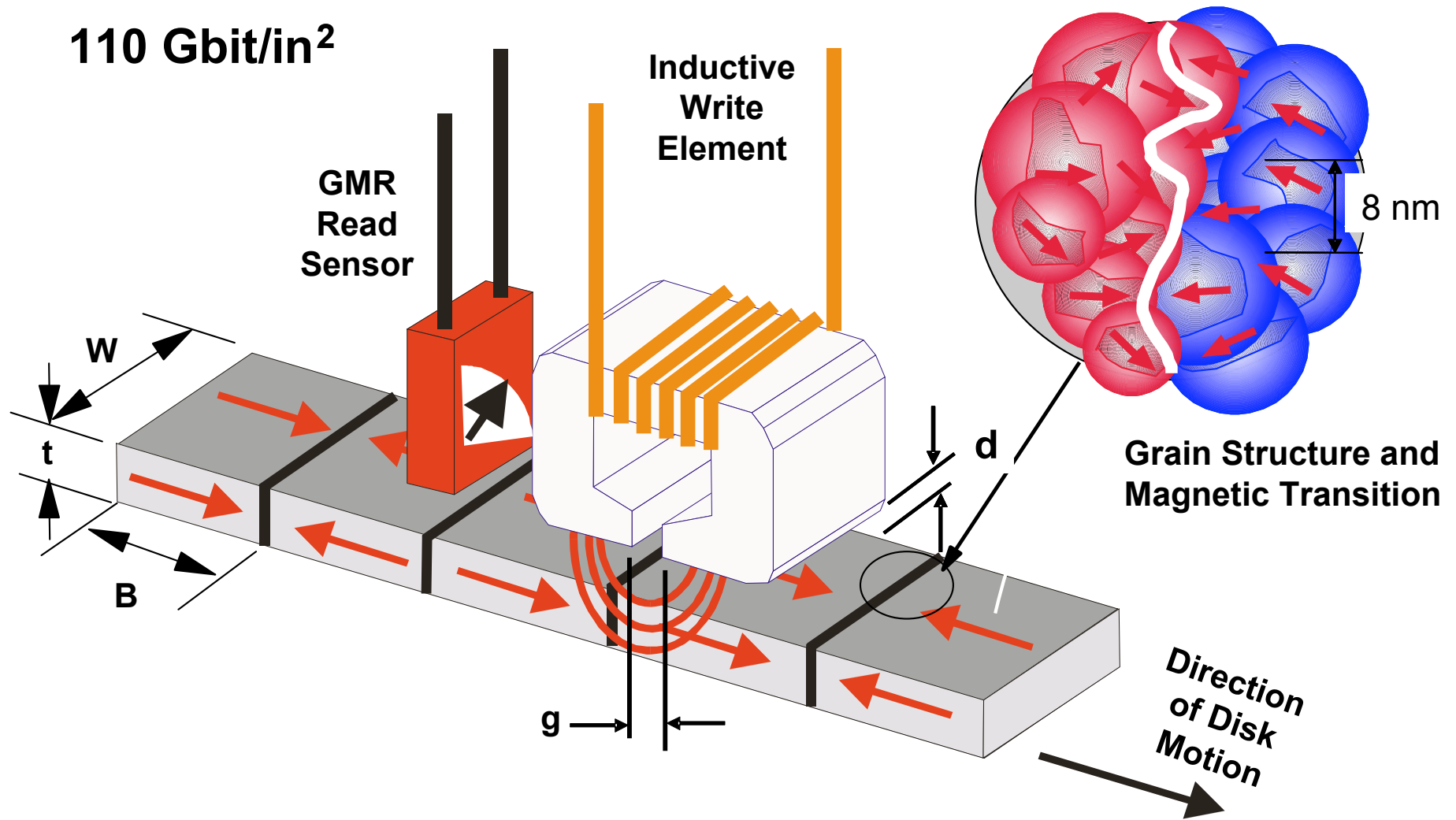
# Areal Density Growth

- Fear: *superparamagnetic effect*
- Longitudinal recording now above 100 Gb/in<sup>2</sup>
- Perpendicular expected to extend to 1 Tb/in<sup>2</sup>
- Additional innovations required at that point
  - heat-assisted recording



# Recording Basics – Some Dimensions

110 Gbit/in<sup>2</sup>



# Dimensions No Longer Scaling

## Writeability

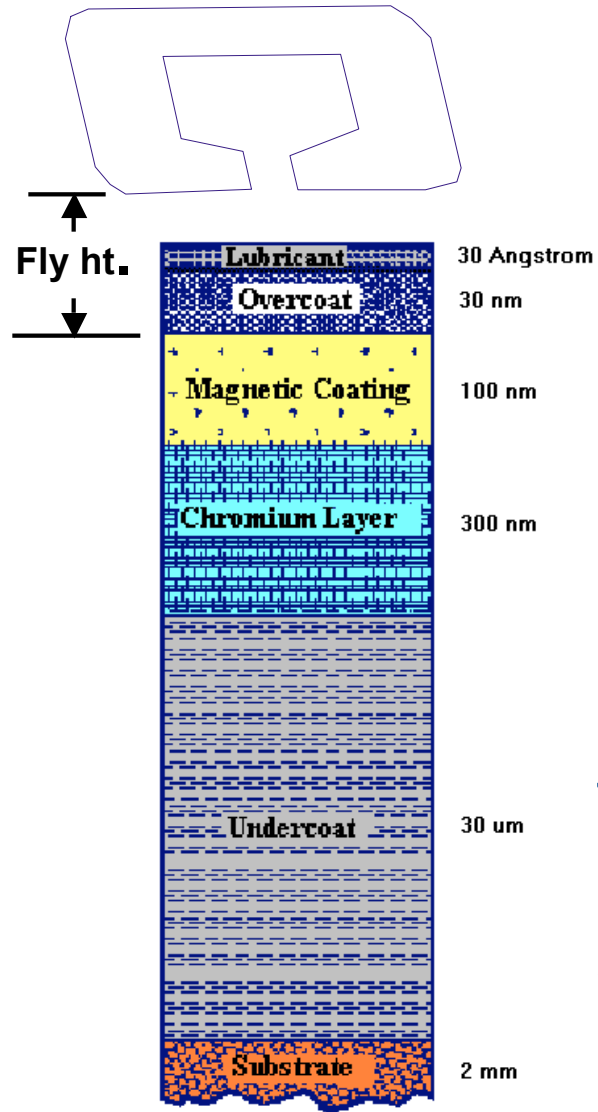
- Media particle size
- Media coercivity

## Readability

- Signal strength
- Fly height

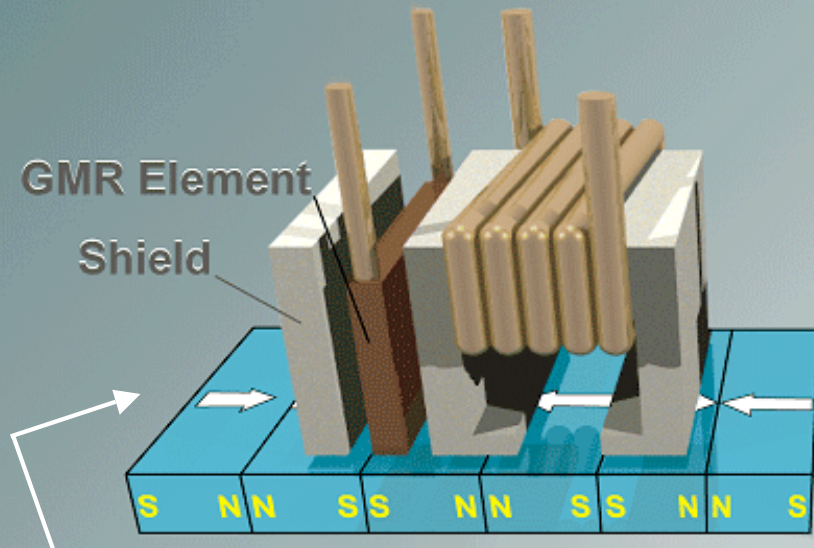
## Thermal stability

- Particle size
- Particle count per bit
- Remnance





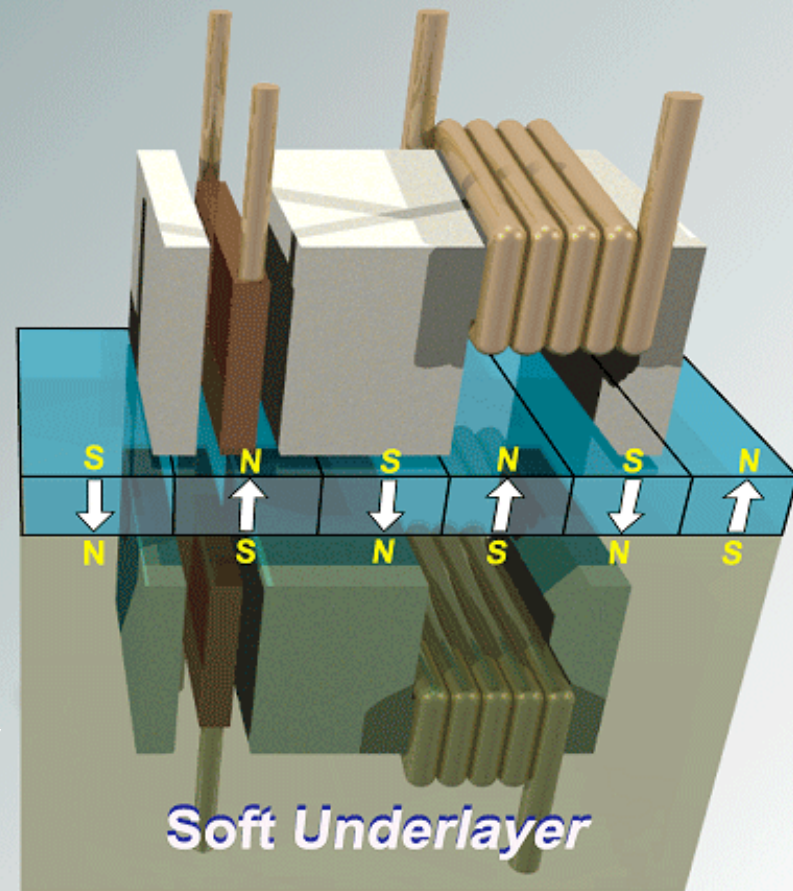
# Longitudinal Recording



Magnetic domains oriented in the direction of travel of the head (much longer than wide/tall).

Soft underlayer “mirrors” write field and allows domains much closer together.

# Perpendicular Recording



Soft Underlayer

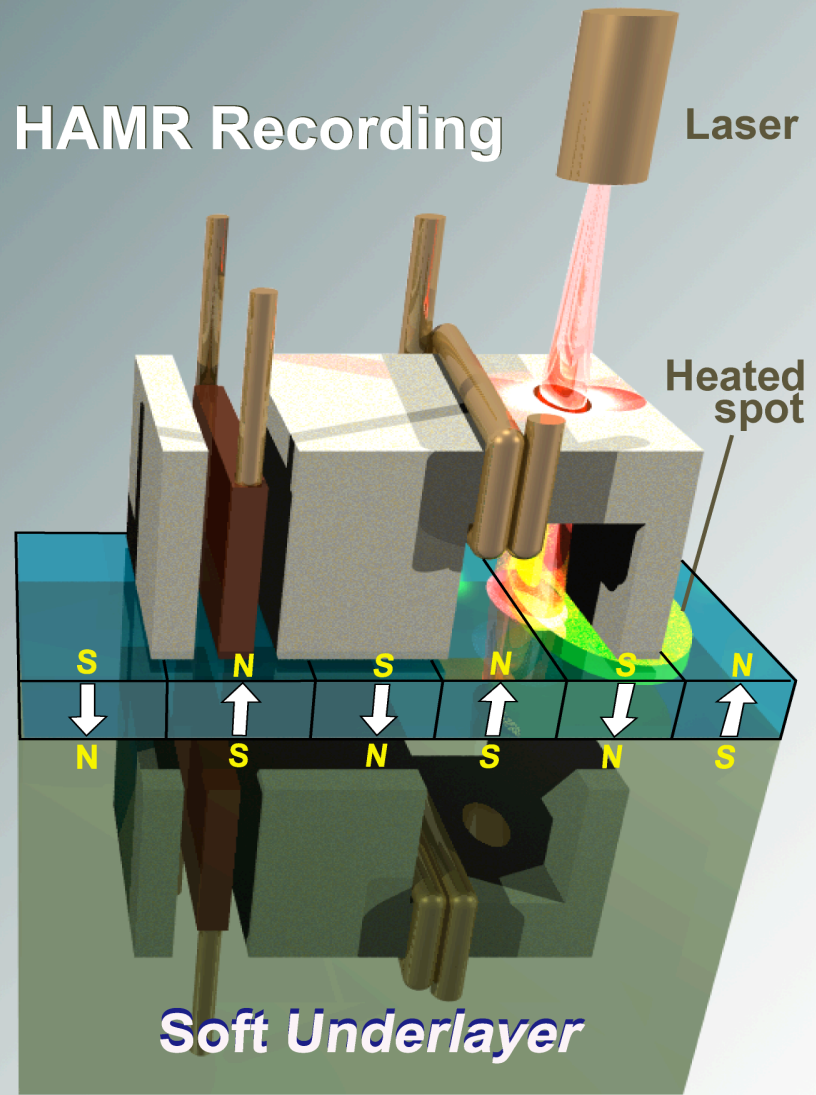
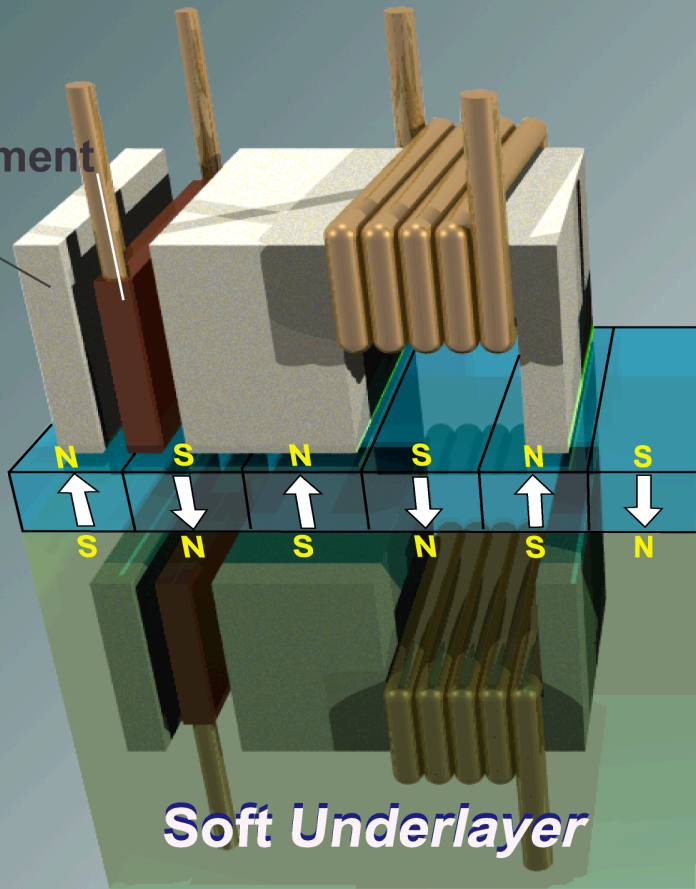
Perpendicular should take us to 1 Tbps



**Change means risk!**

## Perpendicular vs. HAMR Recording

GMR Element  
Shield



HAMR can theoretically extend the density of recording to 10 Tbps





# Protecting Systems

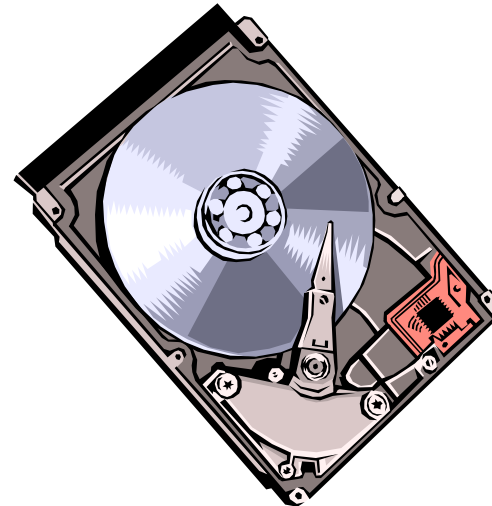
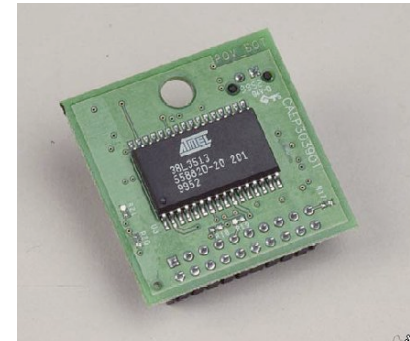
TCG – Trusted Computing Group

- TPM
- Secure peripherals
  - Keyboard (no password sniffing)
  - Readers for Smartcard, Fingerprint, Security token...
  - Disk drives

Trust from boot-up

- Verify BIOS
- Verify OS-core
- Check loaded SW...

HDD can help





# HDD: Separable, Closed System

Hidden space for storage of secrets

No foreign SW

- Authenticated, read only FW

Restricted interface

- Fixed command set, data format

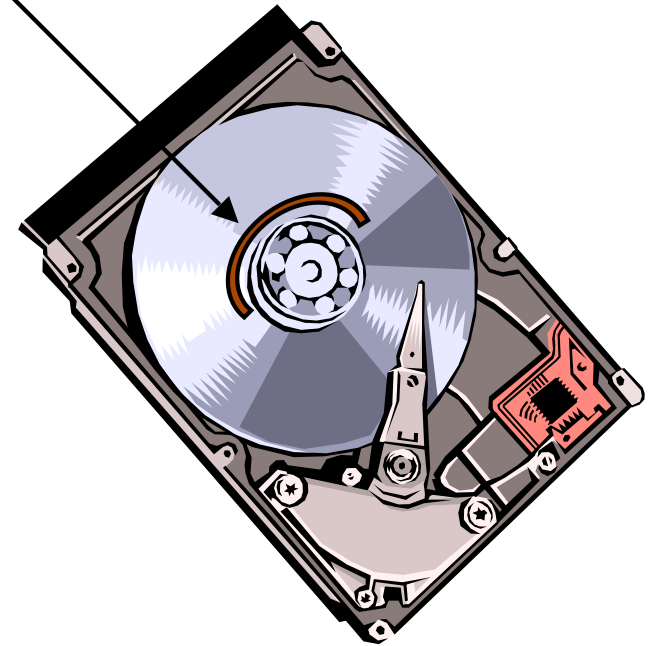
Protected internal buses

- Single chip
- Multi-chip module

Physically separate data and program memory

- No buffer overflow-type attacks

Separable from CPU – can be optional



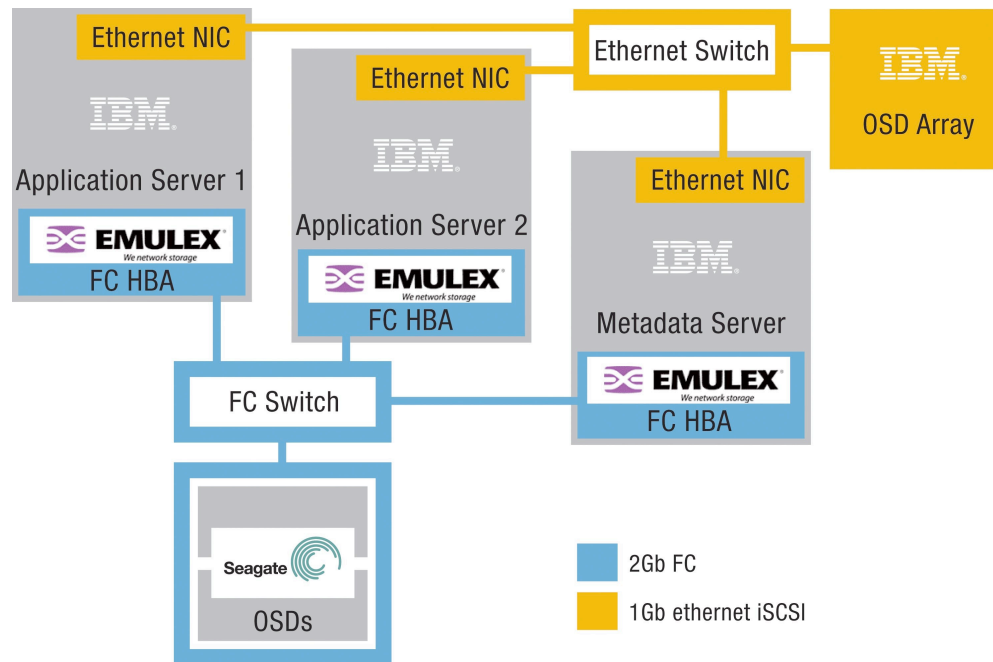
# OSD Headlines

## Emulex, IBM & Seagate Team Up to Demonstrate Industry's First Standards-Compliant Object-Based Storage Devices

### Object-Based Storage Devices

Tuesday April 12, 7:59 am ET

- OSD Technology Demonstration Signals Move Toward More Powerful, Intelligent and Simplified Storage

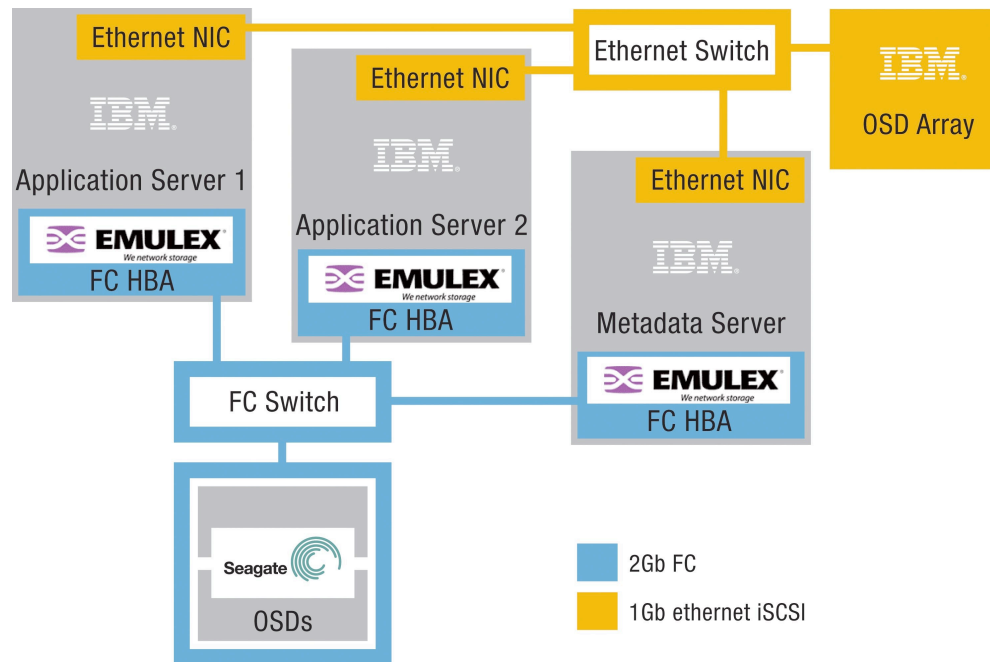


# OSD – Real Technology

SNW - World's first demonstration of ANSI OSD standard

3 company collaboration

- Emulex - FC HBA w/ bidirectional transfers, long CDBs
- IBM - Full host software stack & iSCSI OSD subsystem
- Seagate – OSD in a standard FC HDD



# Summary and Conclusions

HDDs will continue to be primary external storage

Capacity will continue to grow

Growth will be slower and with discontinuities

HDDs can contribute to system operation w/ additional intelligence

Security

Object abstraction (OSD)

