

CPSC 330

Computer Organization

History & Technology

Some figures from Computer Organization & Design,
The Hardware/Software Interface
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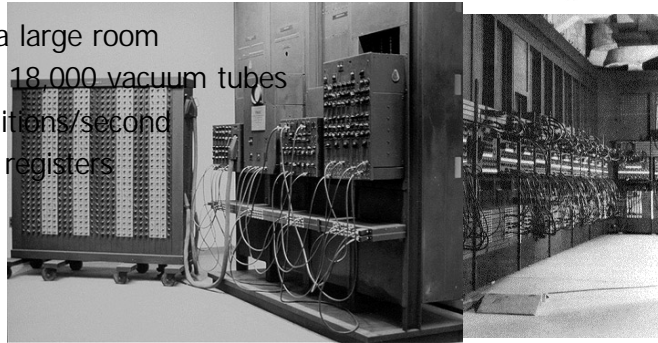
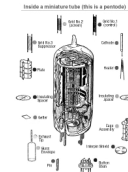
Overview

- Computer History
 - 1st Transistor
 - 1st Integrated Circuit (IC)
 - 1st Microprocessor
- Computer Technology
 - Chip Manufacturing Process
 - World's Smallest Working Silicon Transistor
 - World's Fastest Silicon Transistor
- Intel short movie (May 2007)

Computer History

ENIAC – 1940-45

- Electronic Numerical Integrator & Calculator
- Viewed as the 1st modern computer
- Developed in WW II by Echert & Mauchly
- Stats:
 - Took up a large room
 - Built with 18,000 vacuum tubes
 - 1900 additions/second
 - 20 10-bit registers



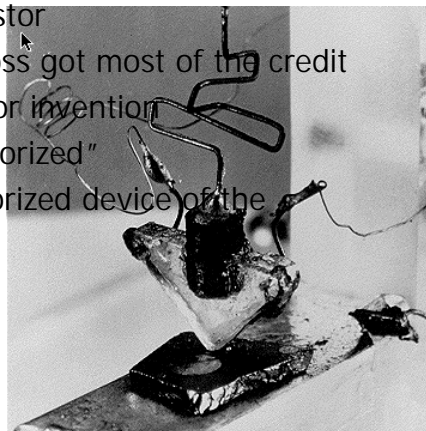
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History

1st Transistor - 1947

- John Bardeen & Walter Brattain built the 1st working amplifying transistor
- William Shockley, their boss got most of the credit
- All awarded Nobel Prize for invention
- See PBS special, "Transistorized"
- What was the 1st transistorized device of the Information Age?



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History

Transistor Radio

- 1st Device of the Information Age
- 1954 – “The Regency” by I.D.E.A. and TR1 by Texas Instruments
- Too expensive!!! (~\$50)
- Shockley blamed the transistor for Rock-n-Roll!



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History

1st Integrated Circuit - 1958

- Jack Kilby of Texas Instruments built the first “IC” on silicon in 1958
- Robert Noyce of Fairchild Semiconductor independently developed one in 1959
- Joyce awarded patent first
- Later Noyce started his own company called ‘Intel’.



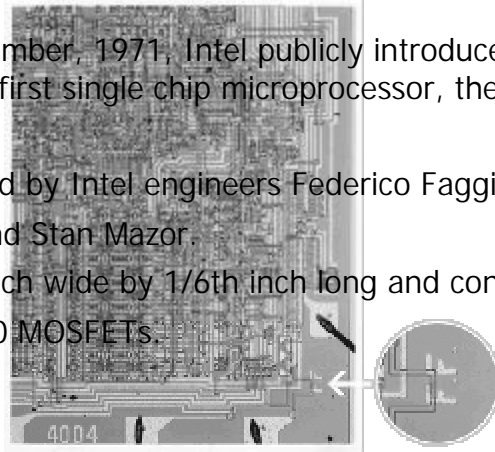
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History

1st Microprocessor - 1971

- In November, 1971, Intel publicly introduced the world's first single chip microprocessor, the Intel 4004.
- Invented by Intel engineers Federico Faggin, Ted Hoff, and Stan Mazor.
- 1/8th inch wide by 1/6th inch long and consisting of 2,300 MOSFETs.

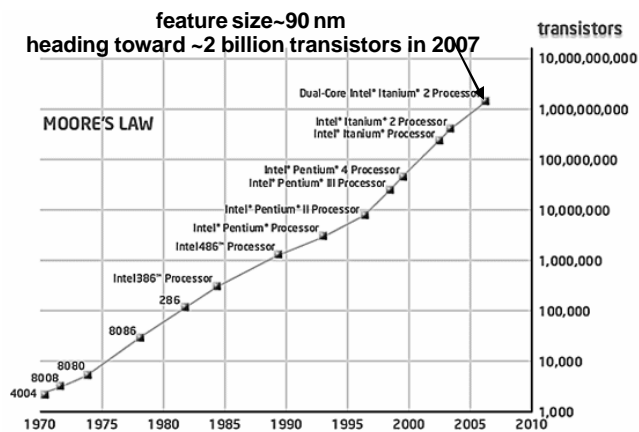


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History

Moore's Law - 1965



Gordon Moore predicted that the number of transistors on a microprocessor chip would double about every two years...he was somewhat pessimistic, it happens about every 1.6 years.

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Technology - dramatic change

■ Processor

- logic capacity: about 30% per year
- clock rate: about 20% per year

■ Memory

- DRAM capacity: about 60% per year
- Memory speed: about 10% per year
- Cost per bit: improves about 25% per year

■ Disk

- capacity: about 60% per year

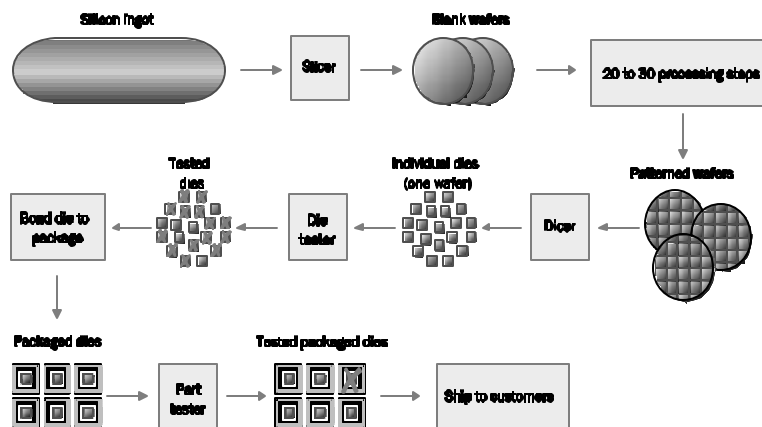
■ Network Bandwidth

- Bandwidth increasing more than 100% per year!

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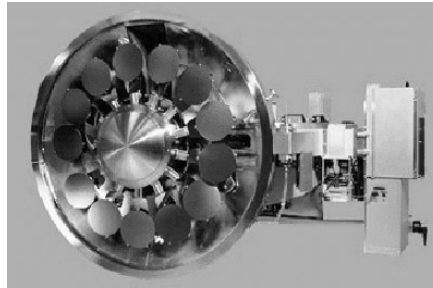
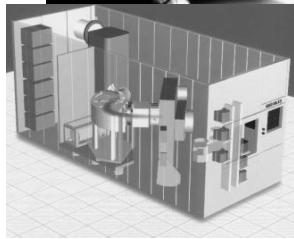
Chip manufacturing process



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Fabrication

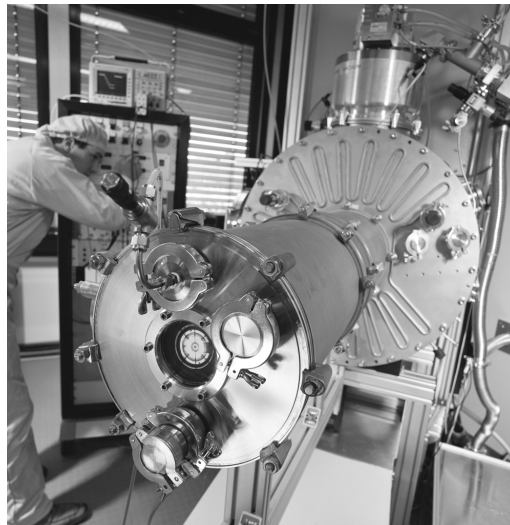


<http://www.casetechnology.com/links.html>

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Fabrication

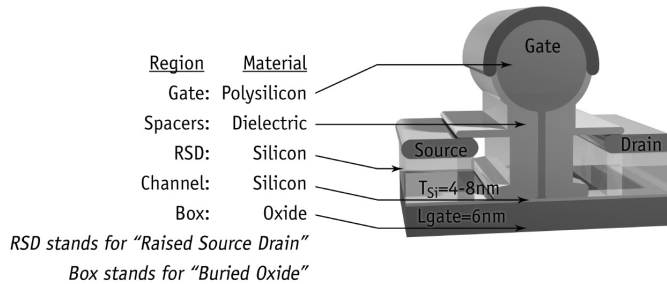


<http://www.research.philips.com/newscenter/pictures/ics-processing.html>

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Computers in the News: IBM Announces World's Smallest Working Silicon Transistor



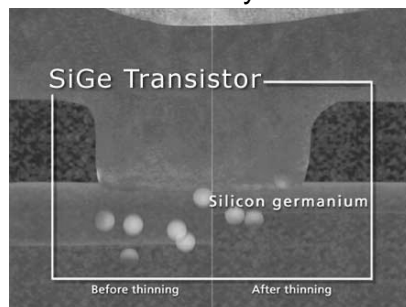
At six nanometers in length, this new transistor is at least 10 times smaller than the state-of-the-art transistors in production today. "The ability to build working transistors at these dimensions could allow us to put 100 times more transistors into a computer chip than is currently possible," said Dr. Randy Isaac, vice president of science and technology, IBM Research.

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Computers in the News: IBM's world's fastest silicon transistor

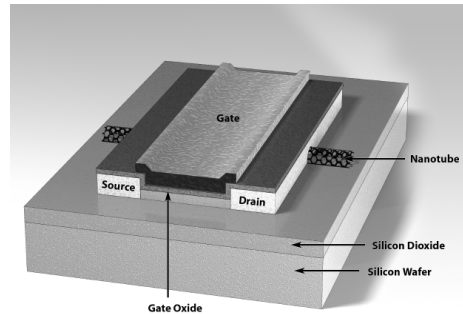
IBM has created the fastest silicon-based transistor in history, running at 350 GHz! IBM has improved the transistor further by thinning the SiGe layer in the transistor, effectively shortening the electrical path, making the transistor faster and more power efficient. Since transistors are the basic building blocks of chips, this advancement is expected to result in chips that run as fast as 150 GHz within two years.



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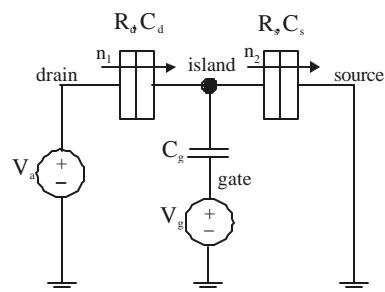
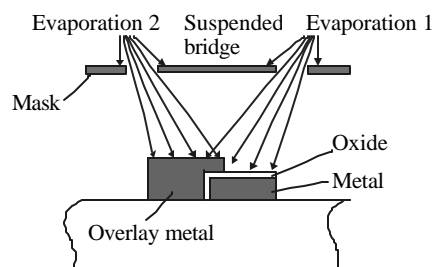
Computers in the News: IBM Creates World's Highest Performing Nanotube Transistors



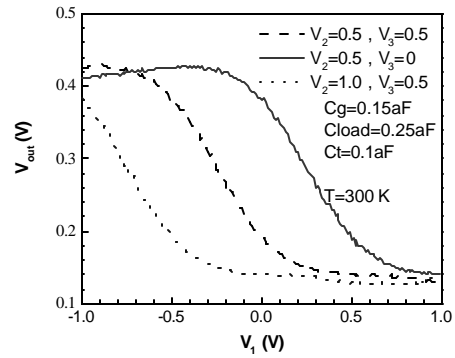
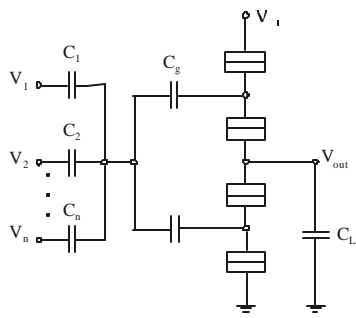
By experimenting with different device structures, the researchers were able to achieve the highest transconductance (measure of the current carrying capability) of any carbon nanotube transistor to date. High transconductance implies that transistors can run faster, leading to more powerful integrated circuits.

Single-Electron Tunneling Transistor (SET) Circuits and Architectures

Metal-Oxide Junction



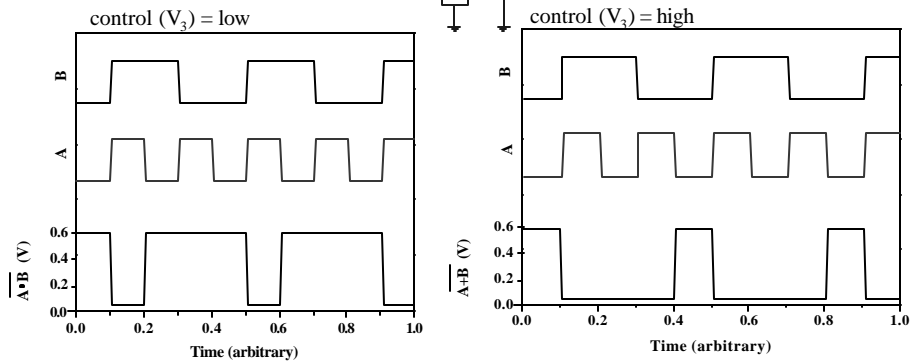
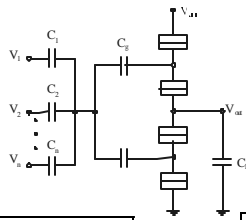
SET neural/non-linear circuit



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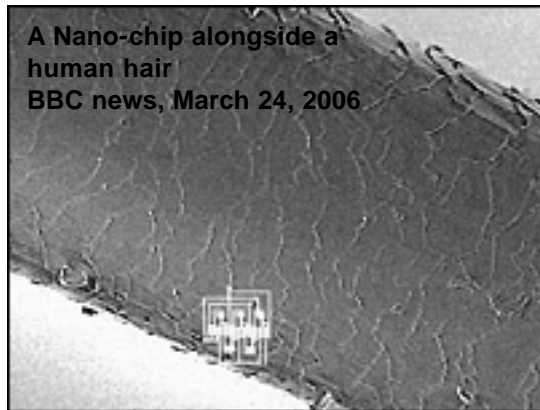
Programmable SET Logic Circuits



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Nano-chip alongside a human hair



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Next Time

Chapter 4

- Performance.
- Benchmarking.

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