



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

Distributed Storage Networks and Computer Forensics

1. Organization & Overview

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Winter Semester 2011/12



Organization

▶ **Lecture**

- Monday 12:15-13:00, 101/SR 00-010/14
- Thursday, 11:15 - 13:00, 101/SR 00-010/14

▶ **Exercise (Christian Ortolf)**

- starts Oct 31, 2011
- Monday 13:00-14:00, 101/SR 00-010/14
- appear Tuesday on the web-pages
- are the bases for the oral exam
- solutions of the exercises are discussed in the following week

Web

▶ **Web page**

- http://cone.informatik.uni-freiburg.de/cone_teach/cone_teach_current/dsacfws11
- Slides, exercises, videos, link to forum

▶ **Forum**

- for discussion, links, funnies etc.
- <http://archive.cone.informatik.uni-freiburg.de/forum3/viewforum.php?f=6>

Exam

▶ **Oral exam**

- based on the lecture and the exercises
- closed book exam
- selected exercises solutions may be used

▶ **Mandatory registration using HIS**

- Questions in the exam from the lecture and the exercises

Overview

▶ **Basic Storage Technology**

- Hard disks
- Flash memory, solid state disks
- Storage device design

▶ **File systems**

- Classic file systems
- Network and distributed file systems

▶ **Storage organization**

- SAN, NAS, FAN
- Storage hierarchies, Tiers

▶ **Redundancy**

- RAID levels

- Coding techniques

▶ **Distributed Storage**

- Peer-to-peer network storage
 - e.g. Oceanstore

▶ **Computer Forensics**

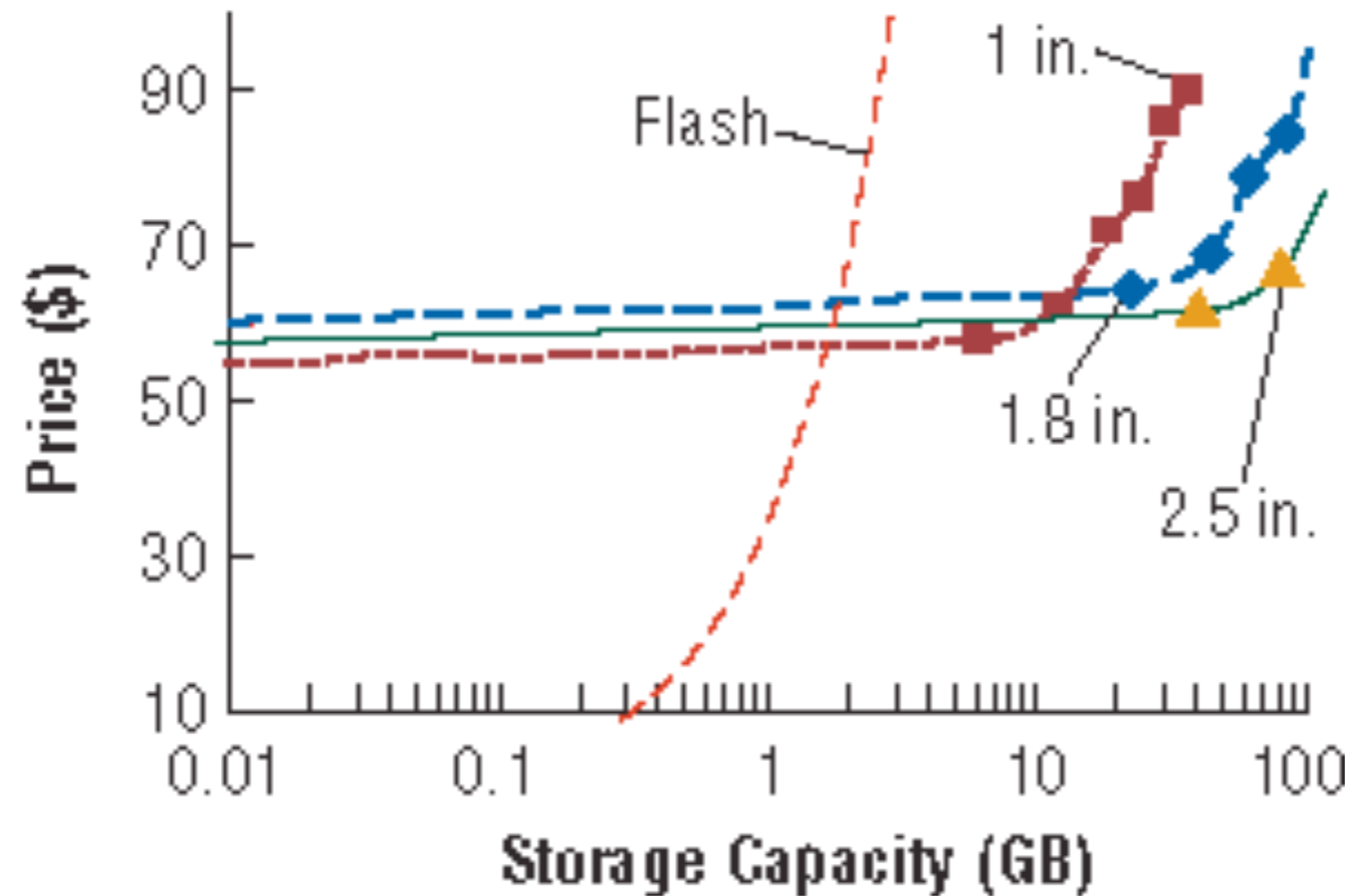
- Foundations
- Methods
- Collecting evidence
- Windows forensics
- Linux forensics

Algorithms and Methods for Distributed Storage Networks

Motivation

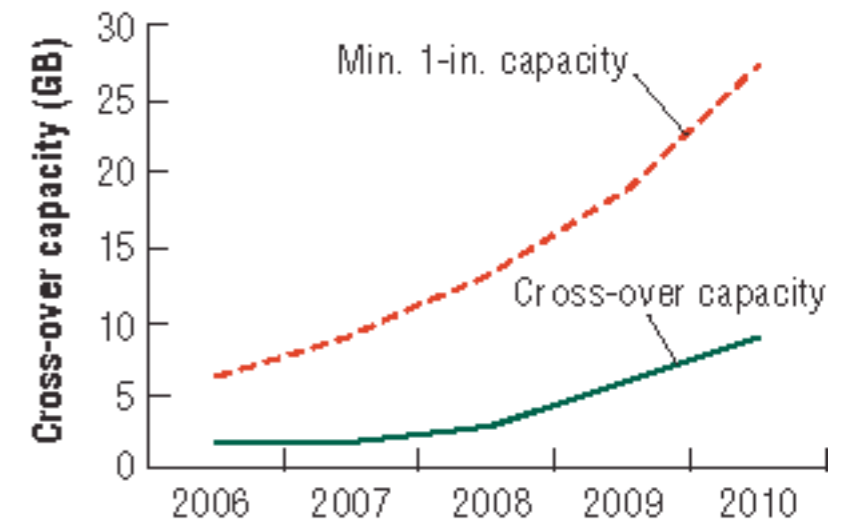
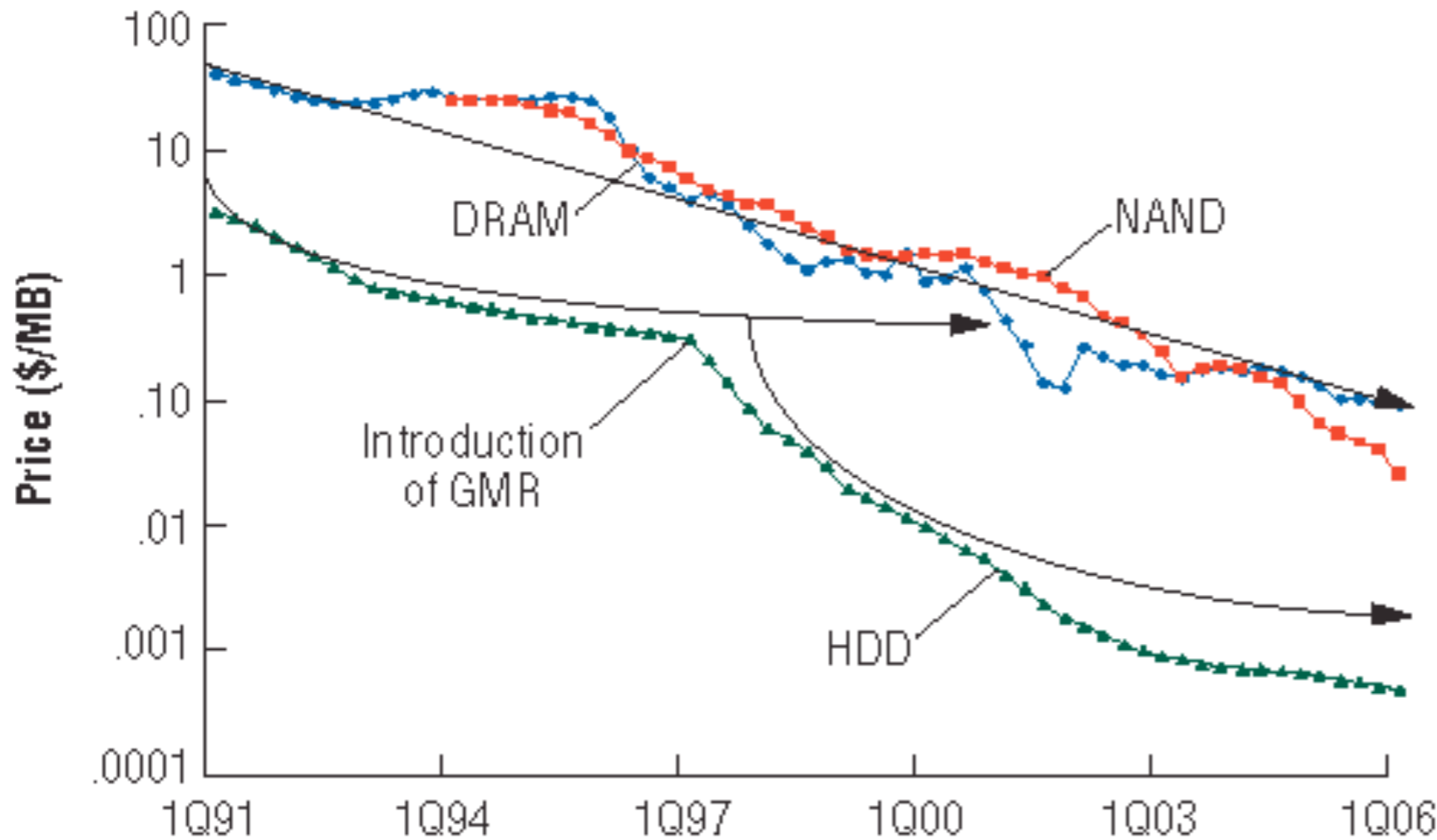
Evolution of Disks

Storage Prices 2006



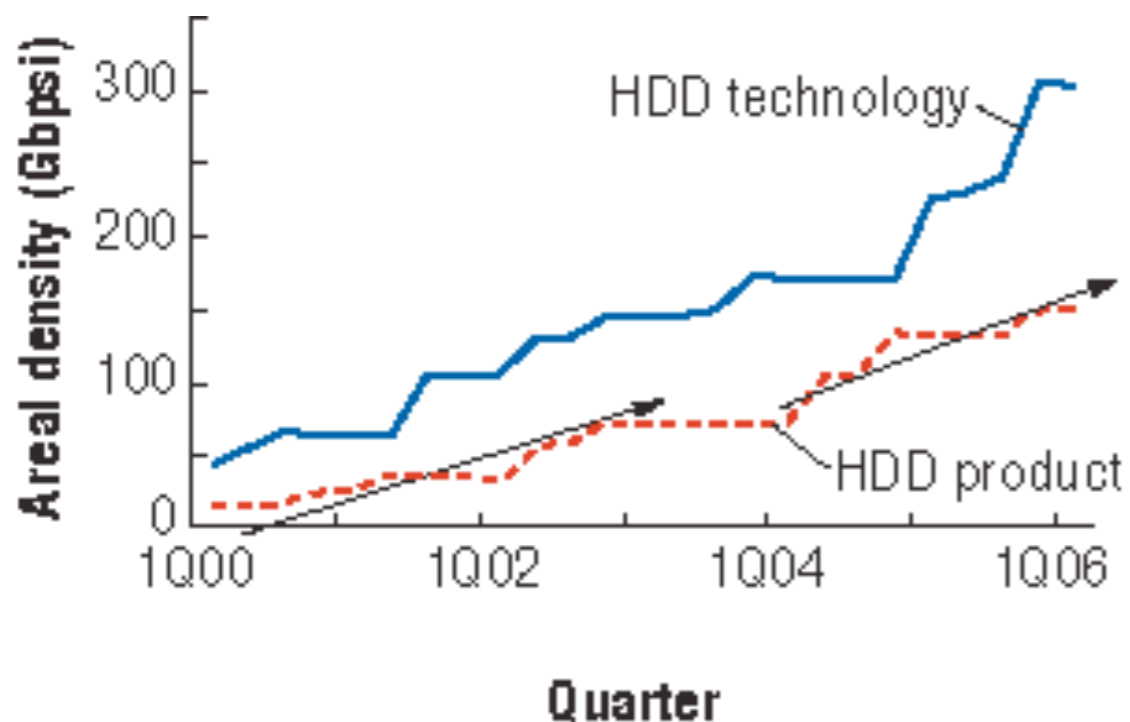
Flash vs. hard drives: The battle intensifies
Tom Coughlin, Jim Handy,
Solid State Technology 2010

Price Fall of RAM and Disk Storage



Flash vs. hard drives: The battle intensifies
Tom Coughlin, Jim Handy,
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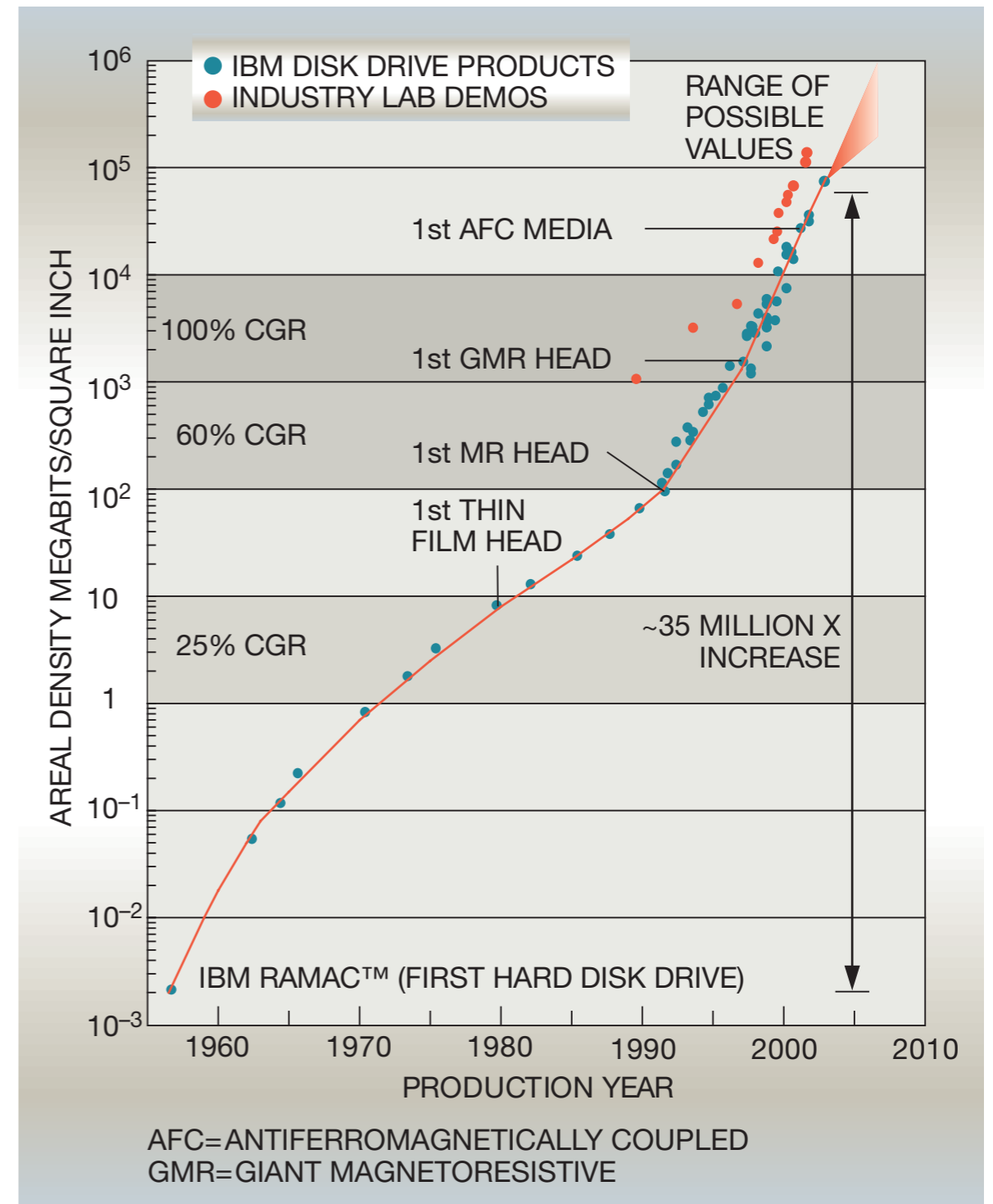
Increase of Density



Flash vs. hard drives: The battle intensifies
 Tom Coughlin, Jim Handy,
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Figure 1 Hard disk drive areal density trend



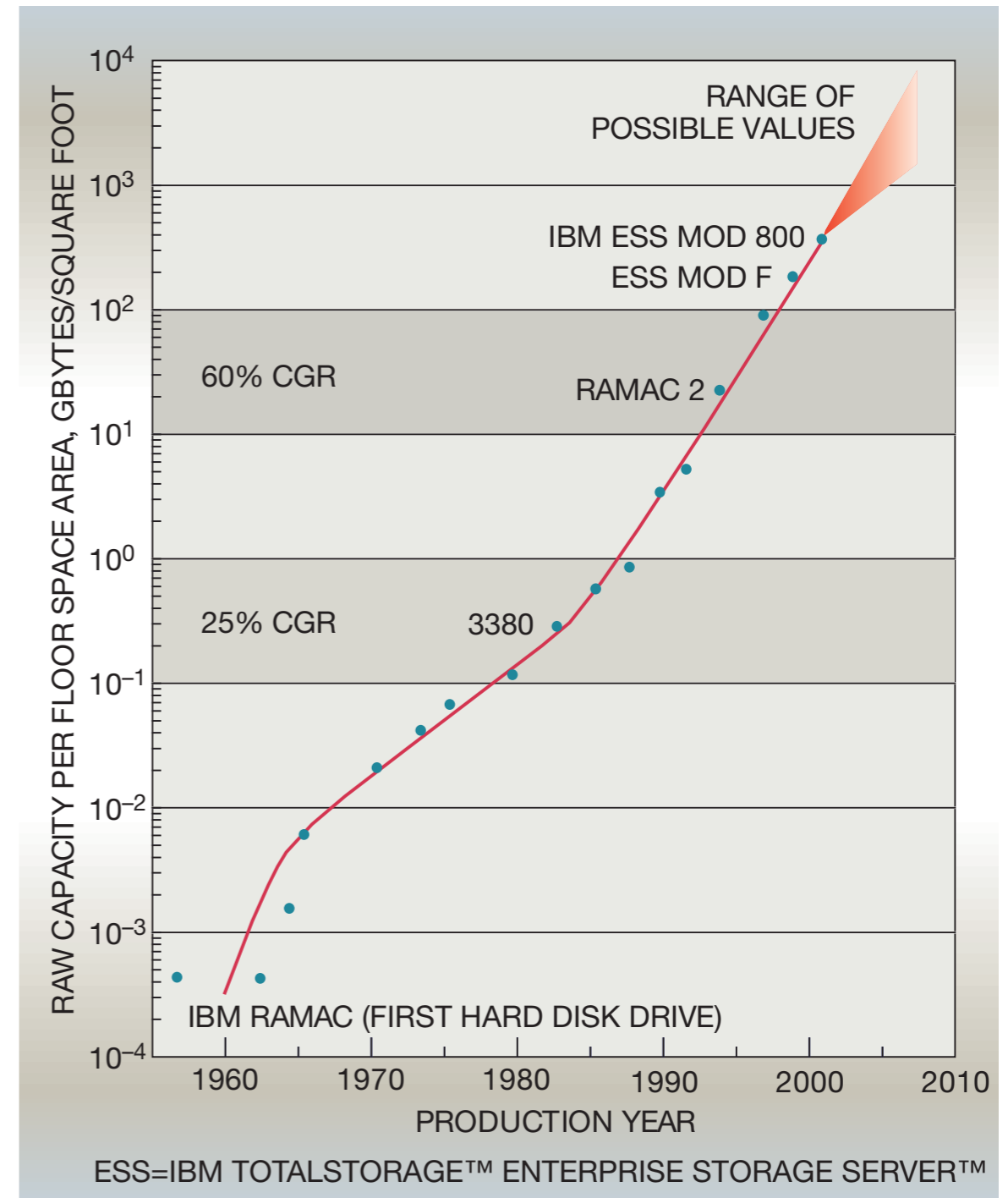
Technological impact of magnetic
 hard disk drives on storage systems, Grochowski, R. D. Halem
 IBM SYSTEMS JOURNAL, VOL 42, NO 2, 2003

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Increase of Density (Floor Space)

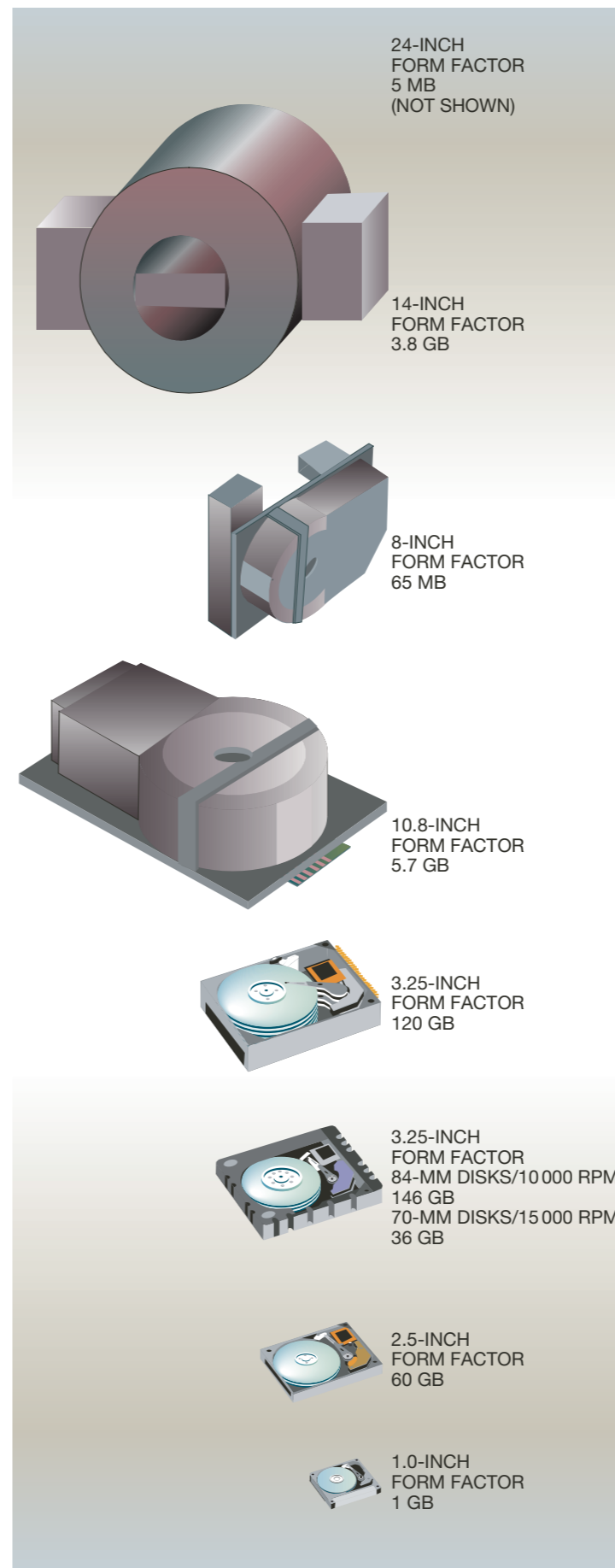
Technological impact of magnetic
hard disk drives on storage systems,
Grochowski, R. D. Halem
IBM SYSTEMS JOURNAL, VOL 42, NO 2, 2003

Figure 2 Storage floor space utilization trend — IBM storage systems

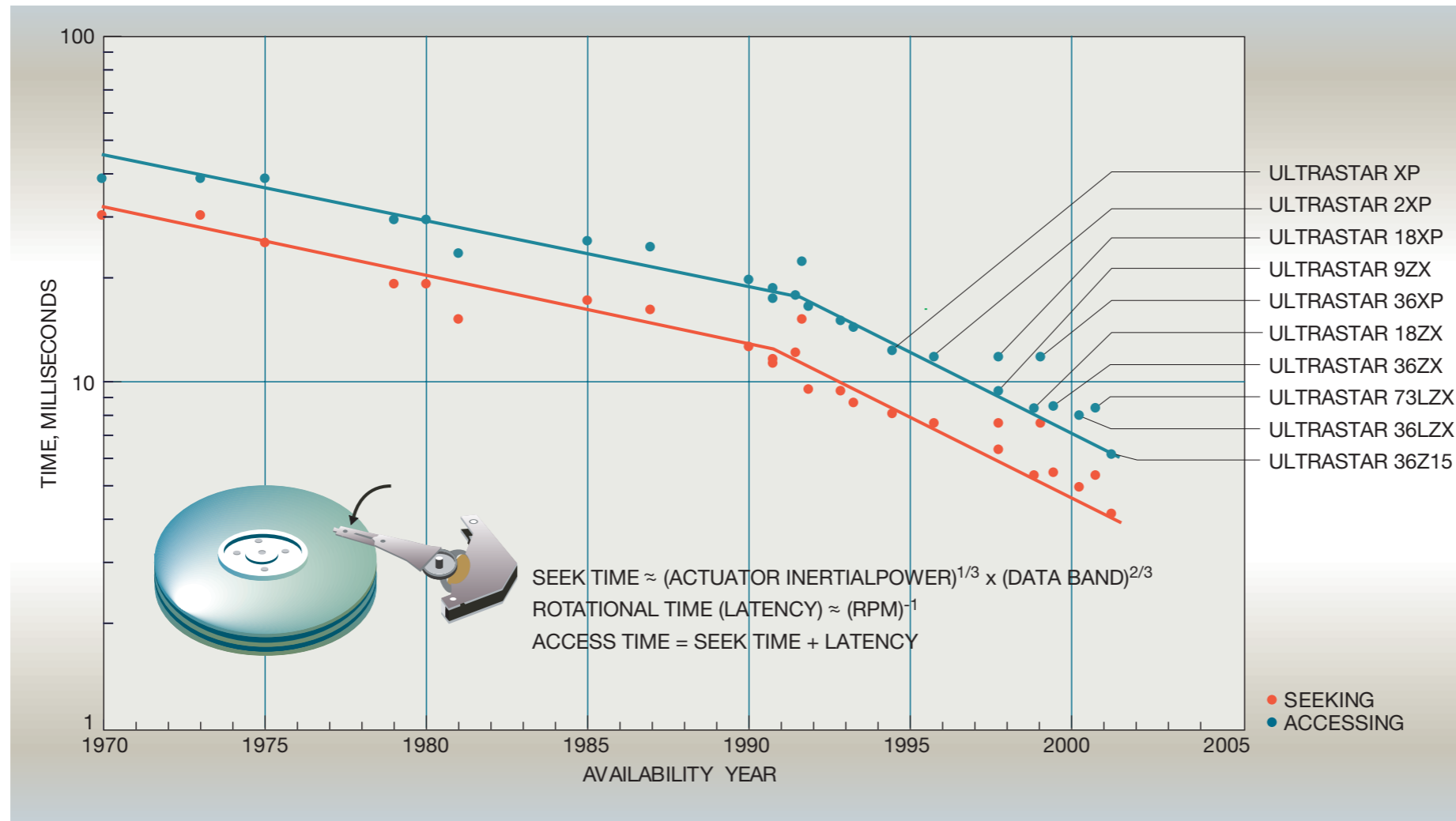


Evolution of Disk Form Factors

Technological impact of magnetic hard disk drives on storage systems,
Grochowski, R. D. Halem
IBM SYSTEMS JOURNAL, VOL 42, NO 2, 2003



Increase of Speed

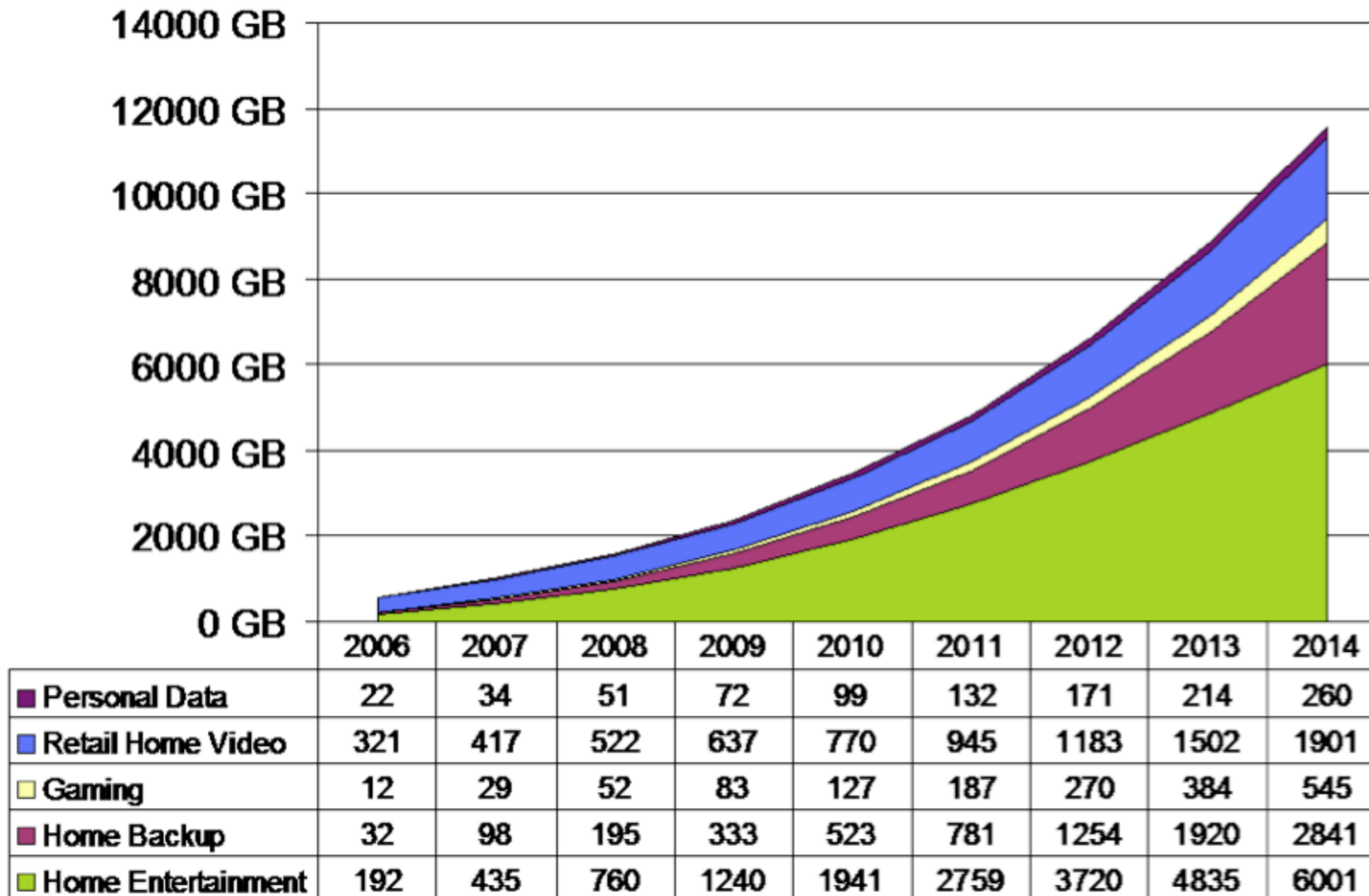


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Algorithms and Methods for Distributed Storage Networks

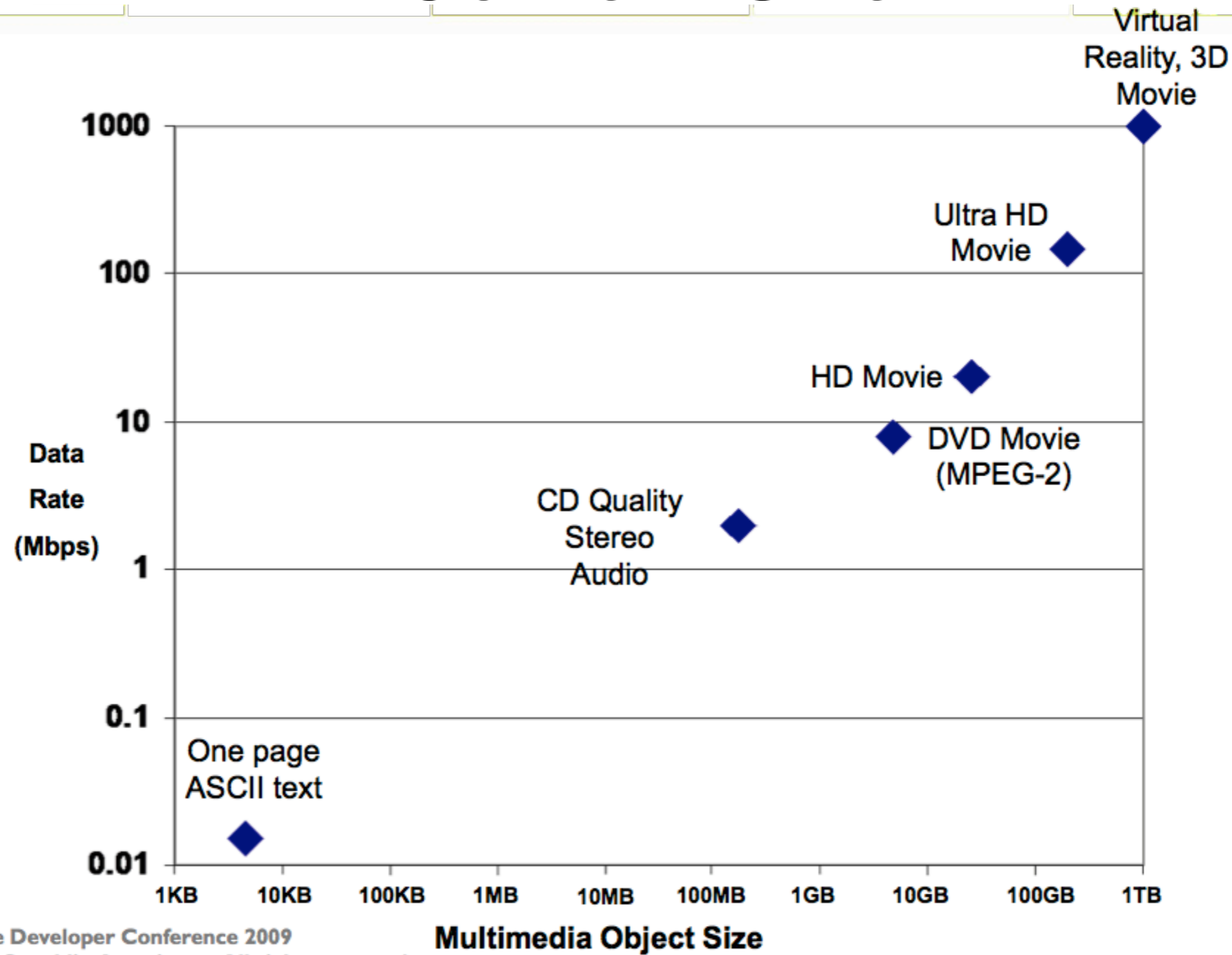
Motivation Consumer Behavior

Consumer Usage



•Consumer Survey on Digital Storage in Consumer Electronics (Coughlin Associates, 2008)

Content Size



Storage Hierarchy

- ▶ **Primary storage**
 - Processors registers
 - Processor cache
 - RAM
- ▶ **Secondary storage**
 - Hard disks
 - Solid state disks
 - CD, DVD
- ▶ **Tertiary storage**
 - tape libraries
 - optical jukeboxes

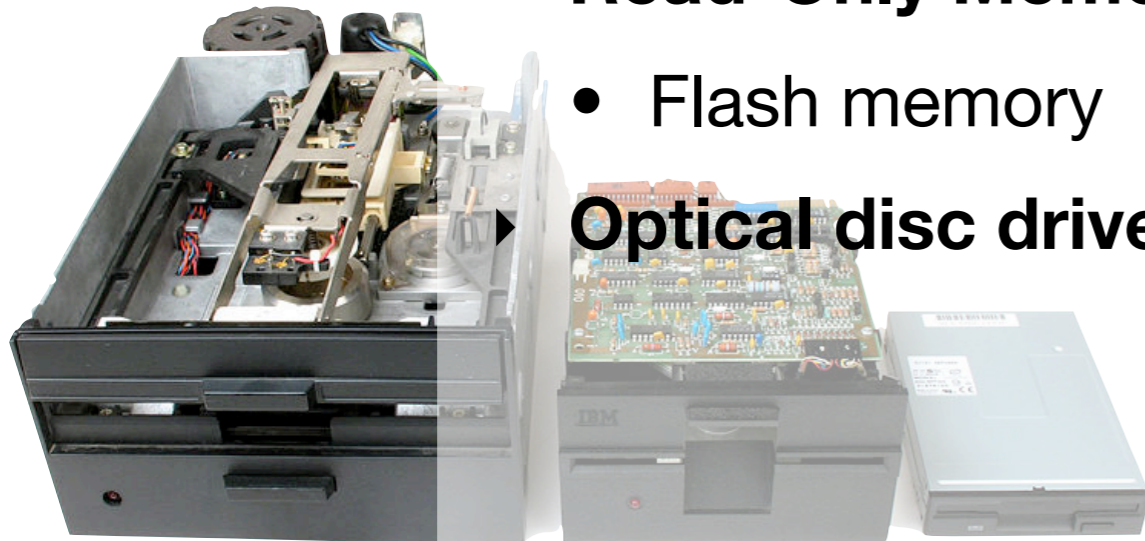
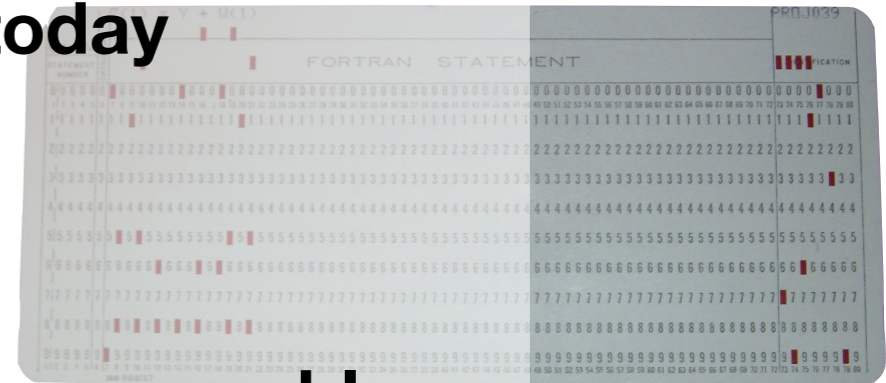
Characteristics of Storage

- ▶ **Volatile – non-volatile memory**
 - non-volatile: dynamic or static
- ▶ **Read & write – Read only – Slow write, fast read**
- ▶ **Random access – Sequential access**
- ▶ **Addressability**
 - location addressable
 - file addressable
 - content addressable
- ▶ **Capacity**
- ▶ **Performance**
 - Latency
 - Throughput

Non-volatile Storage Technologies



- ▶ **Punch cards (Hollerith) 1886-1950s**
- ▶ **Magnetic tape data storage 1951-today**
- ▶ **Hard disk drive 1956-today**
- ▶ **Floppy disks 1970s-1990s**
- ▶ **EEPROM (Electrically Erasable Programmable Read-Only Memory) 1980-today**
 - Flash memory



Network Storage Types

- ▶ **Direct attached storage (DAS)**
 - traditional storage
- ▶ **Network attached storage (NAS)**
 - storage attached to another computer accessible at file level over LAN or WAN
- ▶ **Storage area network (SAN)**
 - specialized network providing other computers with storage capacity with access on block-addressing level
- ▶ **File area network (FAN)**
 - systematic approach to organize file-related storage systems
 - organization wide high-level storage network



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