Preservation vs Technology
Areal Density Growth

- Late 1990s – superparamagnetic limit demonstrated through modeling
- Perpendicular expected to extend to 0.5-1 Tb/in\(^2\)
- Additional innovations required at that point
  - heat-assisted recording
  - bit patterned media recording

- Areal Density CAGR 40%
- Transfer Rate CAGR 20%

- Inductive Writing & GMR
- Inductive Writing/ GMR reading
- Inductive Writing/ MR reading
- HAMR
- HAMR+
- SOMA
- Perpendicular Writing & GMR
Areal Density Growth

- Late 1990s – superparamagnetic limit demonstrated through modeling
- Perpendicular expected to extend to ~1 Tb/in²
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- Areal Density CAGR 40%
- Transfer Rate CAGR 20%

Much better suited to 2.5”
Materials for Higher AD

Areal Density Scale Factor vs. Anisotropy

- **CoCrPt**
- **Co/Pd**
- **Co/Pt**
- **MnAl**
- **FePd**
- **CoPt**
- **CoPt\(_3\)**
- **Fe\(_{14}\)Nd\(_2\)B**

Traditional Recording

HAMR
Heat Assisted Magnetic Recording (HAMR)

Perpendicular Recording

HAMR

GMR Element

Shield

Laser

Heated Spot

Soft Underlayer
Overall PC Market

Total Available Market

Products, not technology
Volume is king
Notebook now higher volume than Desktop
SSD still VERY small

Source: Seagate Market & Competitive Intelligence
Desktop PC
HDD Total Available Market

3.5” minimum drive capacity exceeds desktop requirement

Source: Seagate Market & Competitive Intelligence
NB capacities closing in on DT capacities
2.5” being used in desktop
Overall EC Market

*Total Available Market*

Business Critical (high capacity) growing!

Source: Seagate Market & Competitive Intelligence
Mission Critical Enterprise

Total Available Market

Just as with NB, 2.5” will dominate in 2-3 years

SSD still very small – much smaller than had been forecasted

SSD needs better NAND pricing to make more of an inroad
Business Critical Enterprise

Total Available Market

Annual – Business Critical Capacity Mix

Are you REALLY Ready for 3 TB?

Source: Seagate Market & Competitive Intelligence
Total HDD Industry Unit Mix
By Form Factor

Source: Seagate Market Intelligence
Solid State Disks

Only a very small % of data center storage

Acceptance much slower than forecasted

• Reliability concerns
• In some cases performance less than expected
• Users find difficulty in identifying right data to move

NAND pricing actually increased recently

There will not be (in the foreseeable future) enough wafers processed to eliminate magnetic storage
Other Topics

Interfaces: Where will the client go?
- SATA pretty much limited to 6 Gb/s
- USB-3 will be considered as client drive interface
- What about optical?
- SAS will become a choice for low end server
- Get ready for 3 TB HDDs and 4K sectors!

Form Factor transition?
- New capacity technologies more amenable to 2.5"
- What to look for: 2.5 high capacity drive = ½ of 3.5” drive
  - Today ½ TB vs 2 TB