



Computer Architecture

Lecture 12: Basics of I/O and Storage Systems



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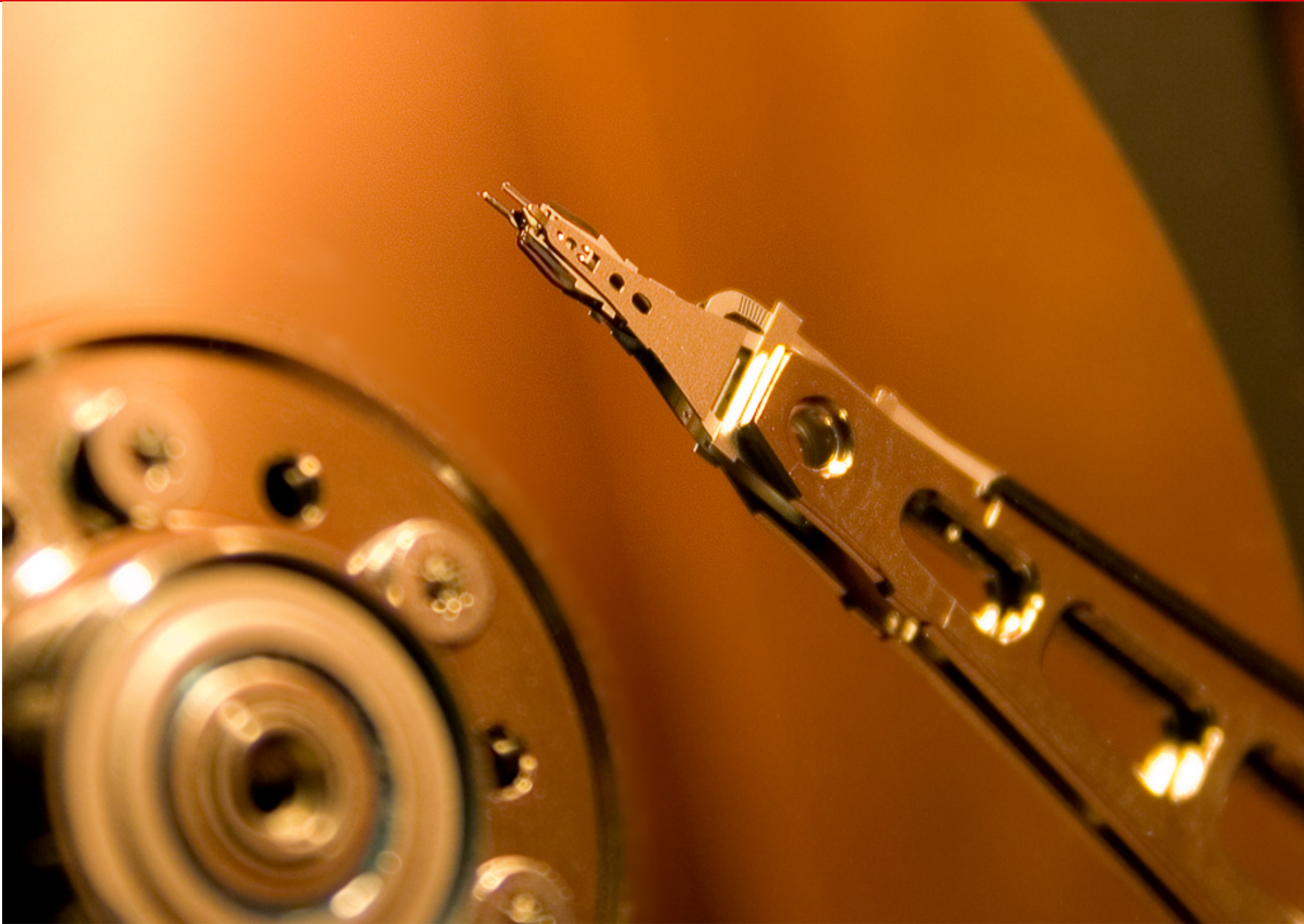
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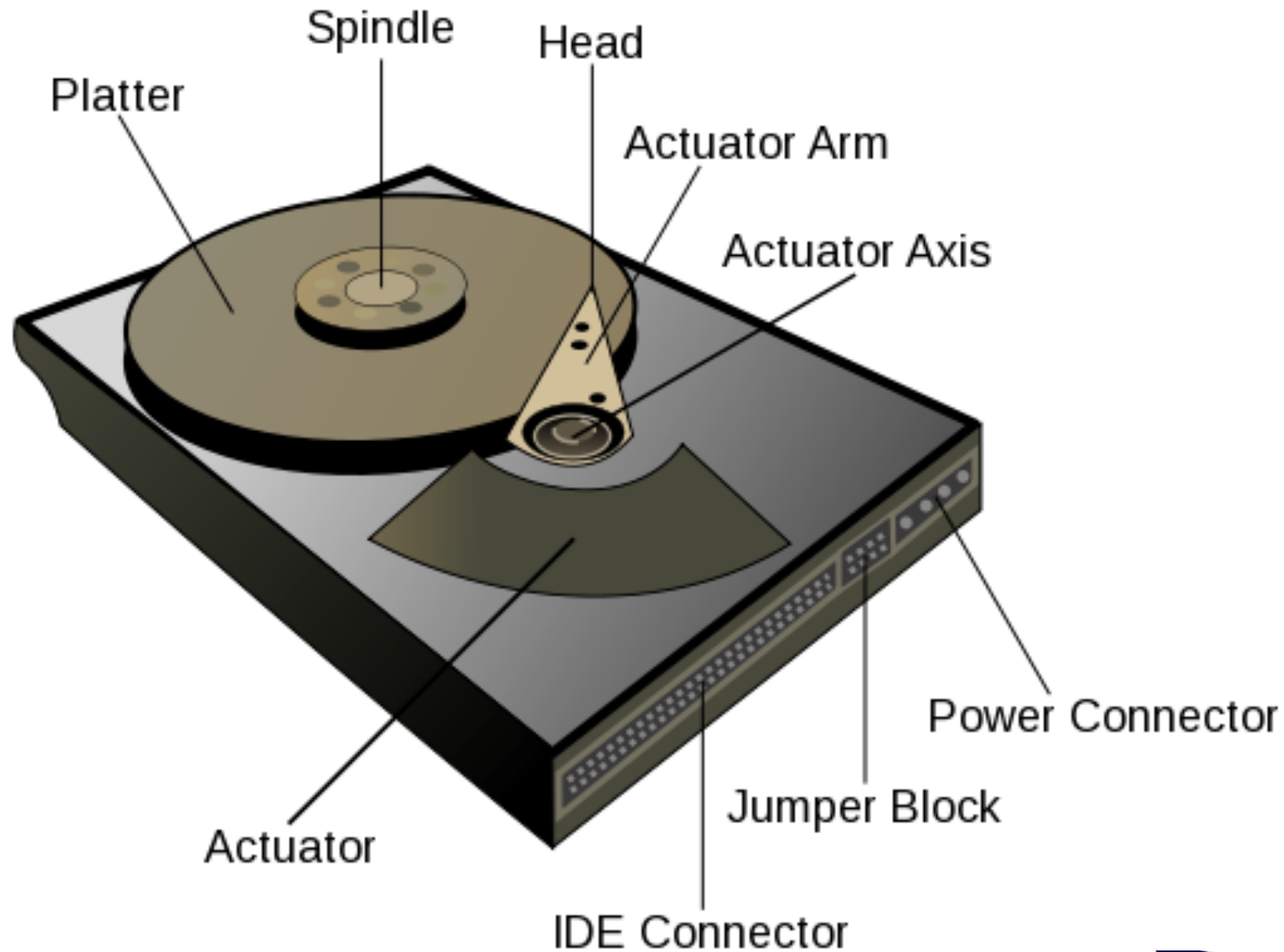
Platter, Spindle, Arm, and Head





- What's a Disk Drive?
- The Importance of a Disk Drive
- The Insides of a Disk Drive
- The Access Time Gap
- Disk Drive Trends
- A Little History
- The Basics of a Bus
- Homework

What's a Disk Drive?



What's Important About a Disk Drive?



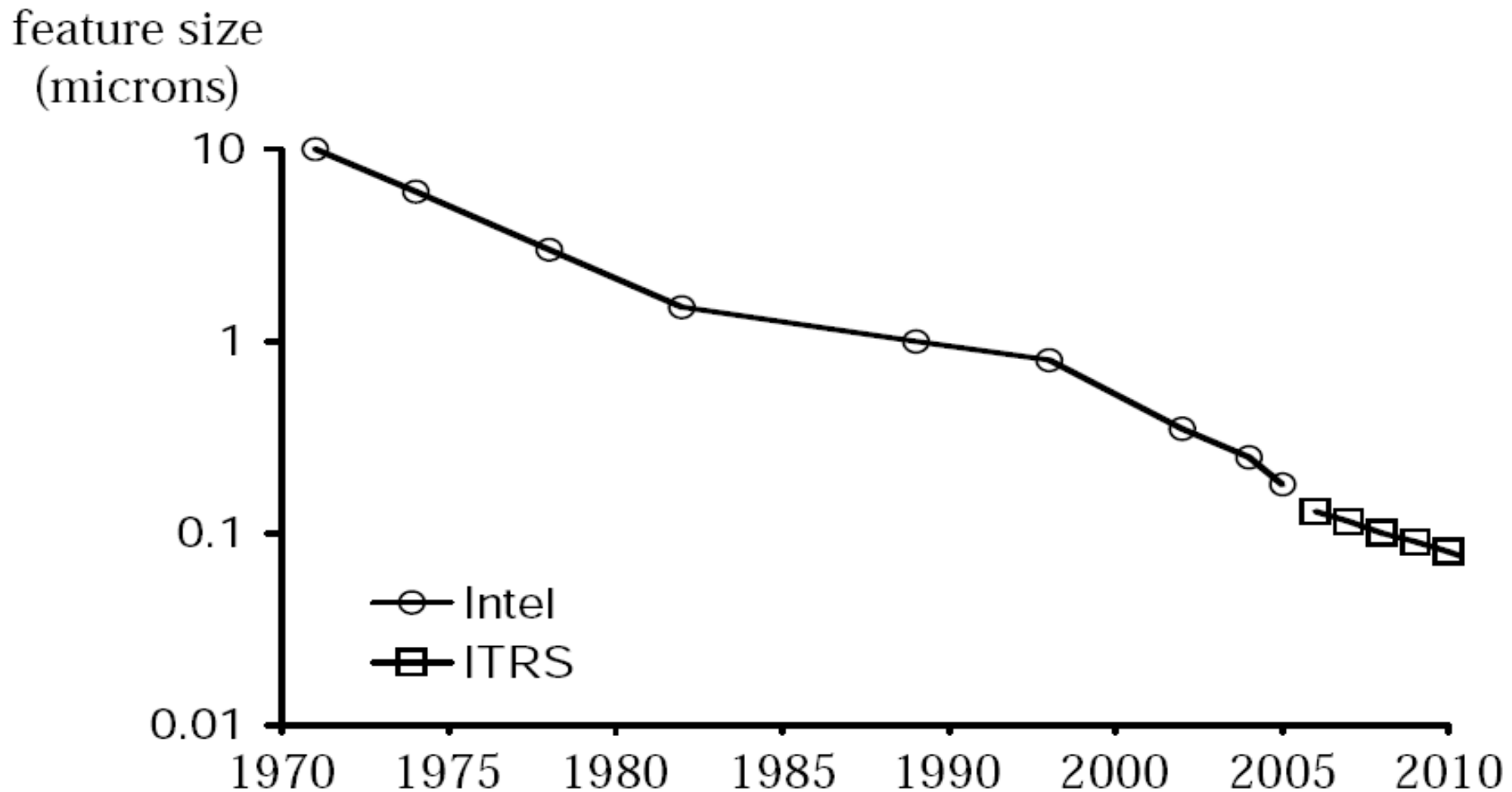
- Expensive
- Consume lots of power
- Performance bottleneck
- Fragile

But they hold your data without power (they are *nonvolatile*), for a long time! Lots and lots of data!

Moore's Law



Minimum Feature Size

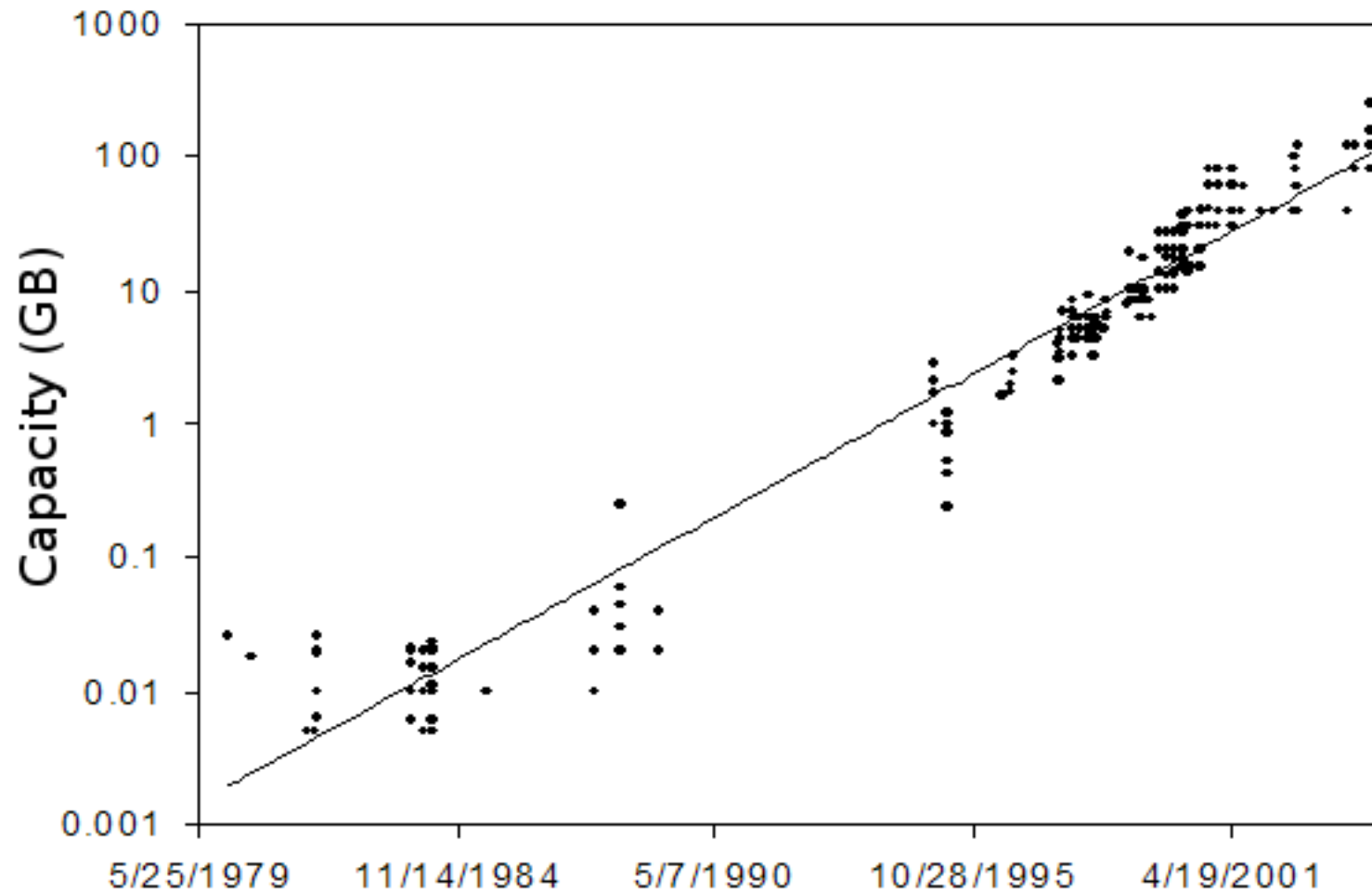


The decreasing minimum feature size of transistor components is shown for both Intel products and data reported by the International Technology Roadmap for Semiconductors (ITRS).

Growth of Capacity Over Two Decades



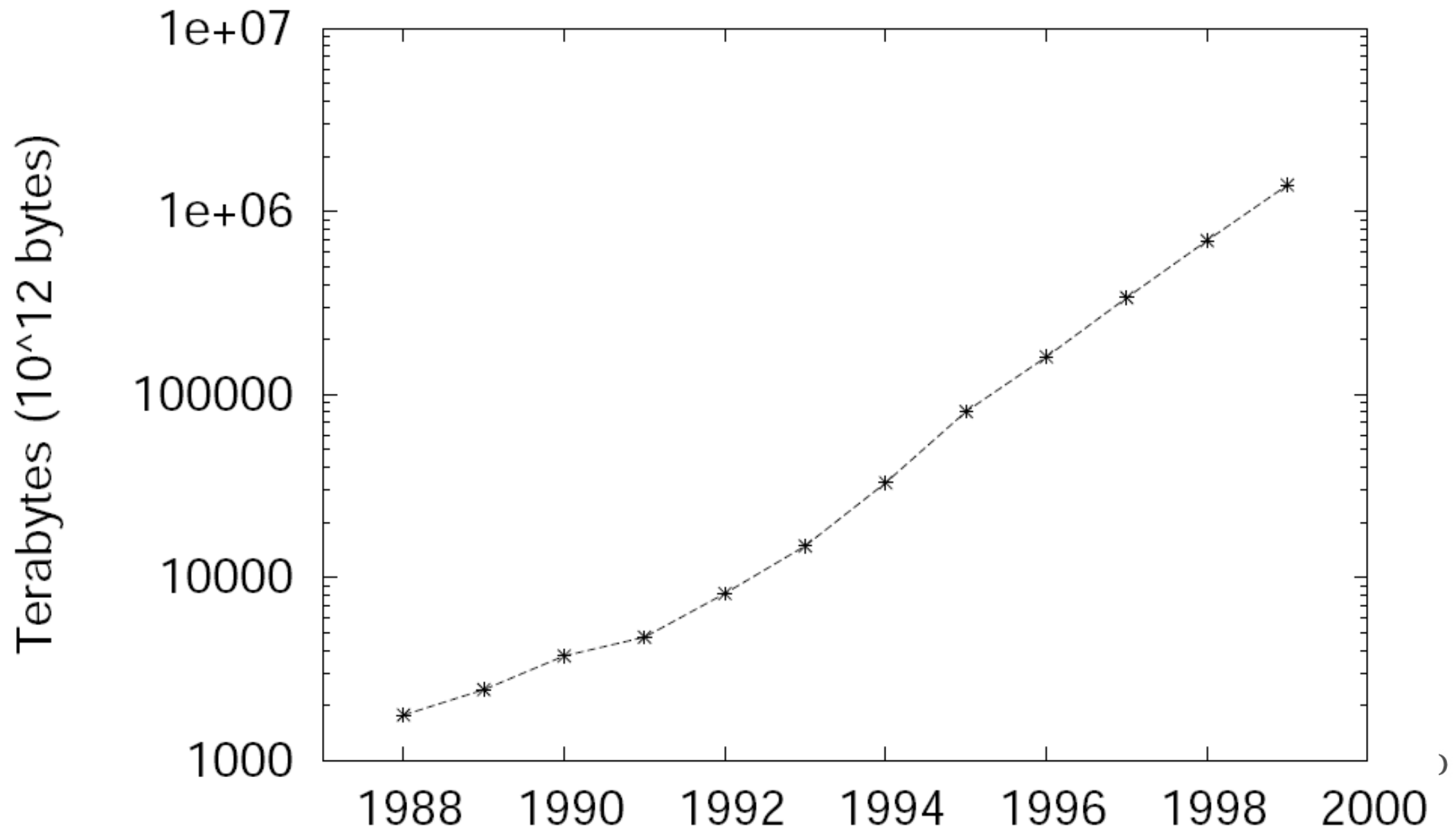
Hard drive capacity



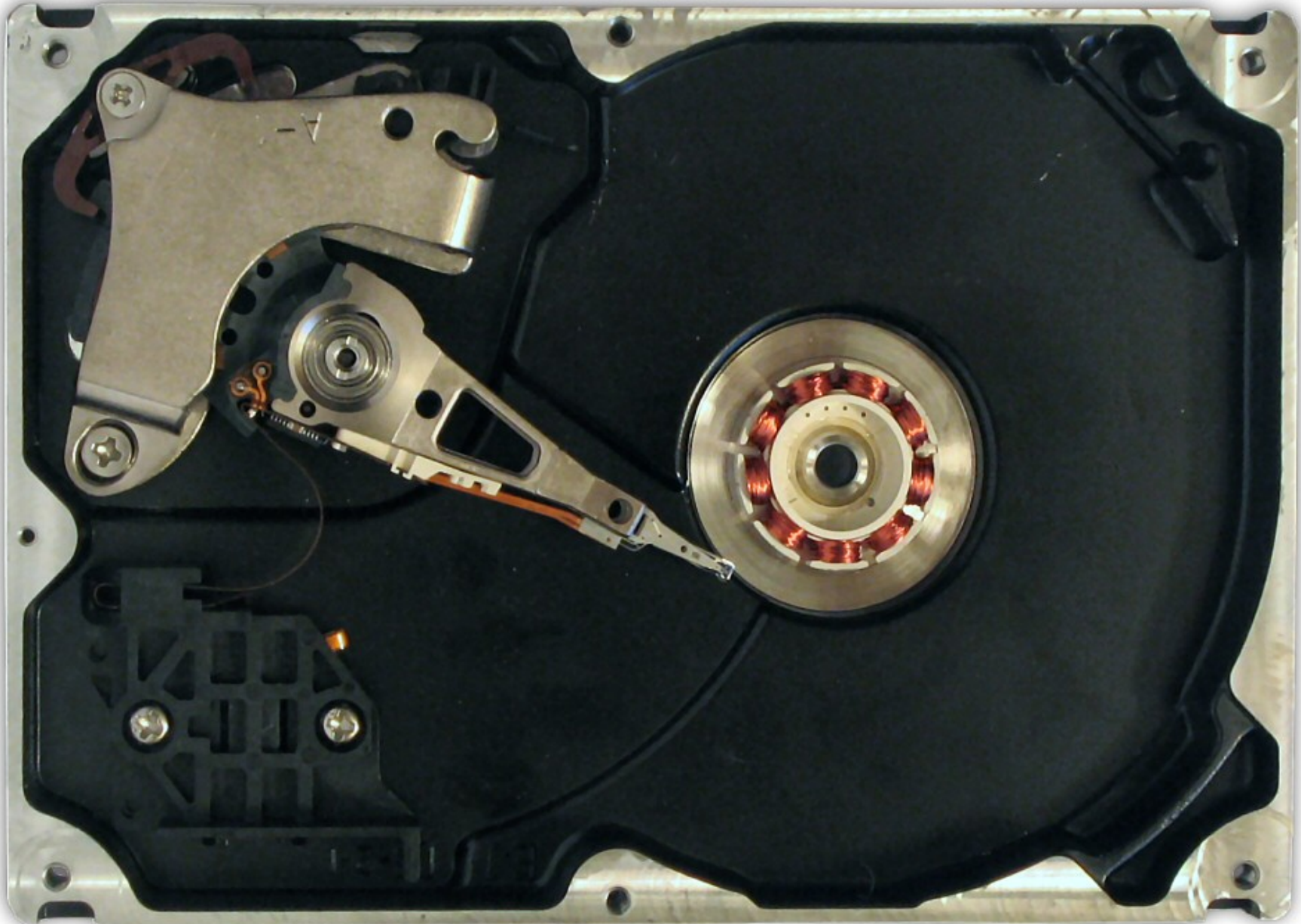
Global Disk Shipments (in TB)



Total Global Disk Shipments



What's a Disk Drive?



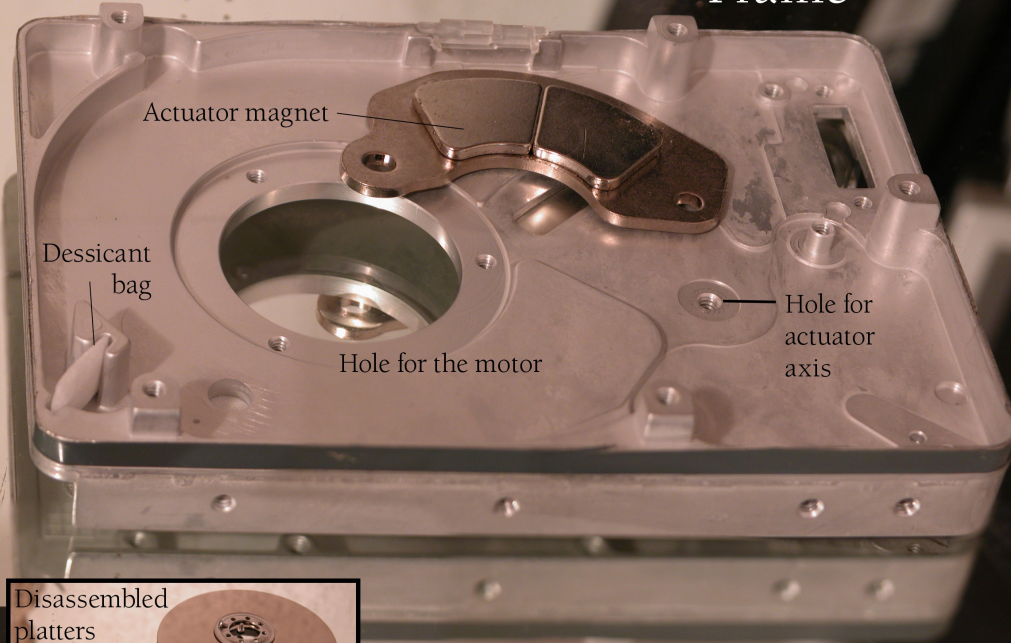
Anatomy of a Hard Drive



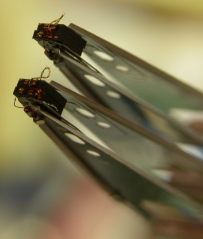
Anatomy of a Hard Disk Drive

Western Digital
Caviar 22100, 2111.8 MB

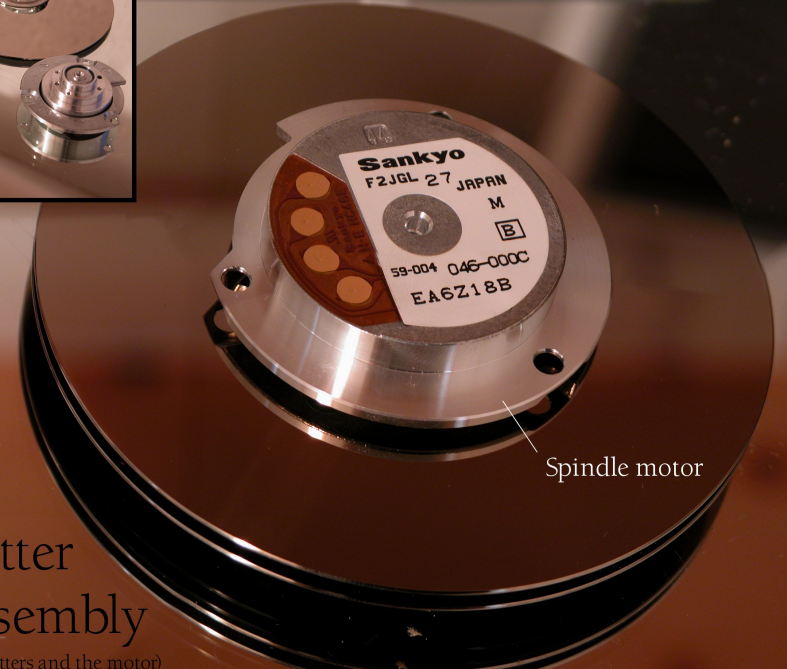
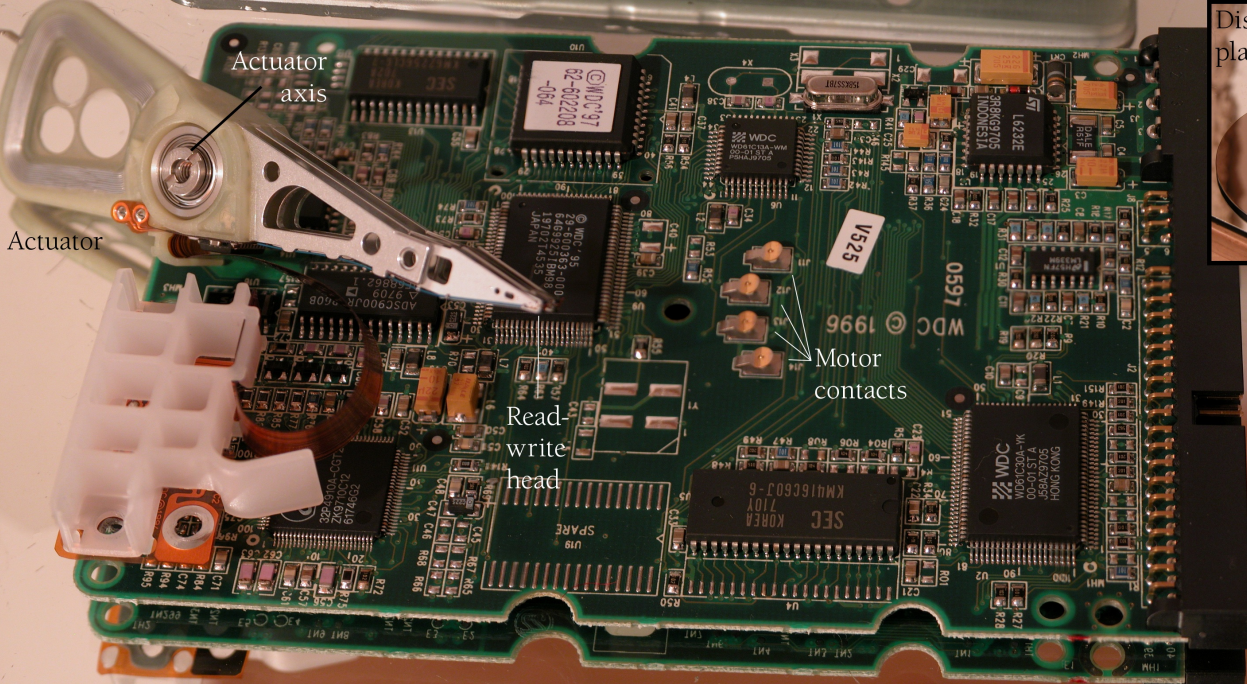
Frame



Closeup of the read-write head



Cover
(upside down)



Controller

Platter
Assembly
(two platters and the motor)

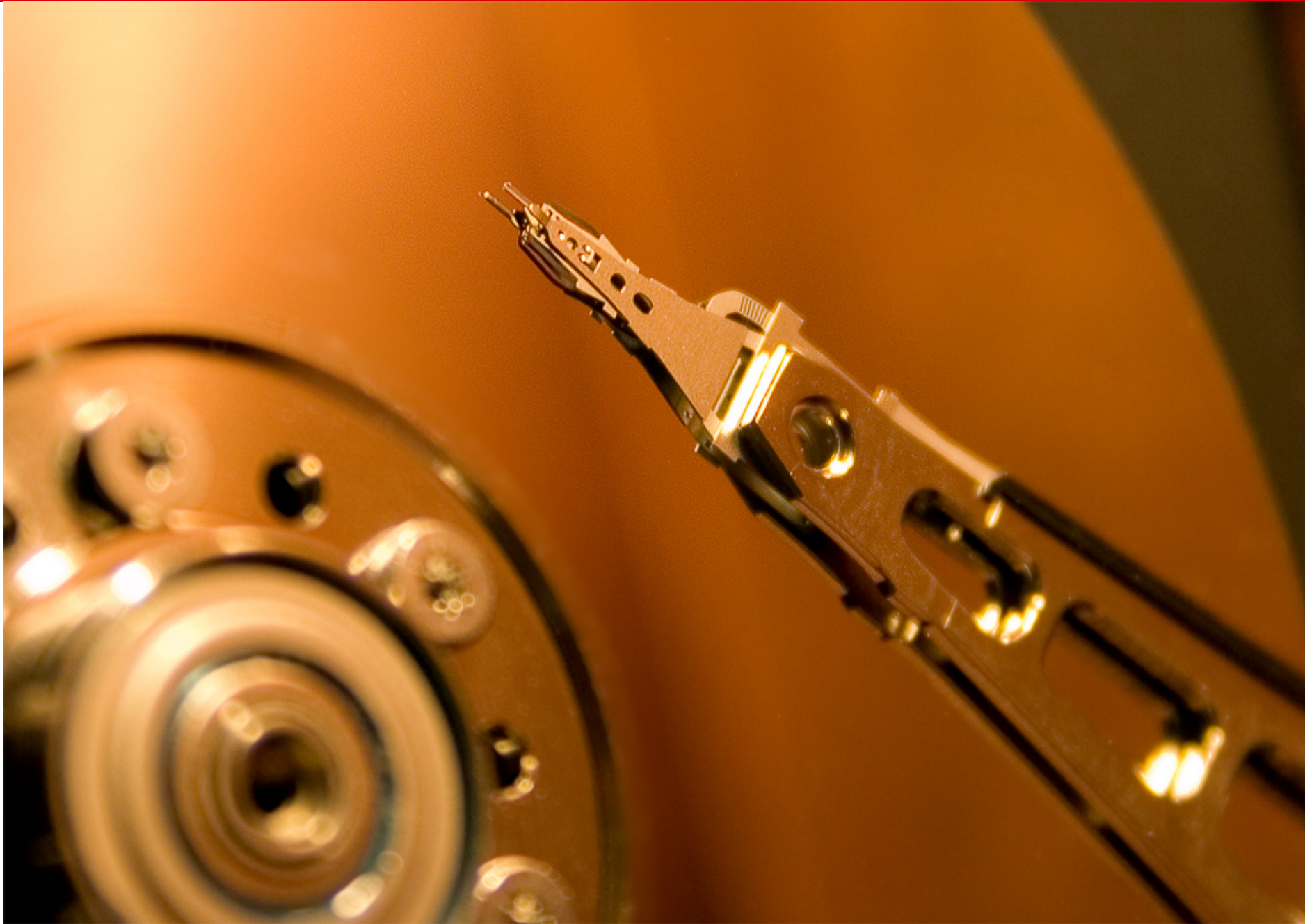
The Platter(s)



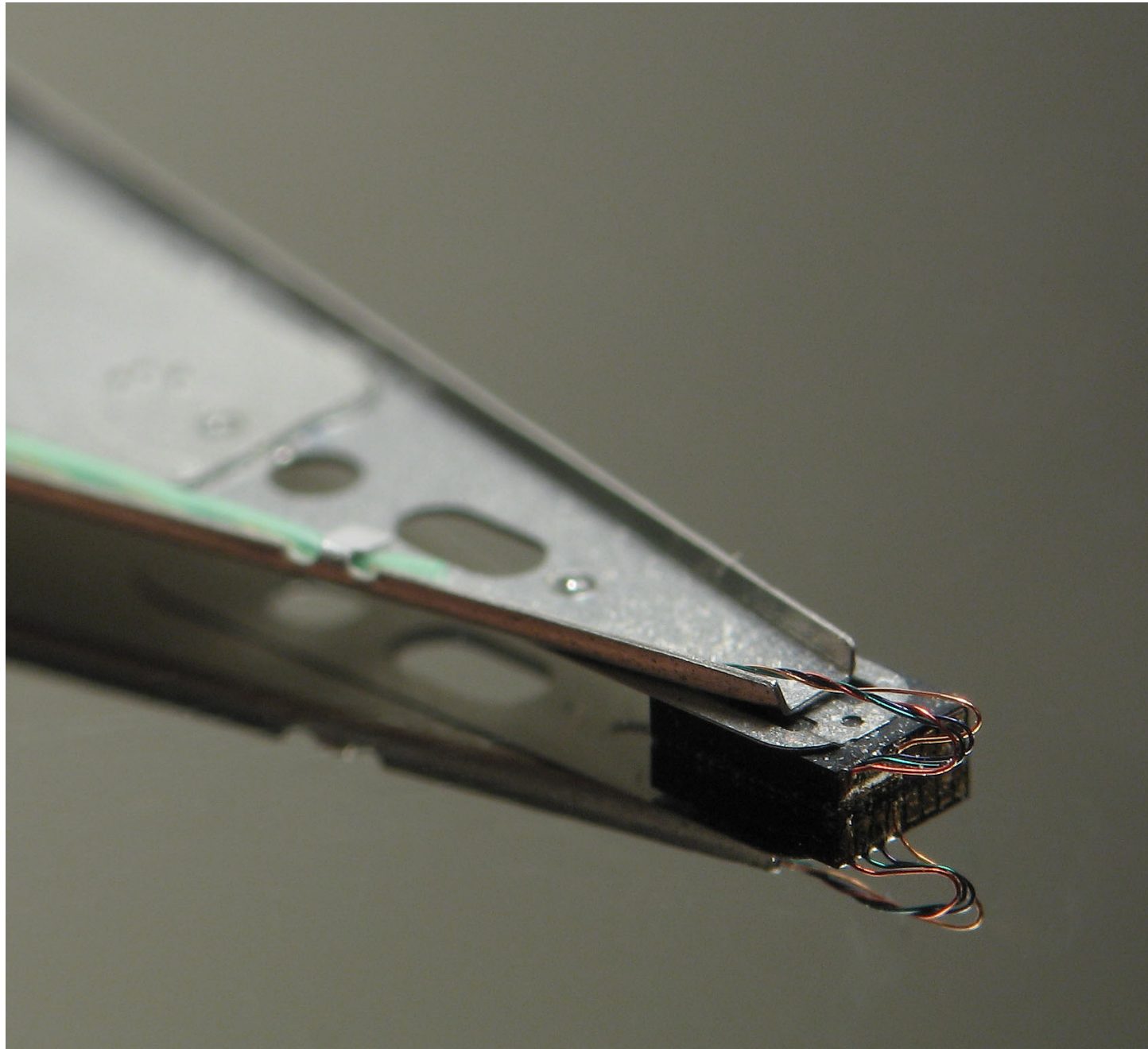
The Platters: 3 Disks, 6 Arms & Heads



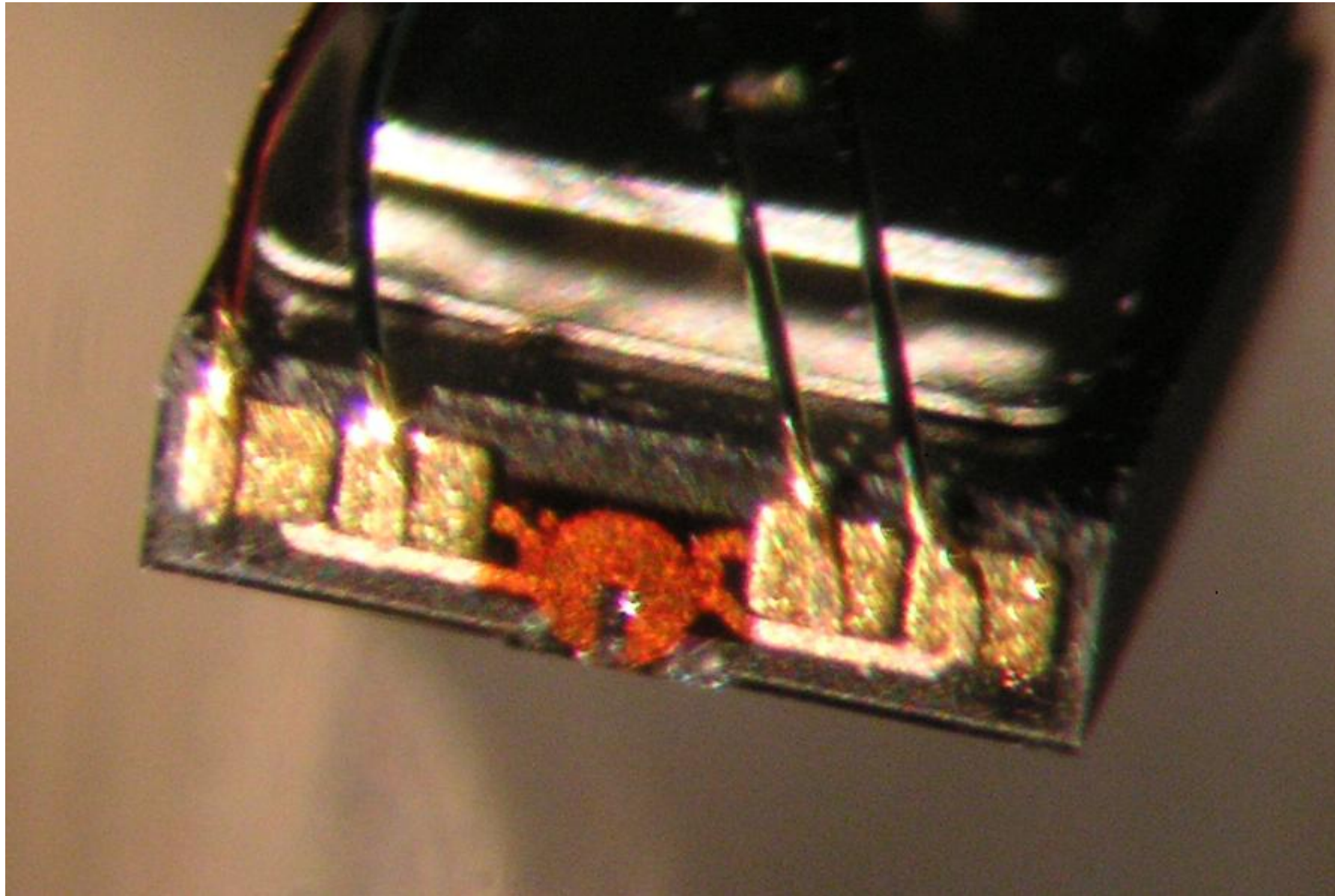
Platter, Spindle, Arm, and Head



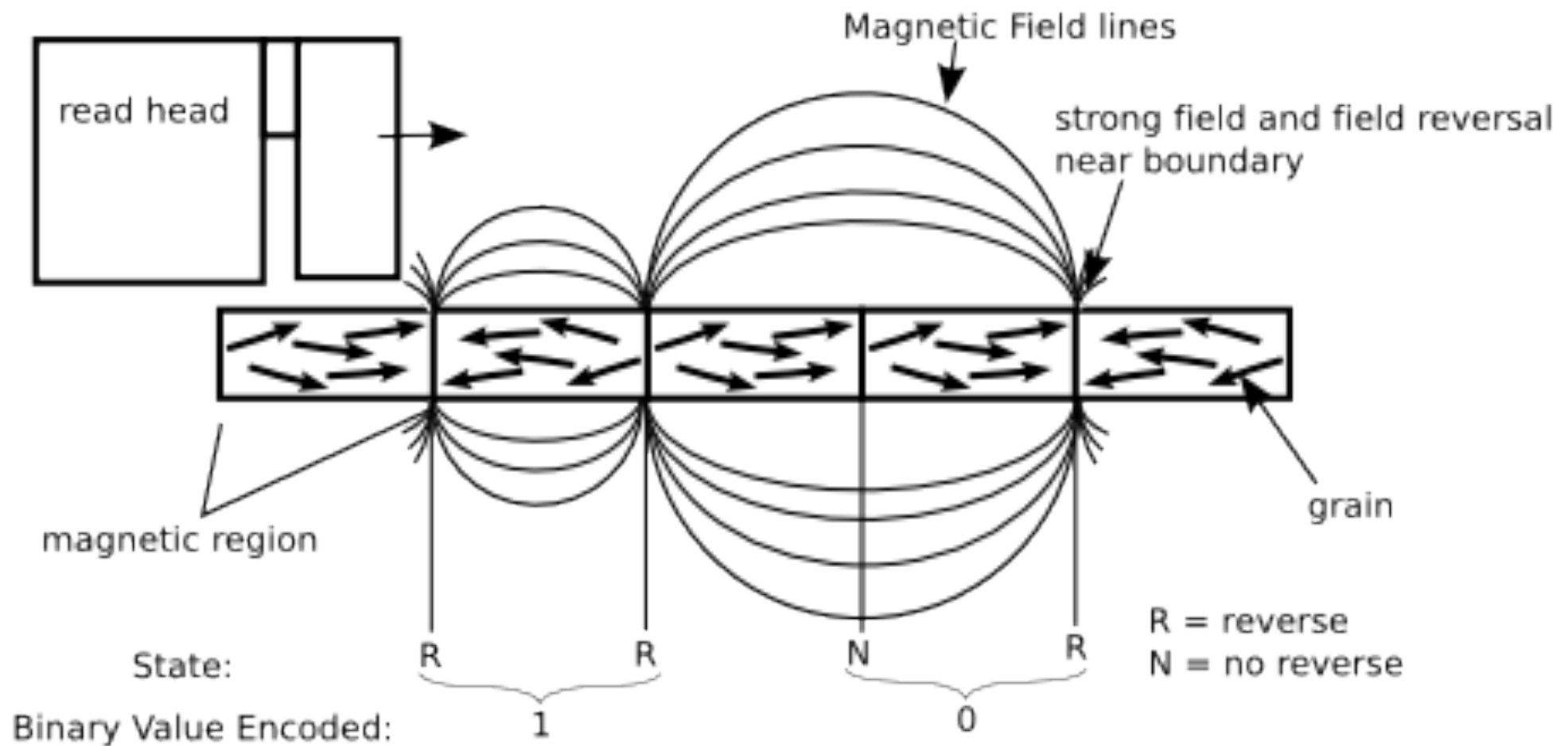
Arm, Slider & Read/Write Head



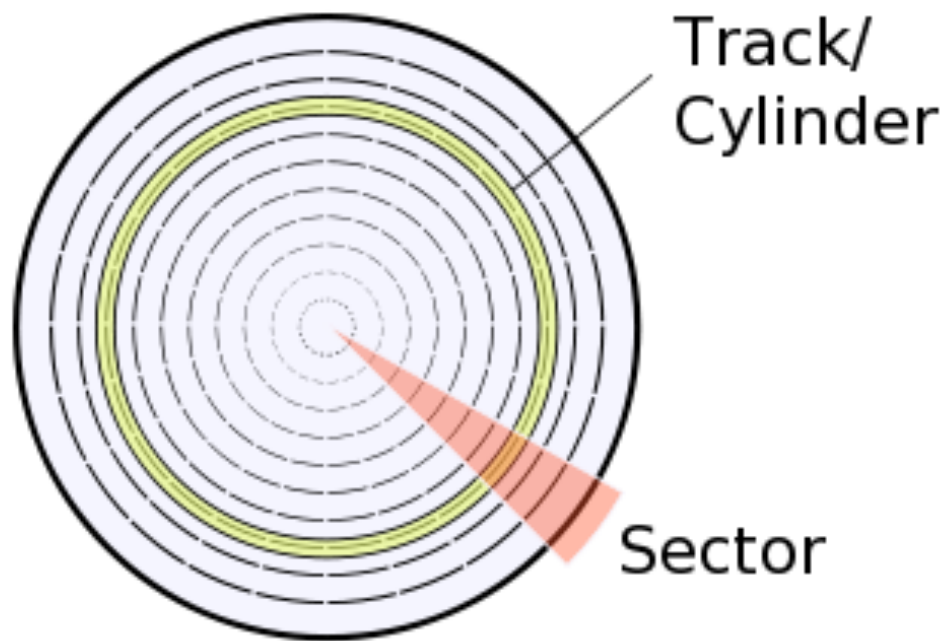
The Head on the Slider



Magnetic Media & R/W Head



Cylinder, Head, Sector (CHS)



Video: Arm Moving

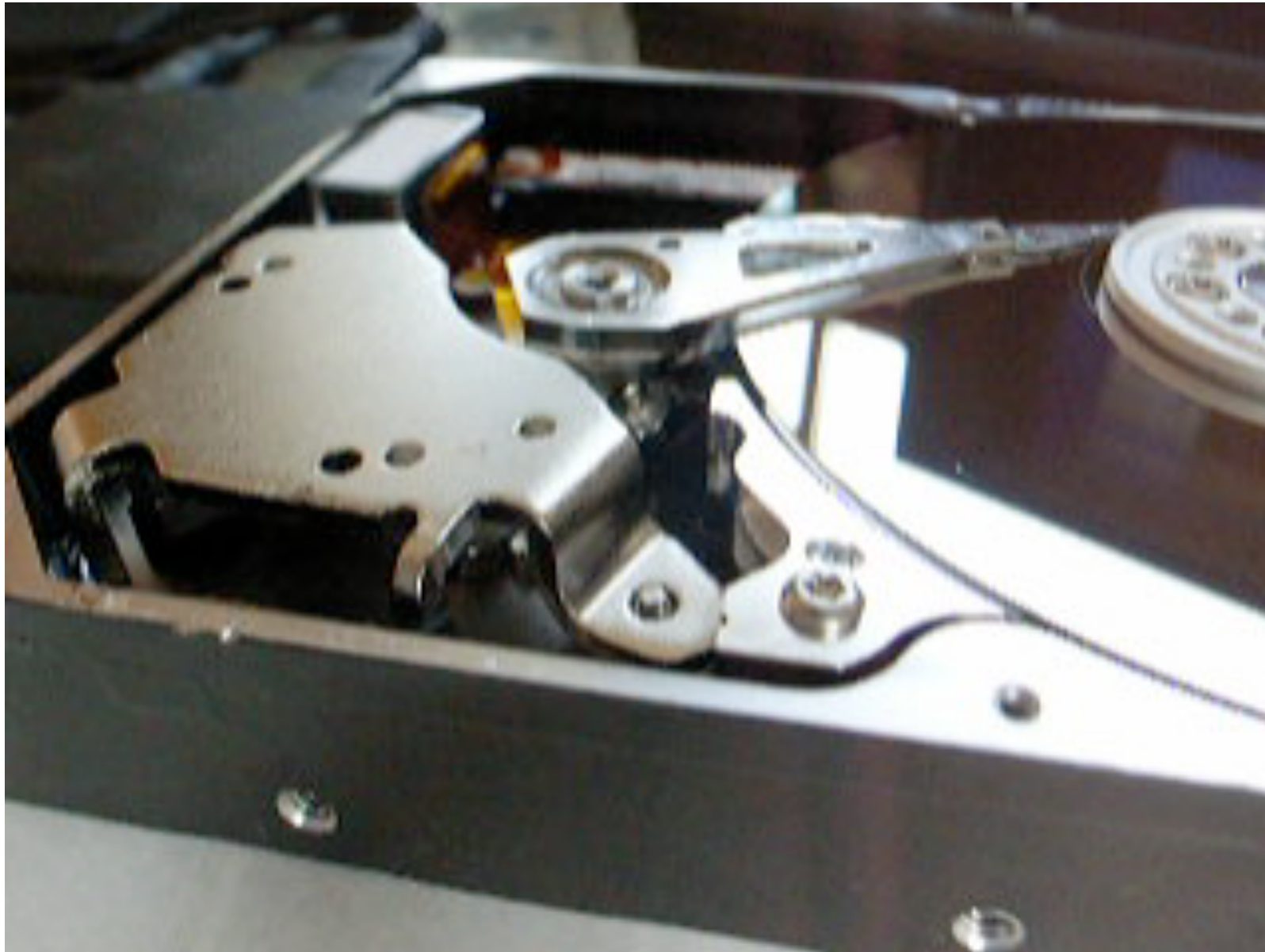


Video courtesy of Jun Takei, Intel



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Video: Arm Moving (2)



video courtesy of Sanjiv Kumar, Intel

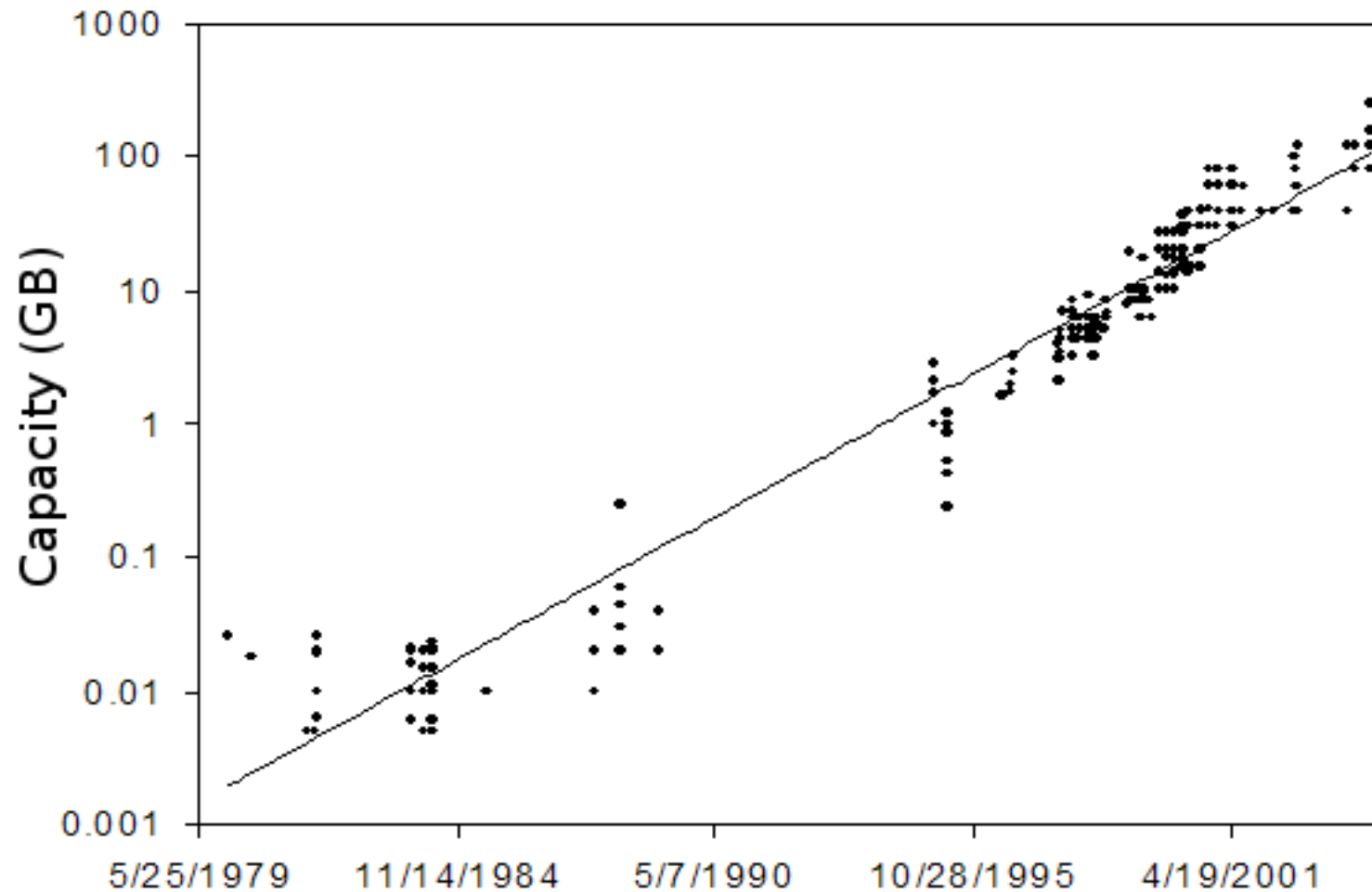


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Growth of Capacity Over Two Decades



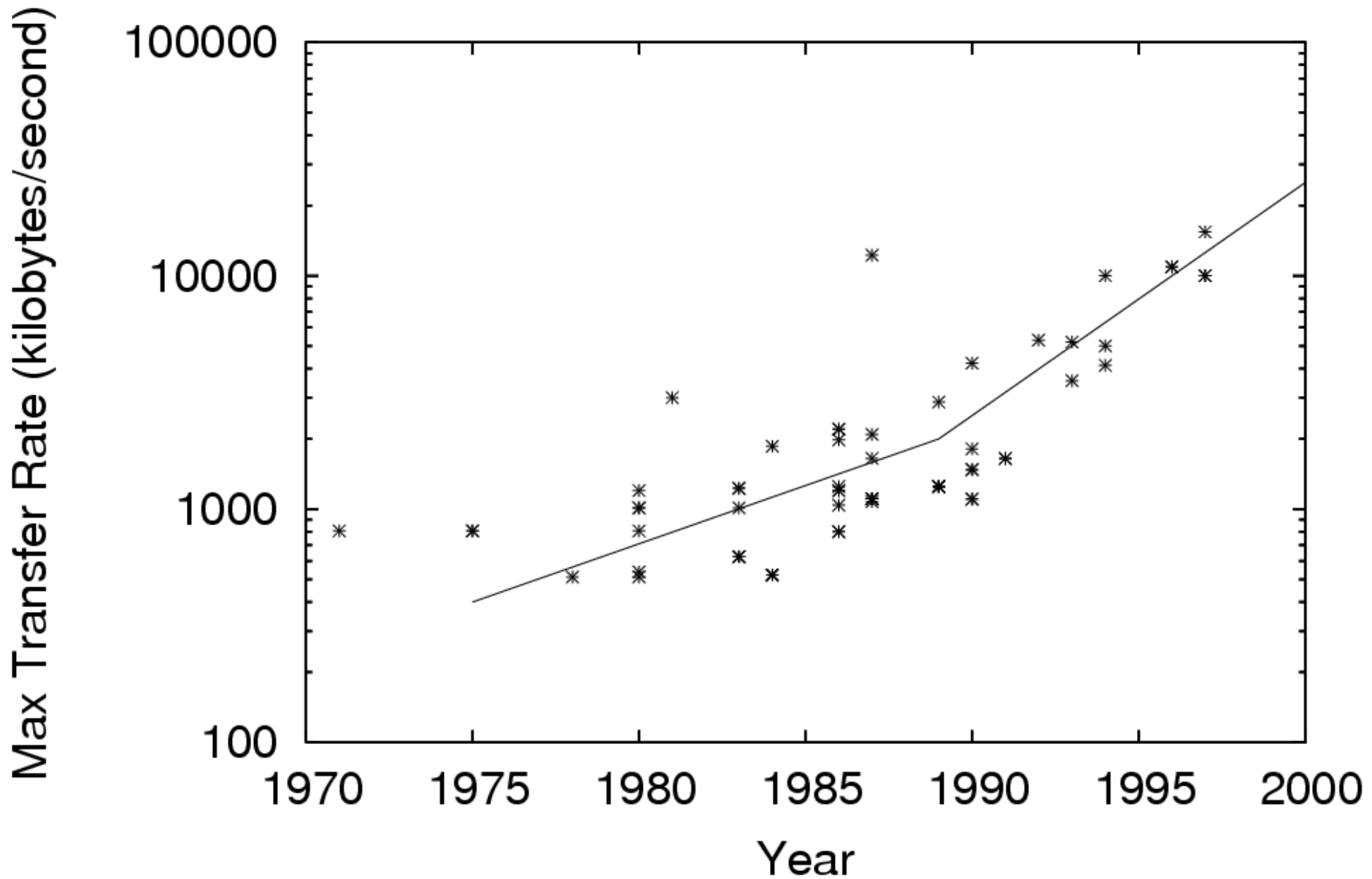
Hard drive capacity



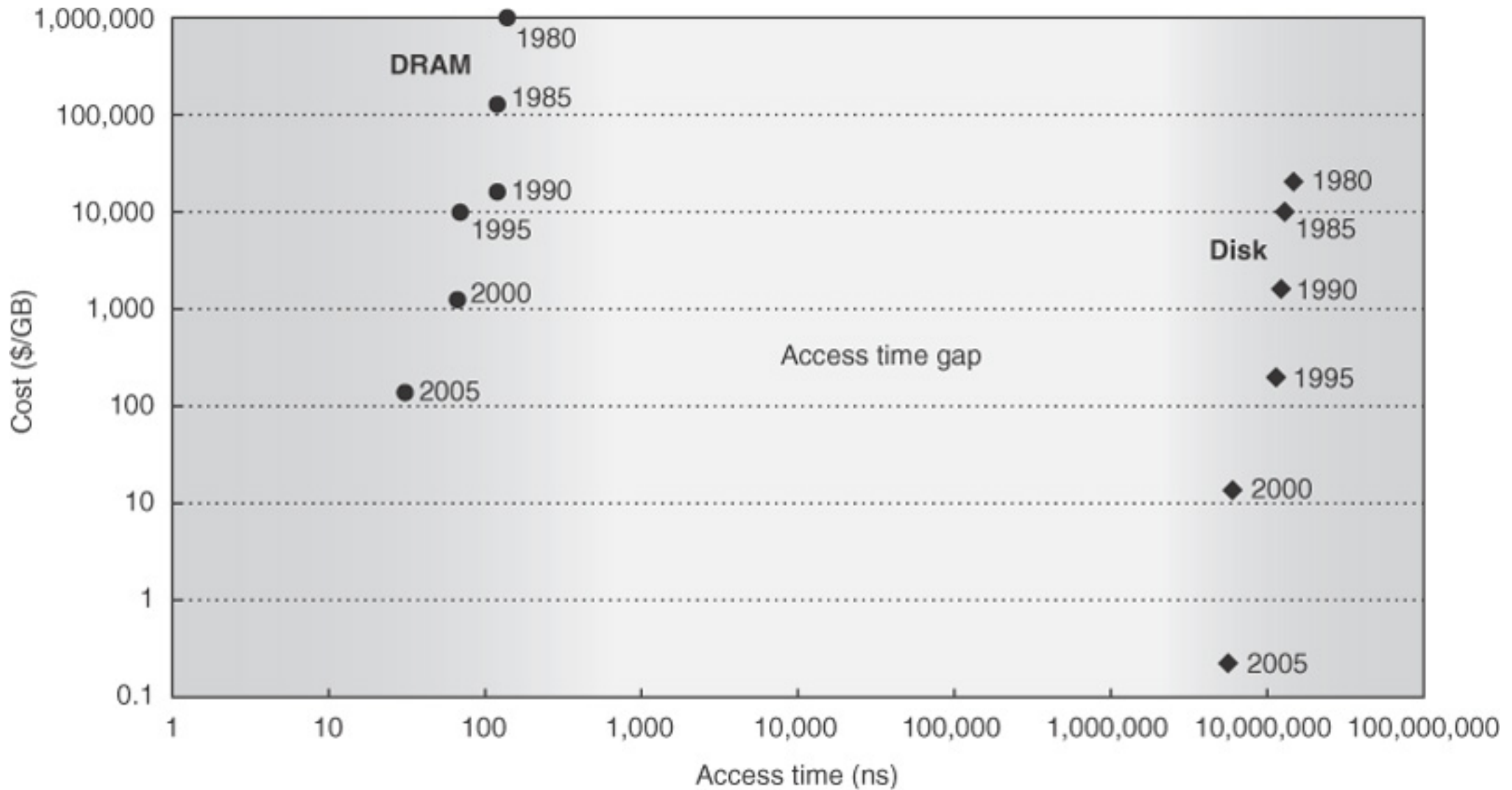
Transfer Rate



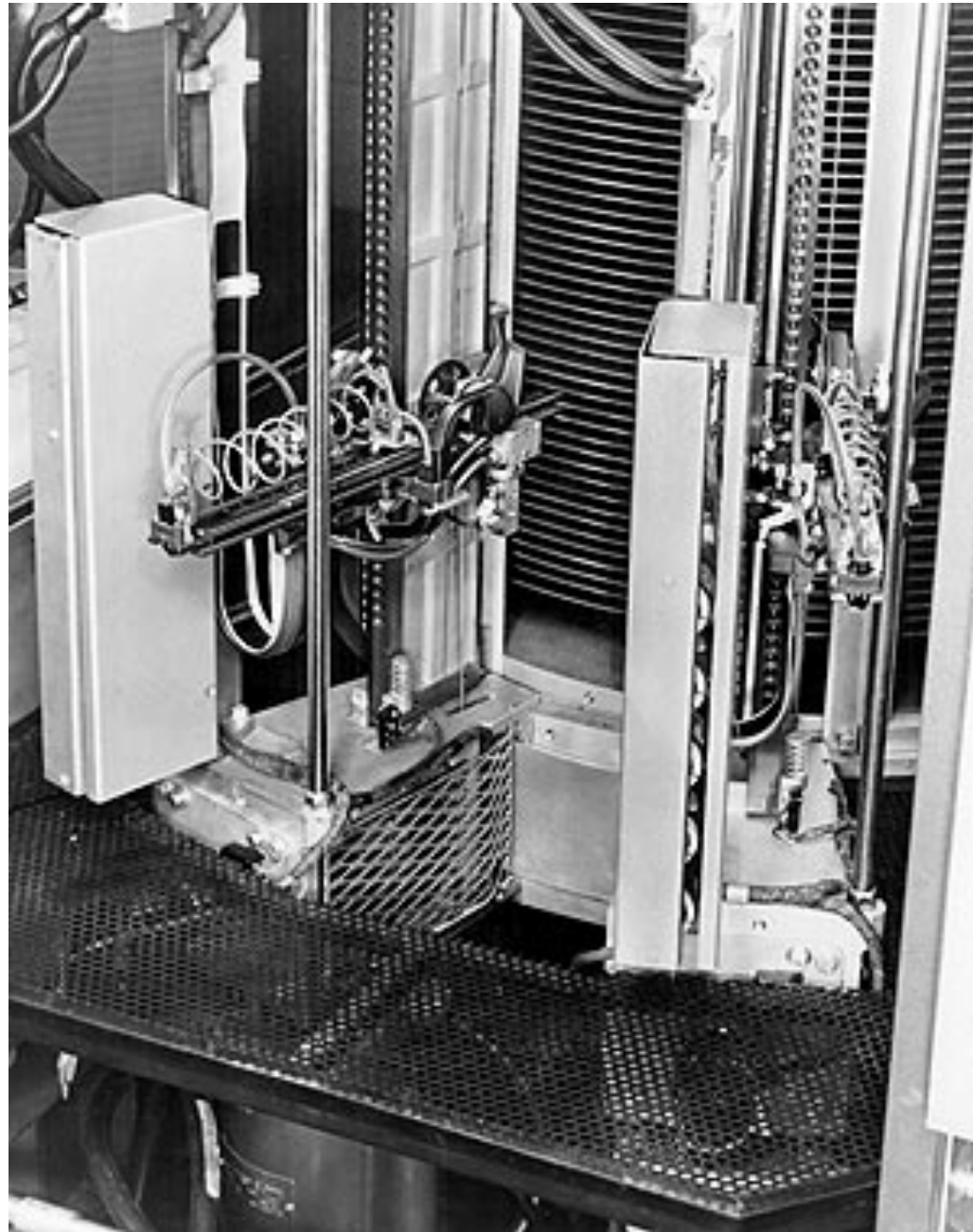
Magnetic Disk Transfer Rate Trends



Access Time Gap



A Little History: The RAMAC



A Little History: The RAMAC



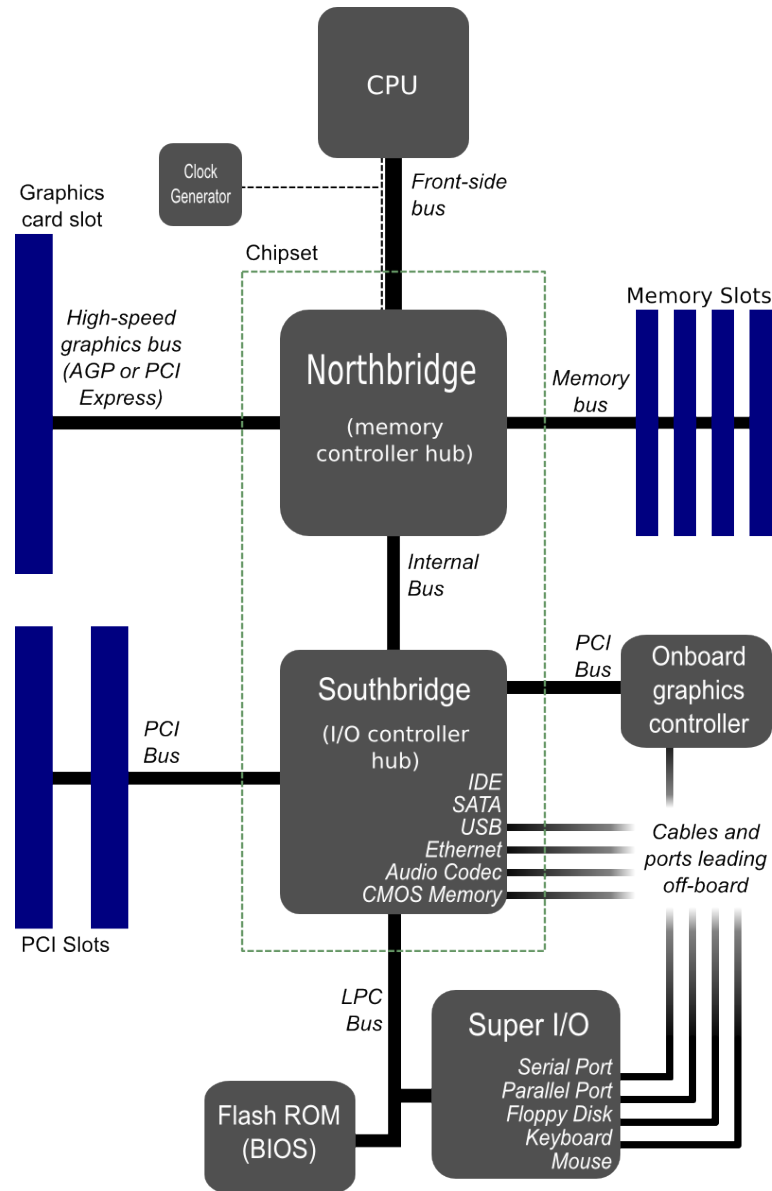
RAMAC Delivery!





- Shared bandwidth
- Requires addressing
- Transactions
- Arbitration: priority, fairness
- Limitations: width, length (capacitance, 電気容量)
- Types: memory, peripheral
- Standardization

Buses: System Diagram



Buses: System Diagram

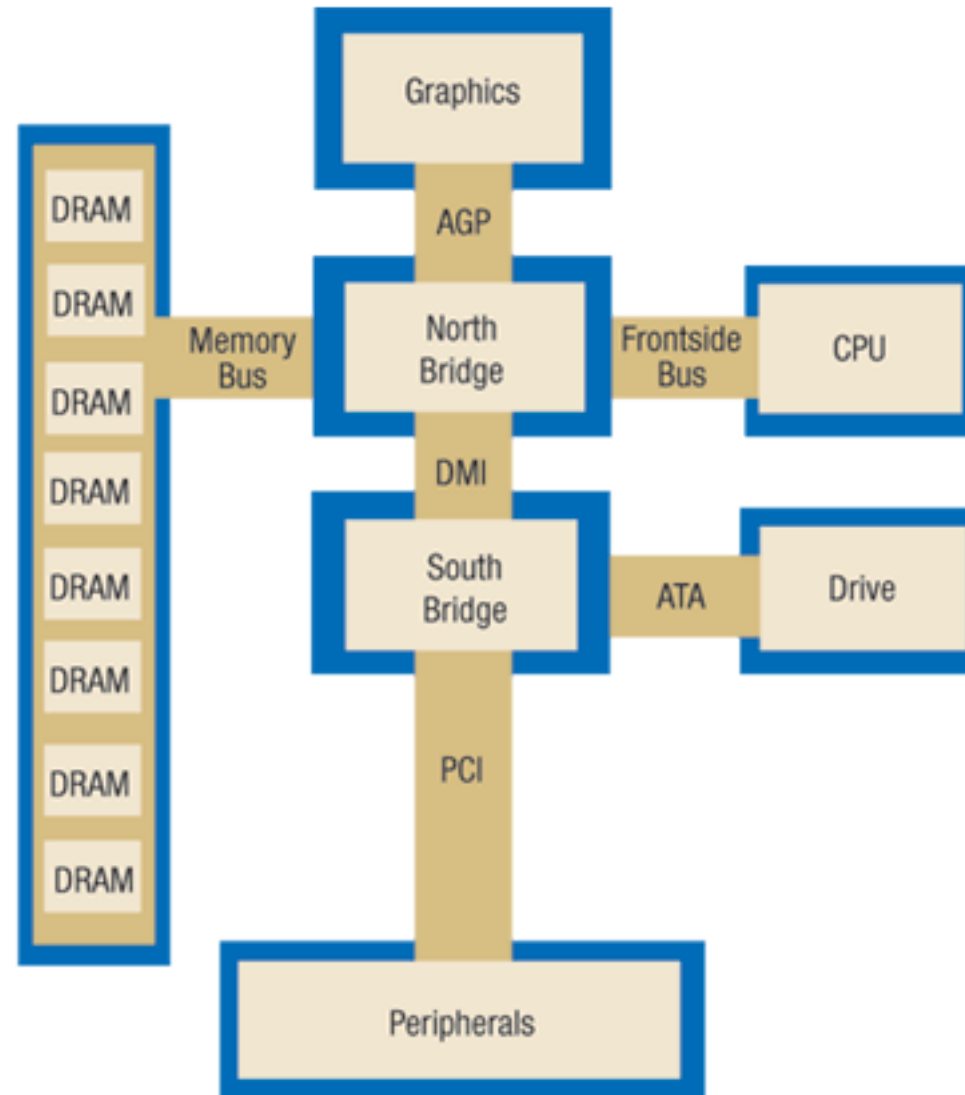


Figure 1 Major semiconductor content of standard motherboard.