



Pesky Physics

What Might It Mean for Mass Storage?

Michael R. Mott

Distinguished Engineer

mottmi@us.ibm.com

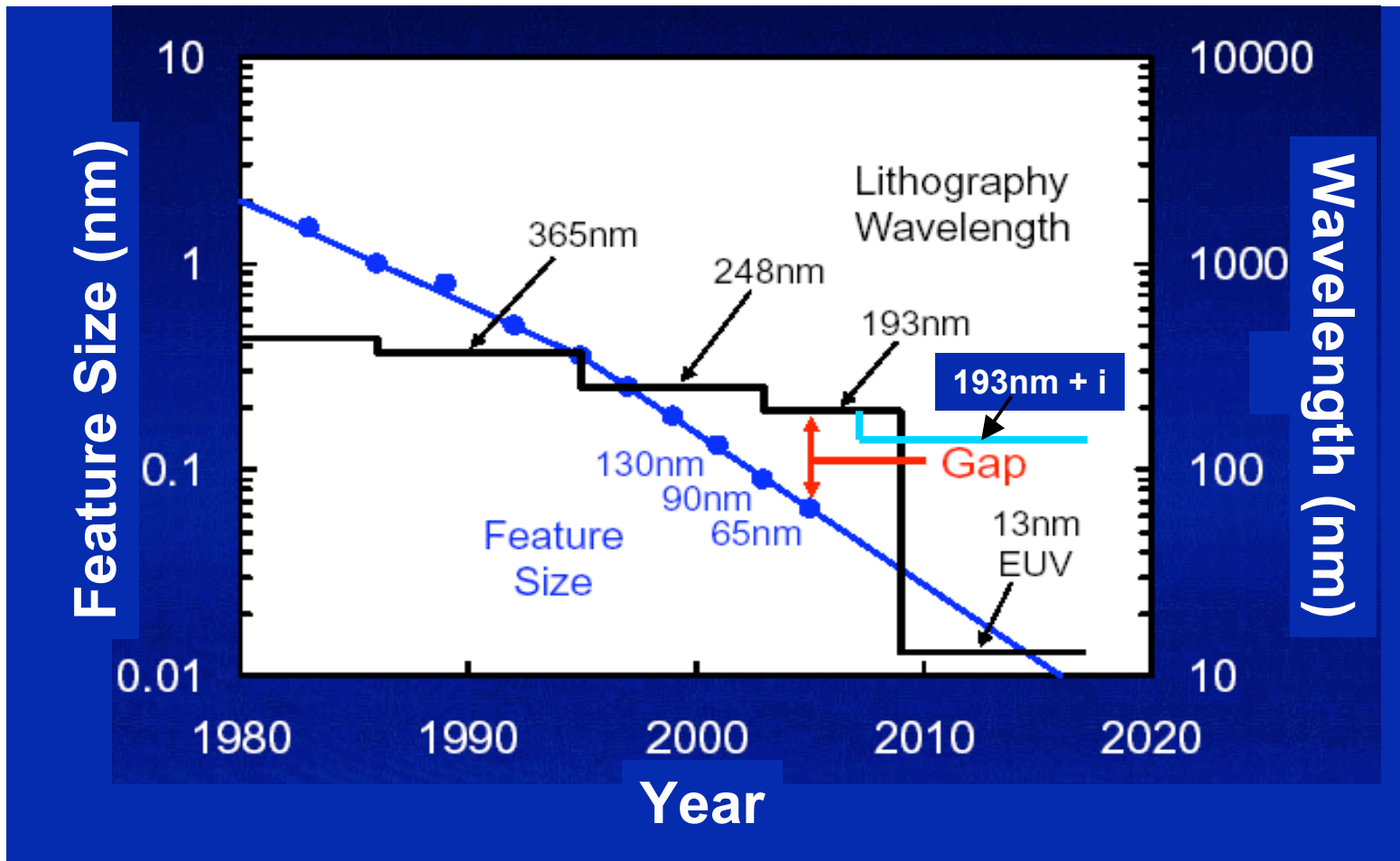


Fundamental Physical Challenges

- ▶ Moore's Law
 - The cost of lithography and tooling
 - The thickness of the FET gate insulator

- ▶ Superparamagnetic Limit

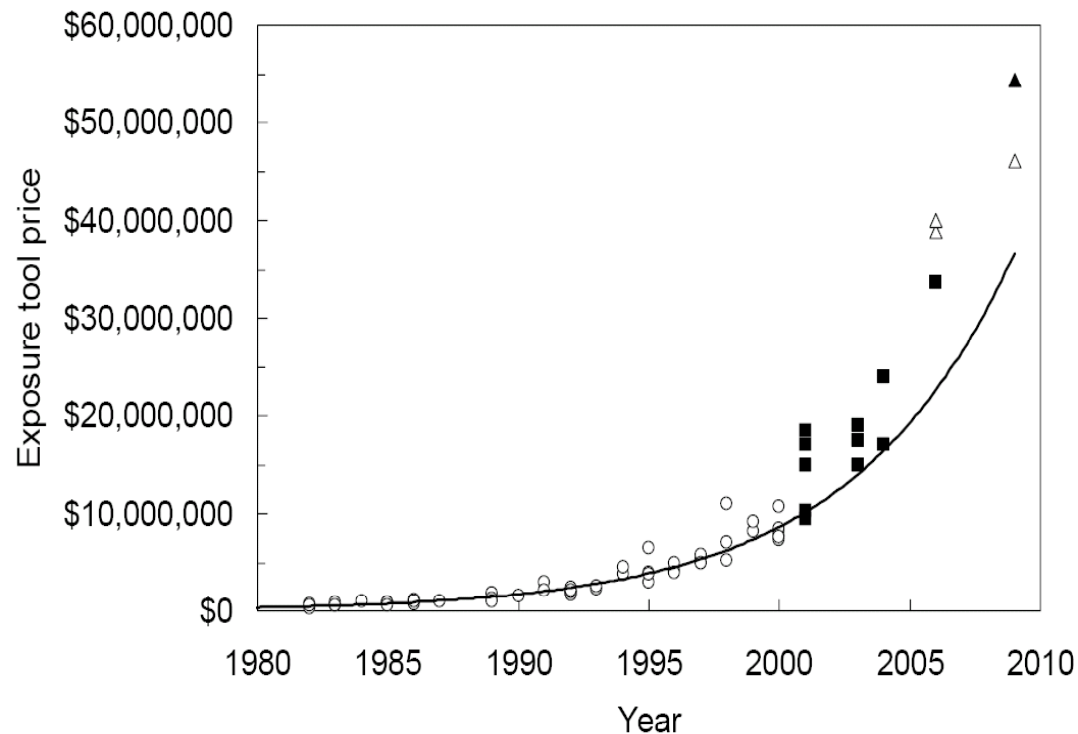
Semiconductor Lithography Scaling Reaching Physical Limits



M. Bohr, http://www.intel.com/technology/silicon/65nm_technology.htm

Litho Tool Cost Growing Hyper-Exponentially → Cost Growing Faster Than Performance Benefit

Tool costs over time



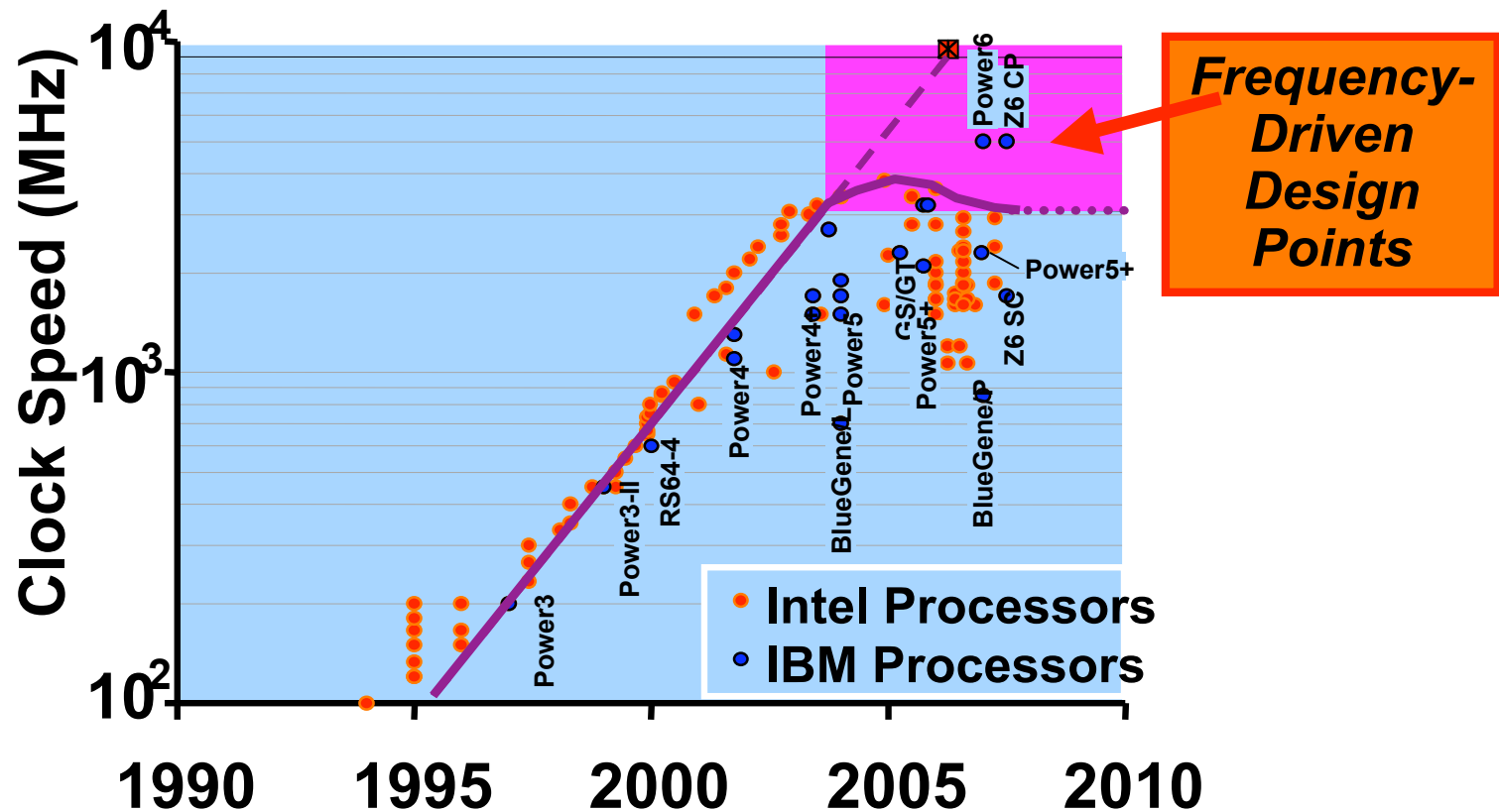
3

29 March 2007

Cost and the Future of Lithography

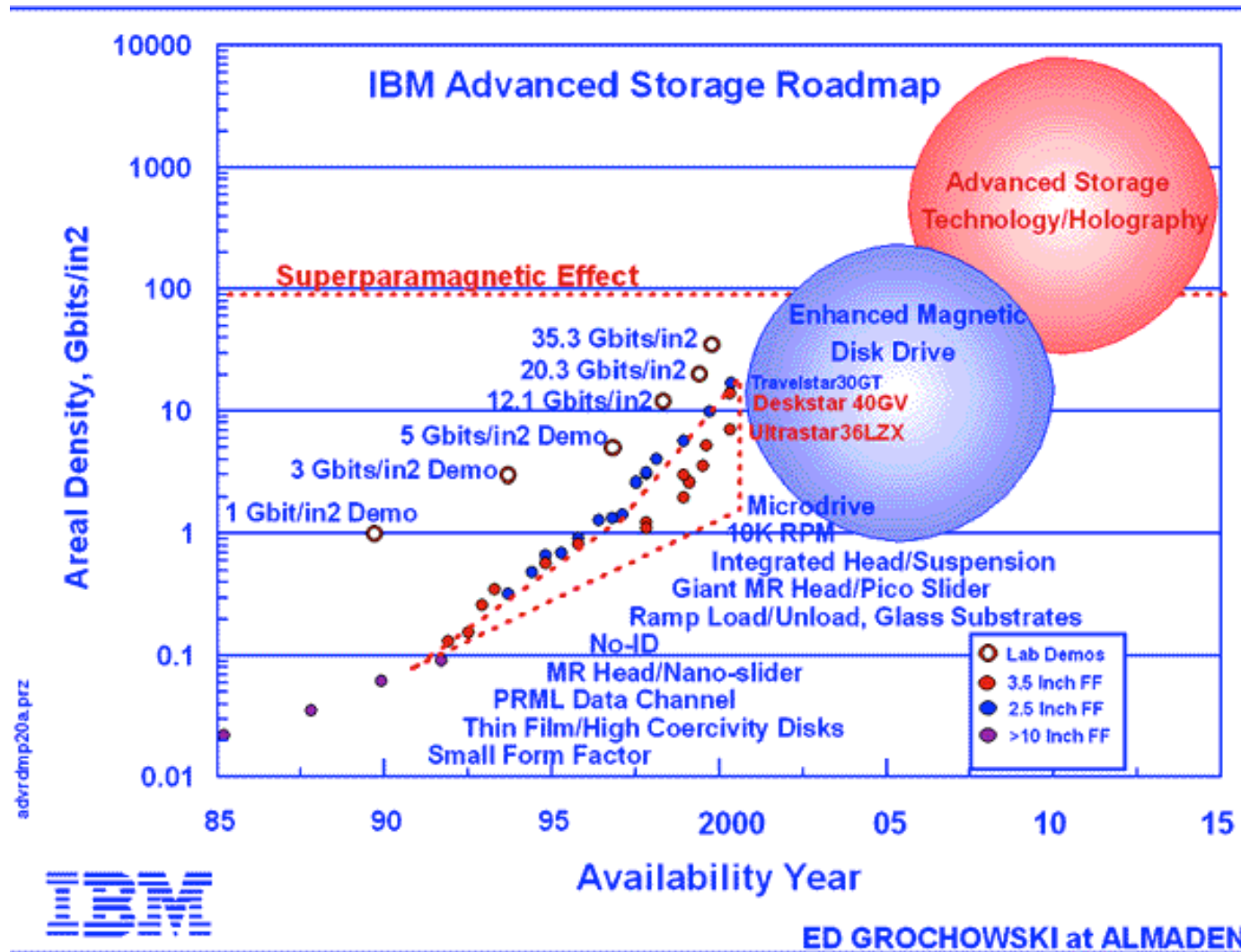
Discontinuity in Processor Design Due to Power Constraint

Designing processors for increased clock speed yields diminishing returns

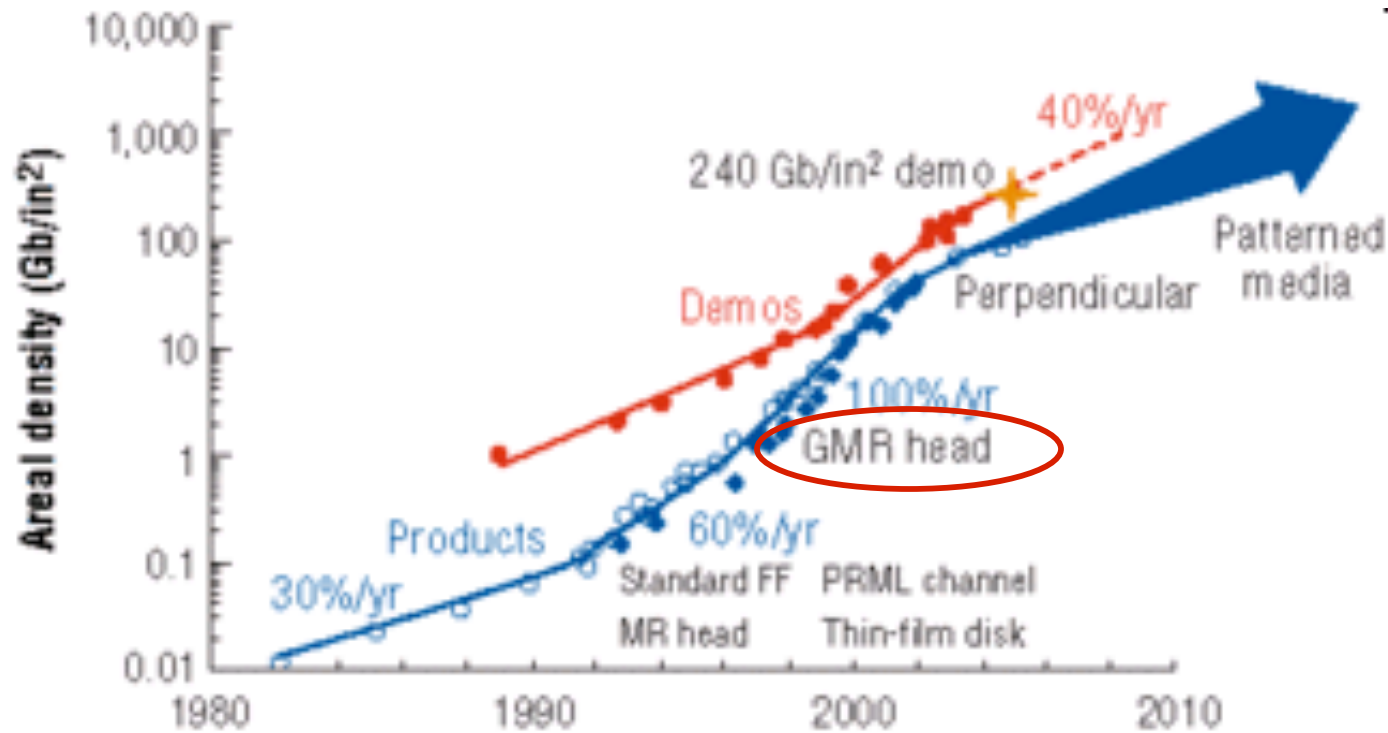


Power constrains benefits of frequency increases
Consequence is the switch to multi-core systems

Superparamagnetic Effect Constrains Magnetic Storage

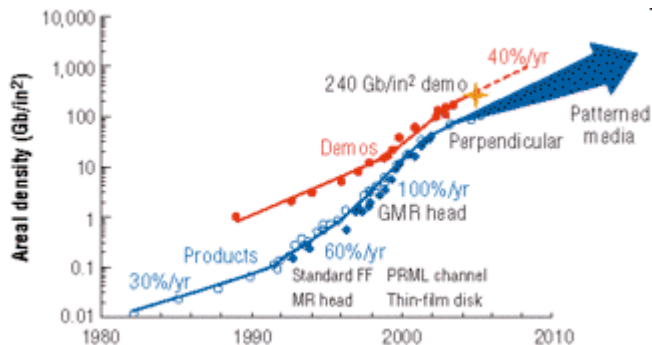
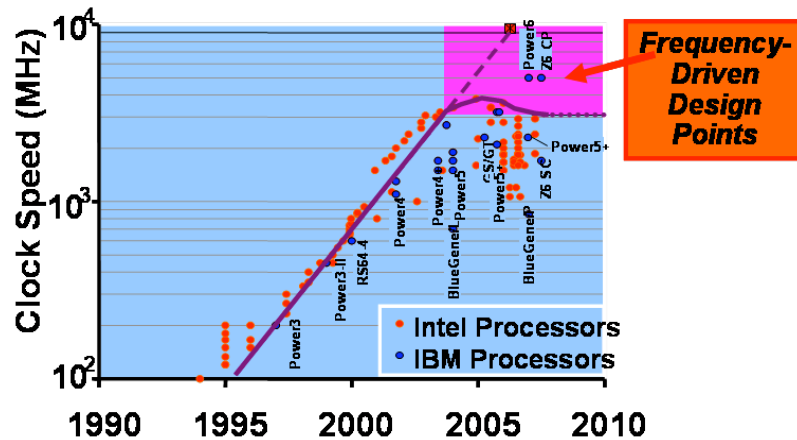


Areal Density Growth is Slowing



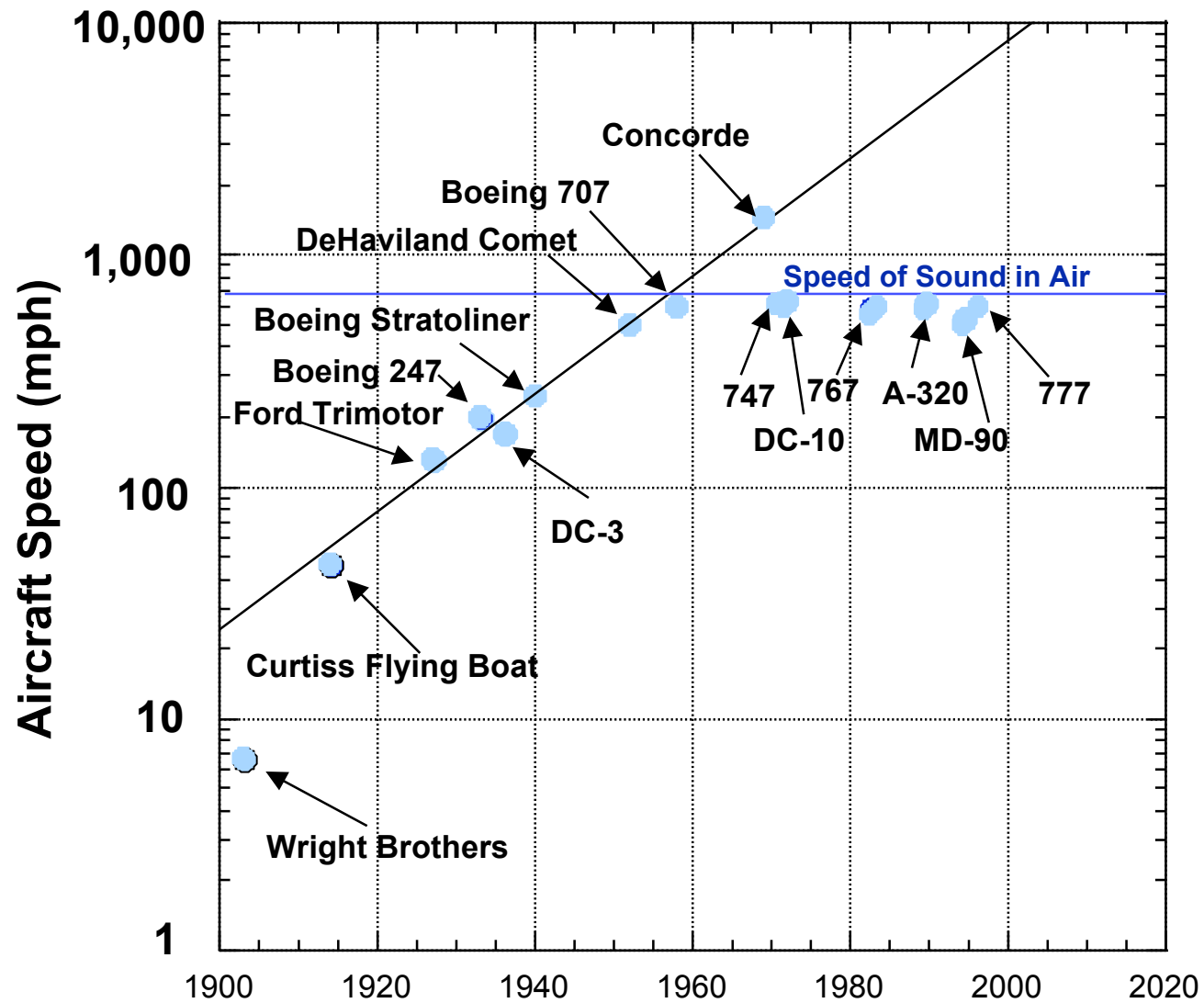
•http://www.solid-state.com/display_article/272292/5/none/none/DtStr/Patterned-magnetic-media:-impact-of-nanoscale-patterning-on-hard-disk-drive

Physical Limits Are Constraining Technology Growth

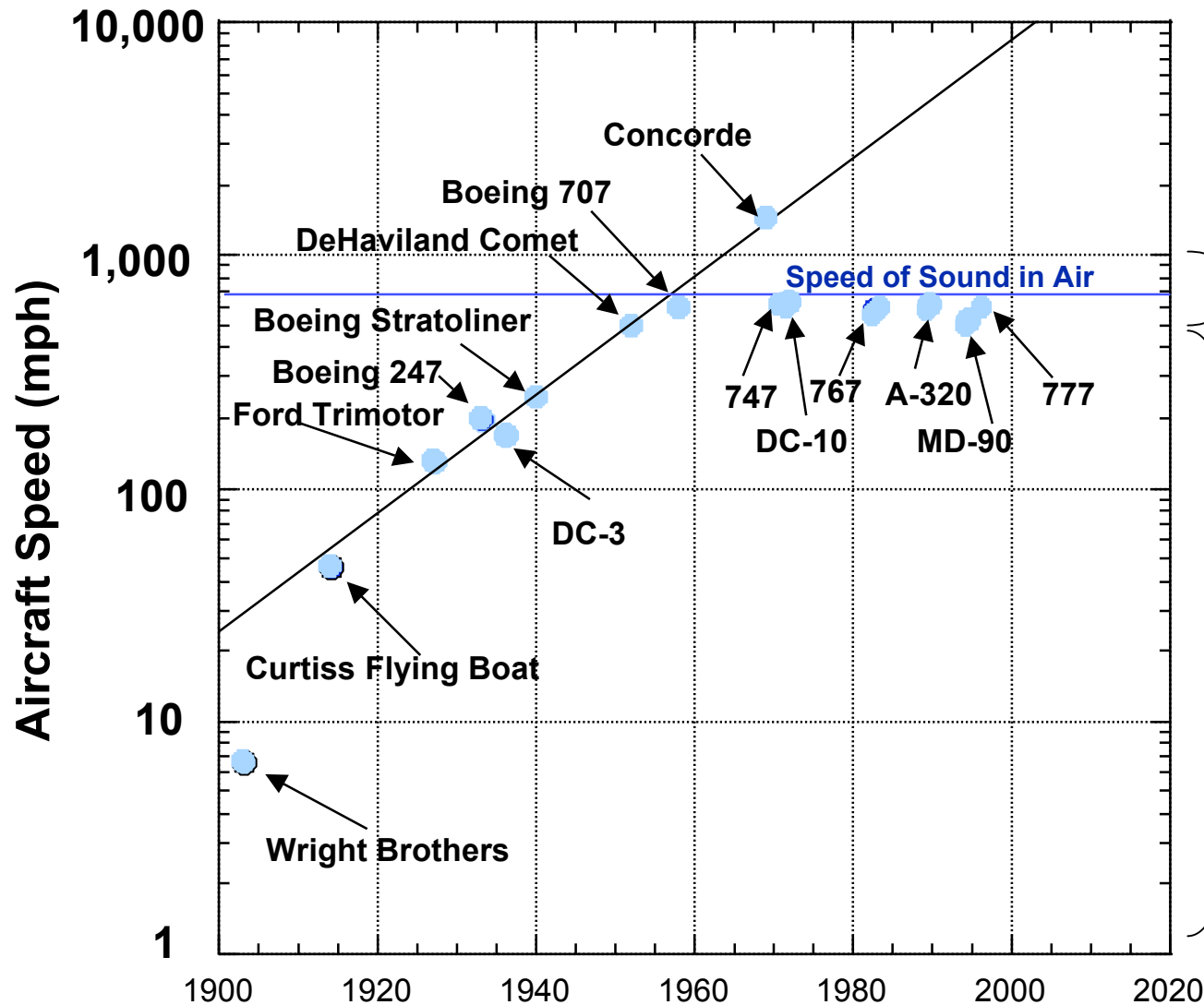


- ▶ Feature Size for semiconductors
 - Severe power and thermal constraints
 - Slowing performance gains
 - Raising costs
 - Direction for progress unclear
- ▶ Superparamagnetic Effect
 - Slowing performance gains
 - Raising costs
 - Optical or other medium to bypass
- ▶ It appears that industry is maturing

Maturation of Commercial Aviation



For Commercial Aviation it Changed the Engineering Focus

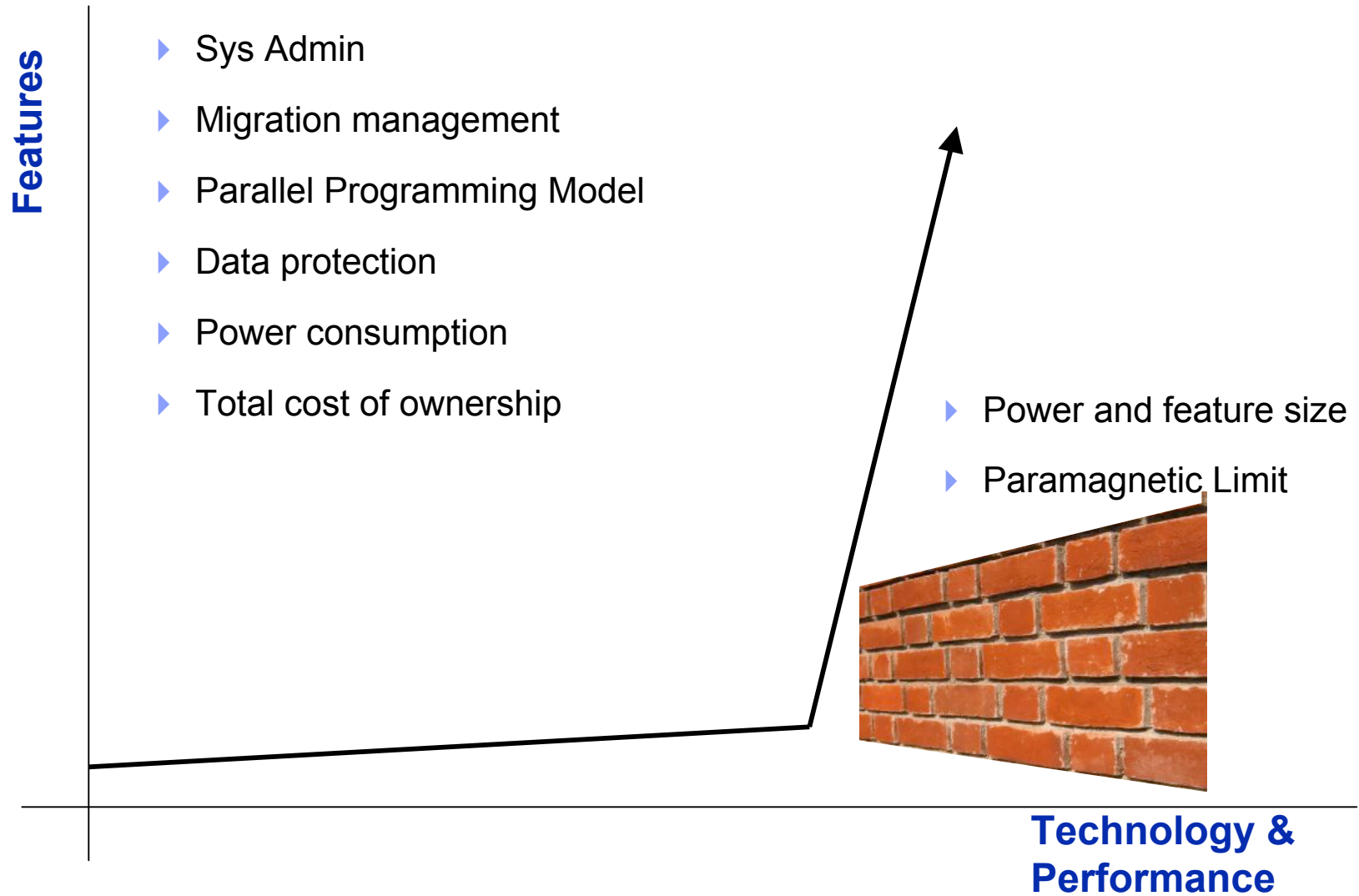


Optimize value

- Manufacture
- Operational

**Technology and
Material
development**

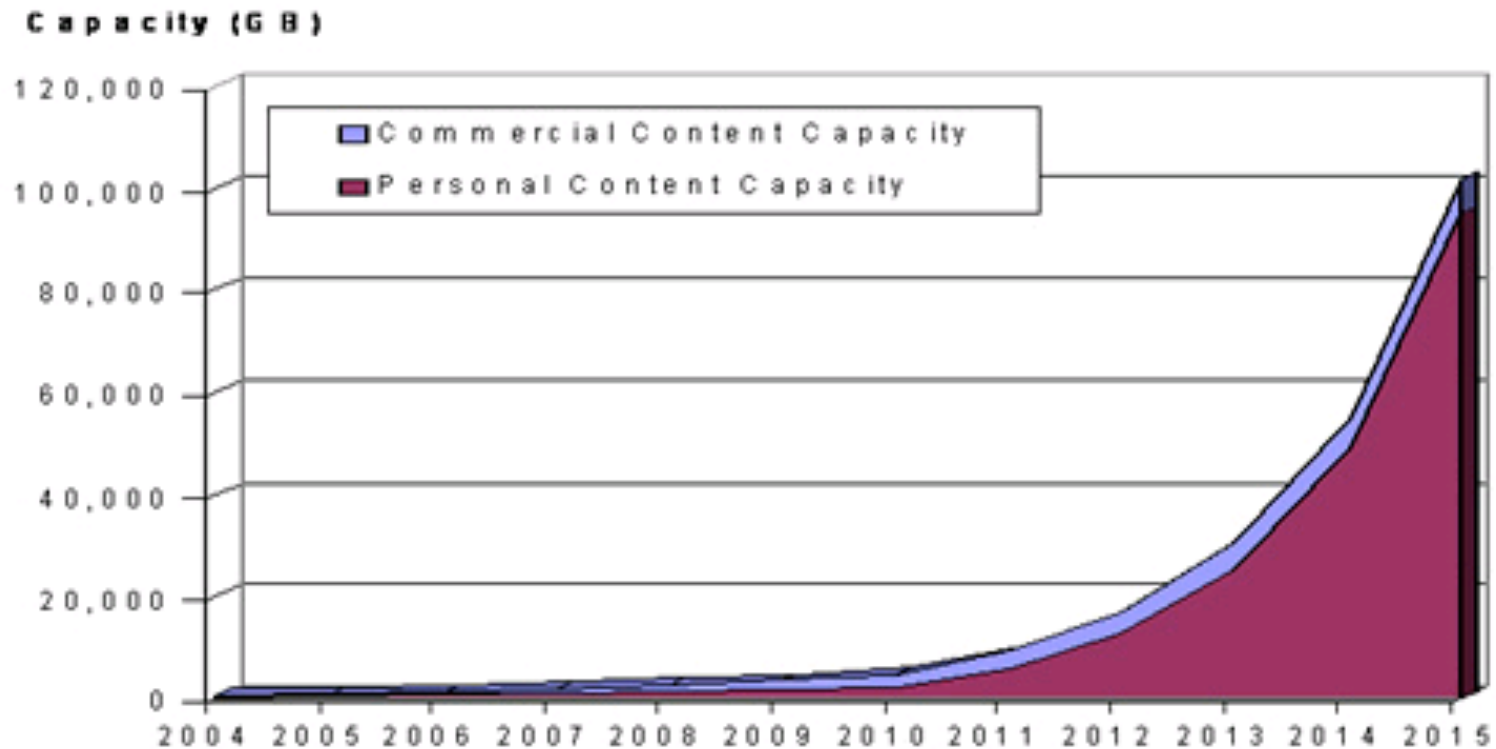
Mass Storage: Features vs Technology



Mass Storage Industry Is Changing

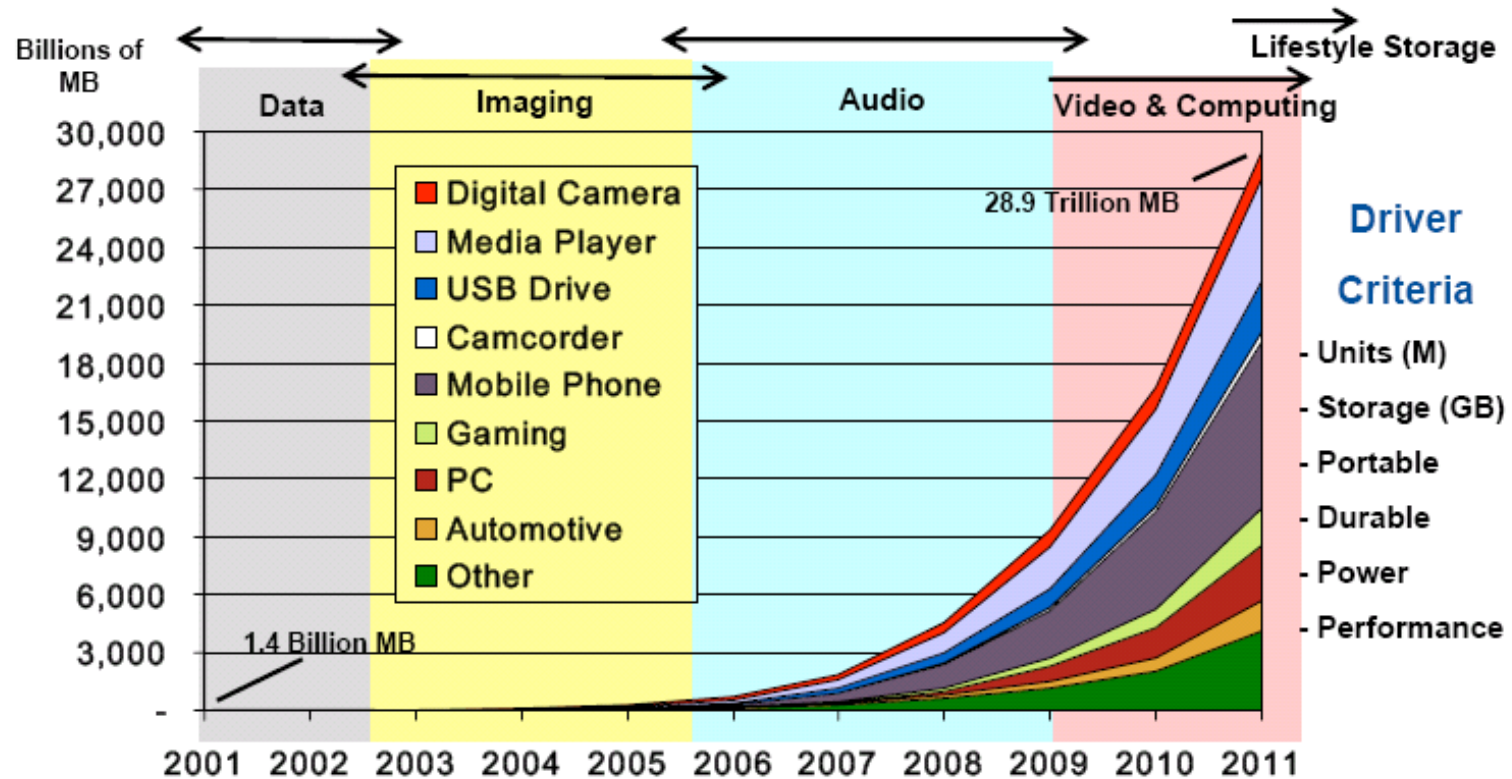
- ▶ The Mass Storage Industry is maturing technically
 - Rate of semiconductor performance gains are slowing
 - Rate of aerial density increases is slowing
- ▶ What are the storage drivers going forward?
- ▶ What does this mean for us?

Personal Devices Are Driving Storage Growth – Big Time



▪ <http://www.storagevisions.com/sv2008.htm> from the Storage Visions 2008 Conference material

What's Driving Personal Content Capacity?



Note: NAND flash consumption includes both in-system and removable storage such as flash cards.

Source: Gartner Dataquest, February 2007

9

Gartner

© 2006 Gartner, Inc. All Rights Reserved.

- Personal digital devices are driving storage demands
- This will impact business investments
- In turn this will impact the mass storage markets

Is There a Digital Family Shoebox in Our Future?

- ▶ Needs traditional mass storage stewardship features
 - Sys Admin (amateur easy)
 - Migration management
 - Low TCO
 - Data Security
 - Data Persistence
- ▶ Multi-media rich
- ▶ Indexed, organized, searchable, & retrievable
- ▶ Require new level of association between elements – for instance, genealogy with photos and videos
- ▶ Need open standards
 - Family shoebox information exchange
 - Data representation for physical media
- ▶ Compatibility with cloud computing???

Integration of Data Storage Islands

- ▶ Motivation prepare to support enhanced collaborations
- ▶ Mass Storage stewardship + services to integrate data storage islands
- ▶ Support for information interoperability – ontology or other semantic mechanism
- ▶ Resulting consolidations
 - Reduces number of copies → virtual performance and cost improvement → end-to-end system performance improvements
 - Simplifies data management
- ▶ Potential industries
 - Retail marketing with RFID and POS data capture
 - Electrical grid sensing to improve service delivery without capital expenditures
 - Automotive – use the sensor data to improve products; perhaps usage pricing
 - WalMart and CostCo photo capabilities: on-line album sharing

What Else????

