Performance

Dina Katabi & Sam Madden
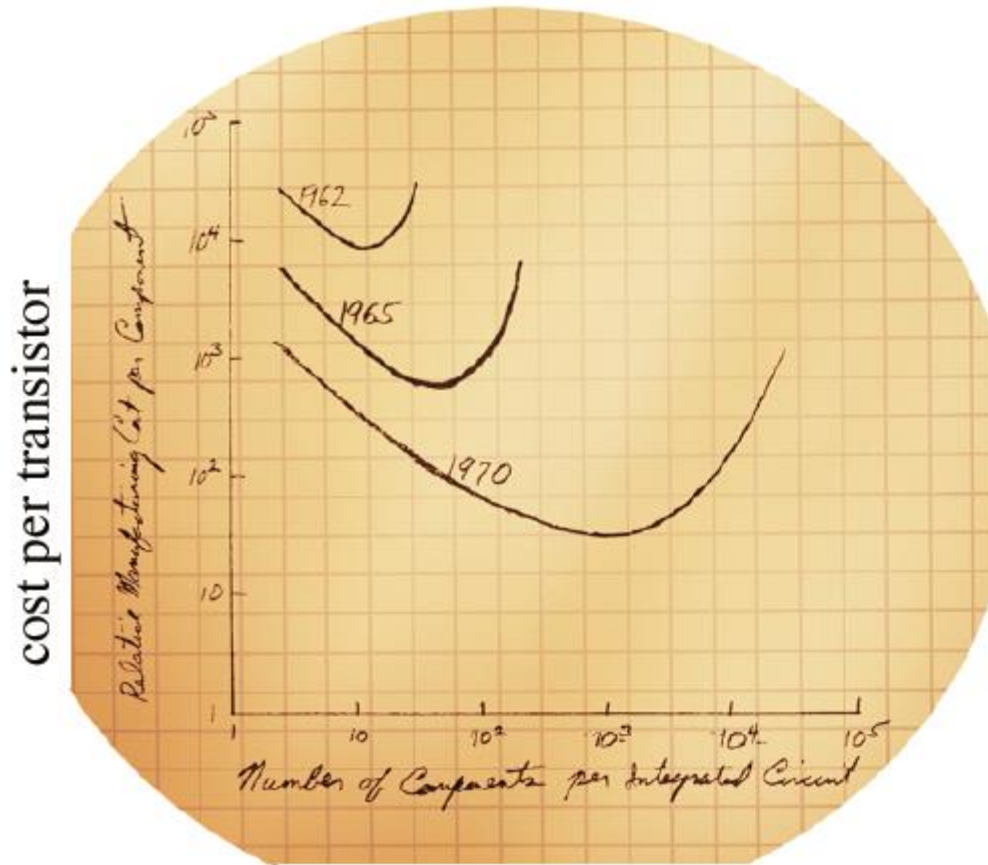
6.033 Spring 2014
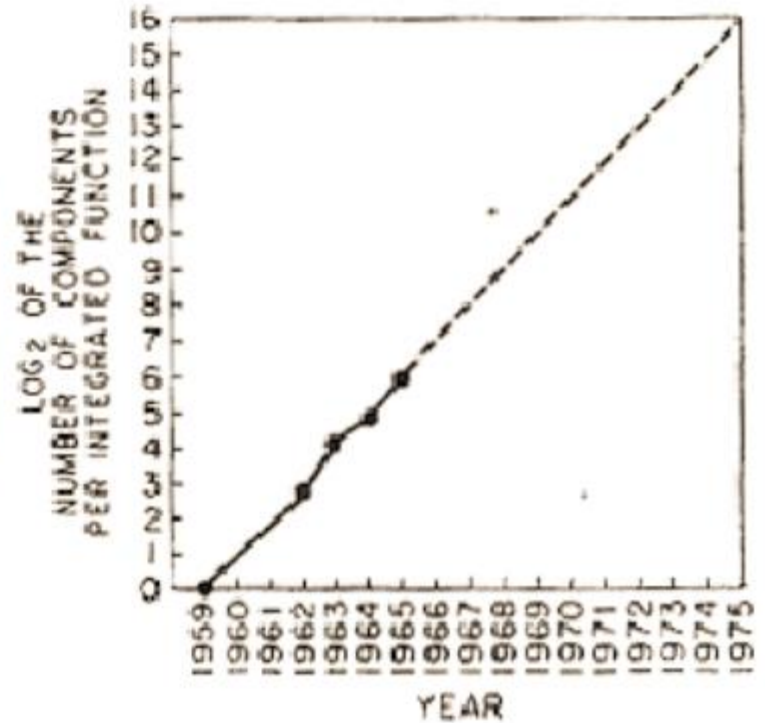
http://web.mit.edu/6.033

Moore's law

cost per transistor
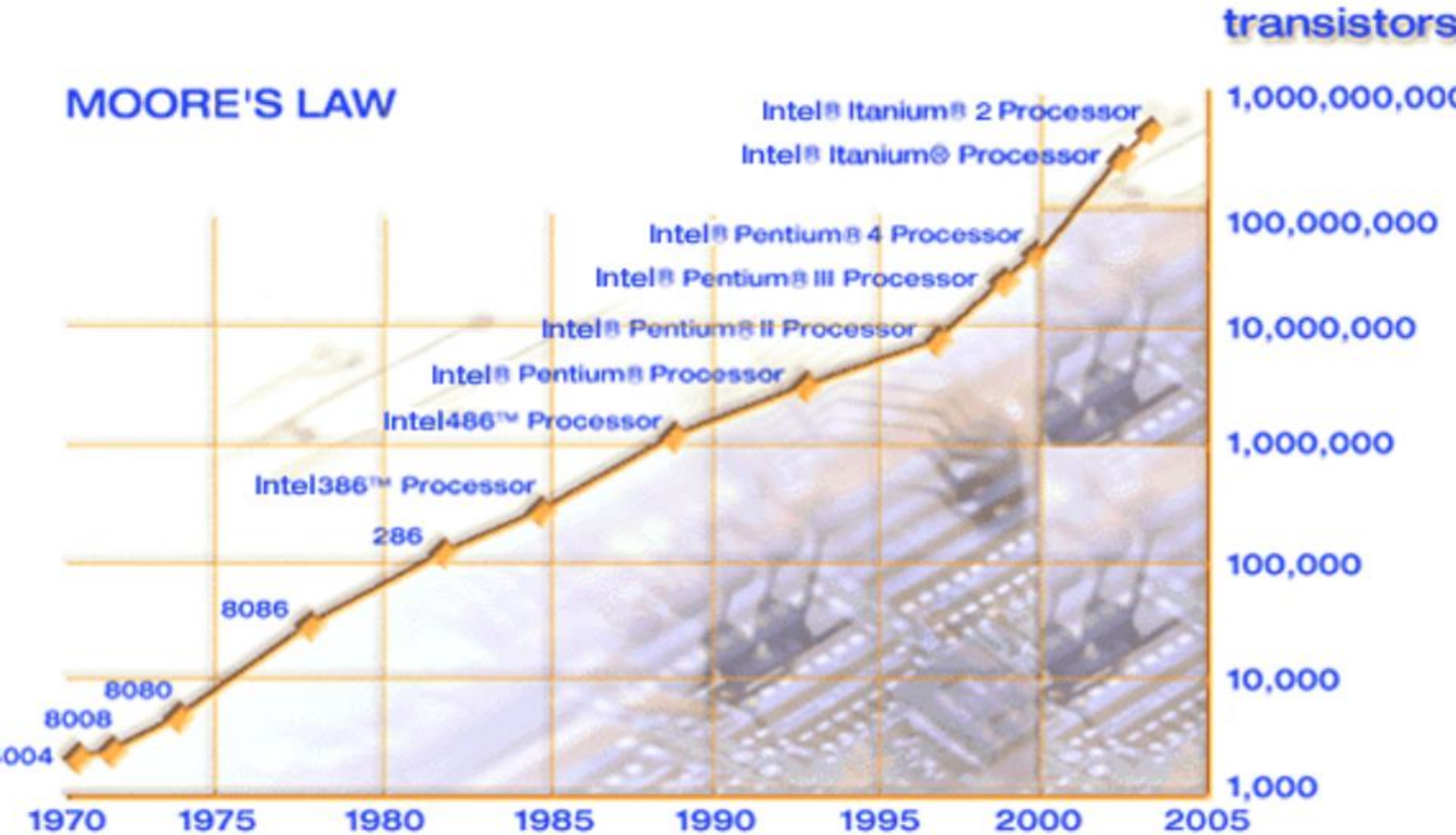
transistors per die

LOG2 OF THE NUMBER OF COMPONENTS PER INTEGRATED FUNCTION
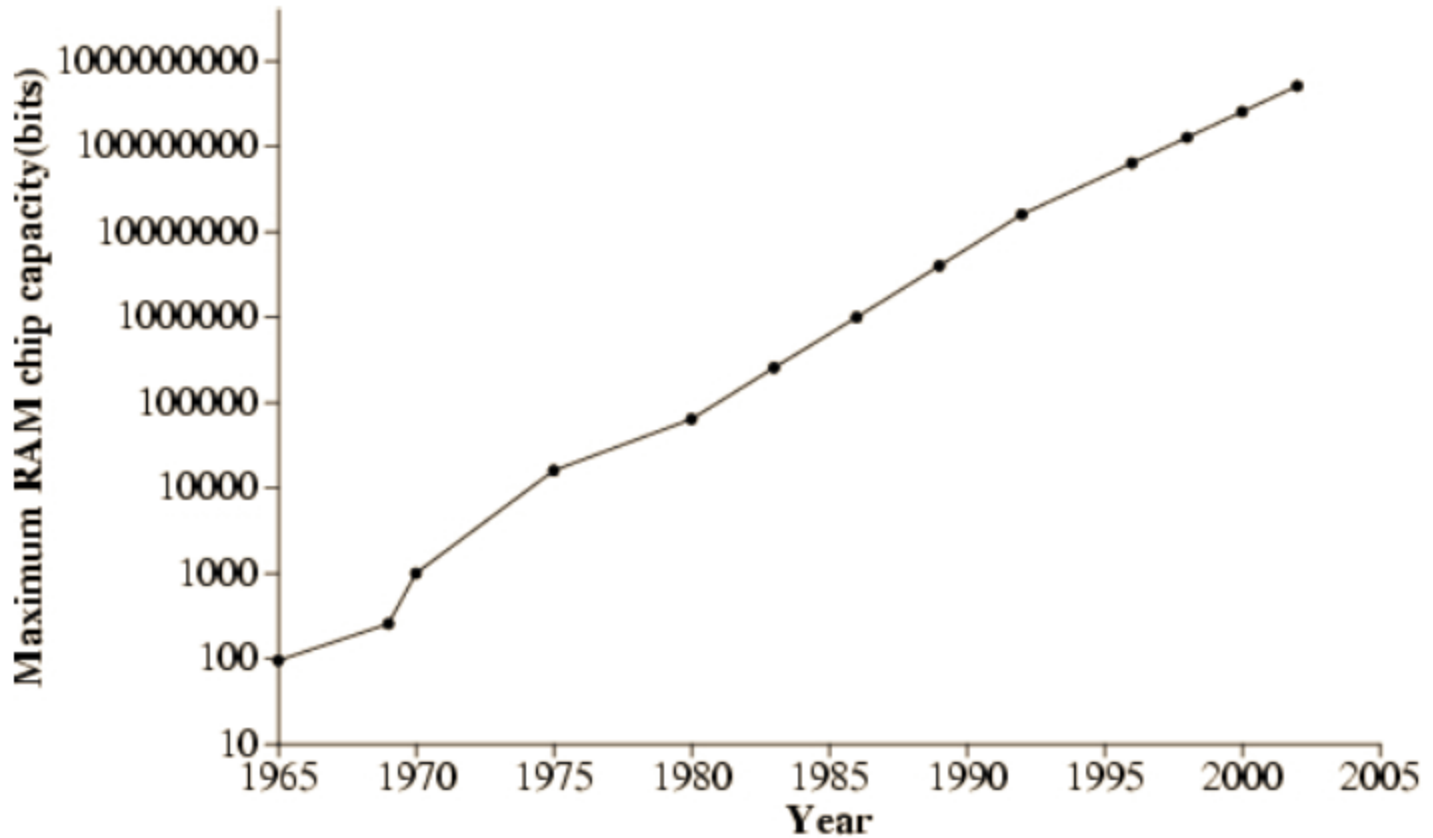
YEAR

"Cramming More Components Onto Integrated Circuits", *Electronics*, April 1965
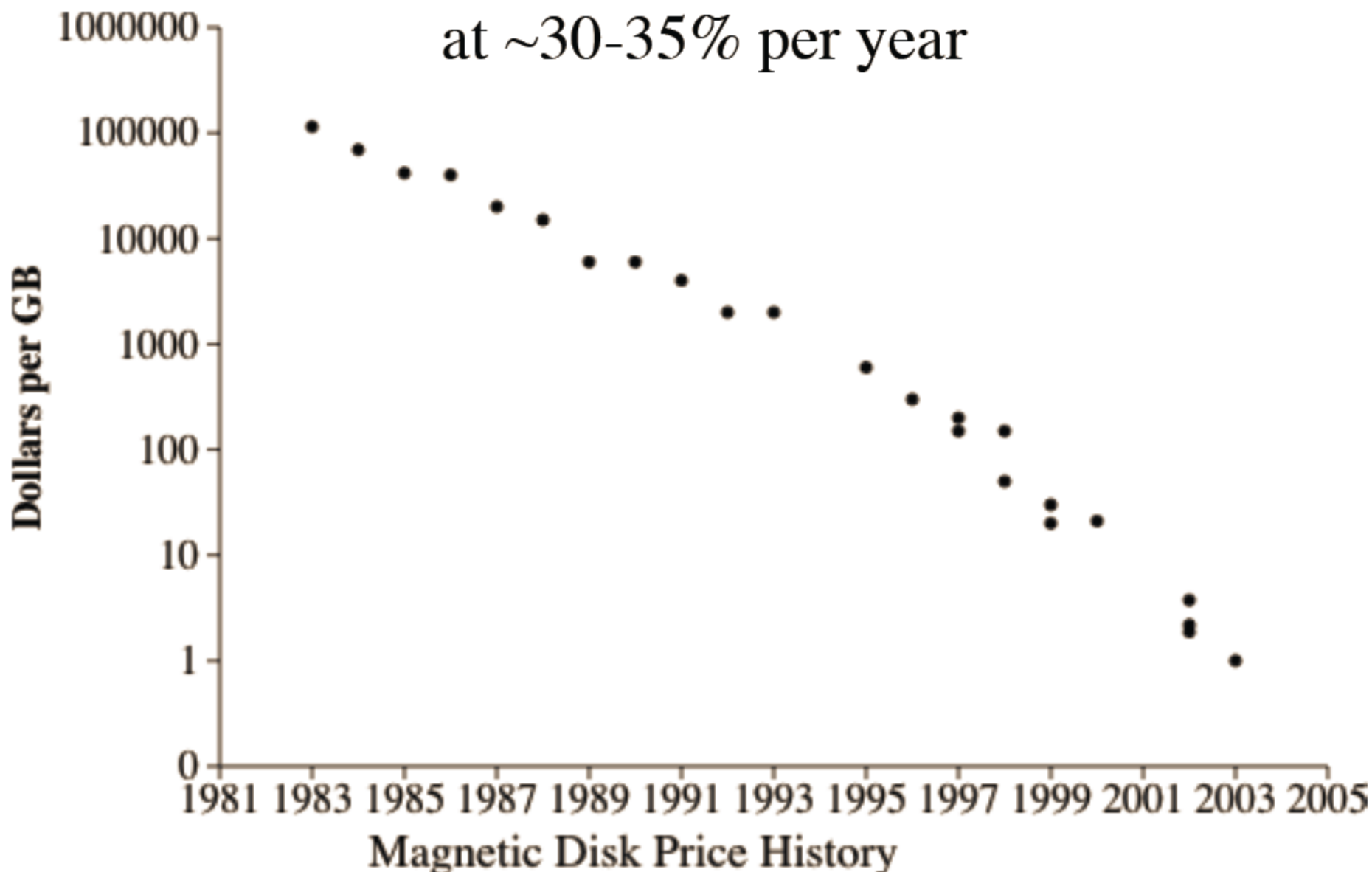
Transistors/die double every ~18 months

DRAM Density

Trends in semiconductor RAM density
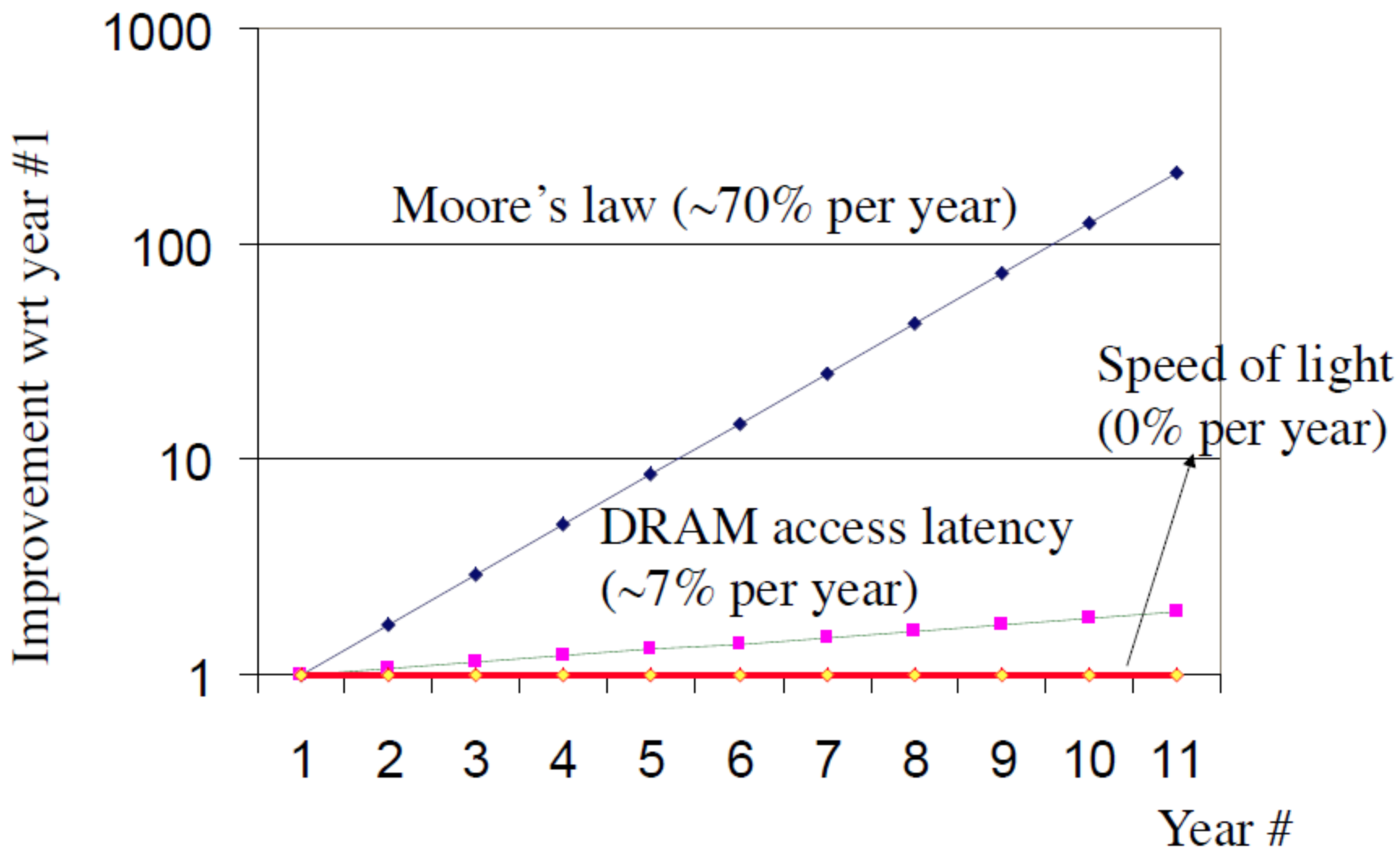
Disk: Price per GByte drops at ~30-35% per year

Magnetic Disk Price History

Latency improves slowly

Improvement wrt year #1

Moore's law (~70% per year)

Speed of light (0% per year)
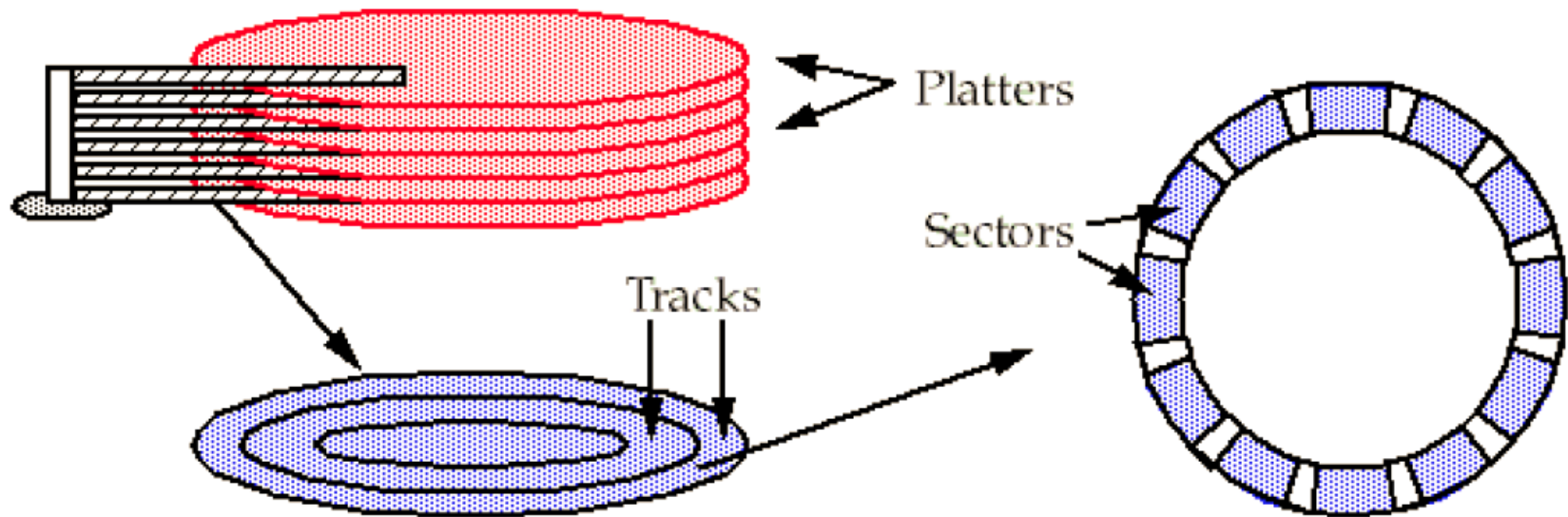
DRAM access latency (~7% per year)

Year #

Example

```
while True:
    wait for request
    data = read(name)
    compute
    send response
```

Hitachi 7K400

Top view

Platters

Sectors

Tracks

88,283 tracks per platter

576 to 1170 sectors per track

Important numbers

- Latency:
  - 0.00000001 ms: instruction time (1 ns)
  - 0.0001 ms: DRAM load (100 ns)
  - 0.1 ms: LAN network
  - 10 ms: random disk I/O
  - 25 ms: Internet east -> west coast
- Throughput:
  - 10,000 MB/s: DRAM
  - 1,000 MB/s: LAN (or100 MB/s)
  - 100 MB/s: sequential disk (or 500 MB/s)
  - 1 MB/s: random disk I/O