

ENEL489

History of VLSI Design

History of VLSI

- 1948 Transistor (Shockley et al @ AT&T)
germanium-gold contact
- 1954 Silicon transistor (Teal @ TI)
high temperature
- 1956 Transistor computer (Cray)
- 1958 First monolithic circuit (IC)
BJTs (Kirby @ TI & Noyce @ Fairchild)

History of VLSI (cont.)

- 1960 SSI (< 100 transistors)
MOSFET - pMOS, Al gate (Bell Labs)
- 1961 TTL (Pacific Microtel)
25um feature size
- 1962 ECL (Motorola)
- 1964 u709 opamp (Wildar @ Fairchild)
- 1965 PDP-8 < \$20,000

History of VLSI (cont.)

- 1966 MSI (100 - 1000 transistors)
- 1967 First production MOS chips
- 1969 LSI (1000 - 10000 transistors)
pMOS, nMOS, CMOS
- 1969 E-beam production
digital watches, calculators
- 1970 CCD (Bell Labs)

History of VLSI (cont.)

- 1970 Microprocessor (Hoft @ Intel)
- 1971 Ion implantation
- 1972 I²L (IBM), 16 bit microprocessors
- 1975 VLSI (10,000 - 100,000 transistors)
self-aligned processes
- 1975 SPICE developed (UCB)

History of VLSI (cont.)

- 1980's
 - ULSI (> 100,000 transistors)
 - ASICs
 - PLD
 - Trench capacitors
 - Dual well
 - BiCMOS
 - HVICs
 - feature size 2 μ m

History of VLSI (cont.)

- 1990's
 - > 1,000,000 transistors
 - 64-bit microprocessors
 - Micro-machining
 - Digital Light Processor (DLP)
 - FPGA
 - Synthesis
 - VHDL
 - feature size 0.5um

History of VLSI (cont.)

- 2000
 - Intel announces first working transistor at 0.03um

Future of VLSI

- **Barriers**

complexity: > 10M transistors

testing: number of pins

interconnect: metal limited designs

device: < 0.25 μm

physical: 30cm/ns speed of light

Laying out an VLSI IC is equivalent to designing all of the streets in a city the size of New York with no dead ends and no potholes. Just to keep it interesting, all of the lights are synchronized as well.