# Chapter 2
# Computer Evolution and Performance – Part 04

Dr. Mostafa Elhosseini

# Agenda

- Commercial computers
- Transistors
- Integrated Circuits
- Moore’s law
- Microprocessors

# Commercial Computers

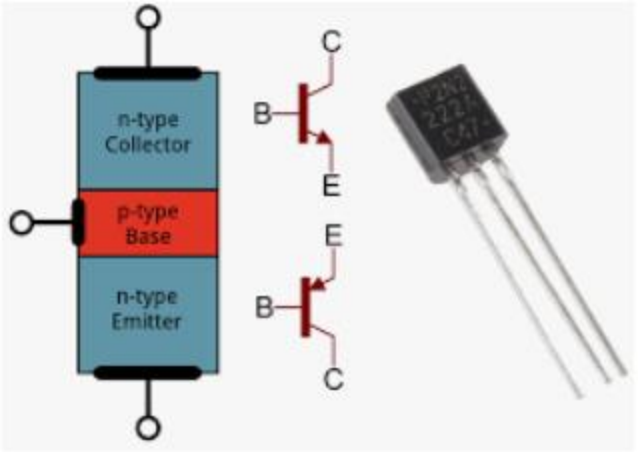
- 1947 - Eckert-Mauchly Computer Corporation
- UNIVAC I (Universal Automatic Computer)
- US Bureau of Census 1950 calculations
- Became part of Sperry-Rand Corporation
- Late 1950s - UNIVAC II
  - Faster
  - More memory

# IBM

- Punched-card processing equipment
- 1953 - the 701
  - IBM's first stored program computer
  - Scientific calculations
- 1955 - the 702
  - Business applications
- Lead to 700/7000 series

# Transistors

- Replaced vacuum tubes
- Smaller
- Cheaper
- Less heat dissipation
- Solid State device
- Made from Silicon (Sand)
- Invented 1947 at Bell Labs
- William Shockley et al.

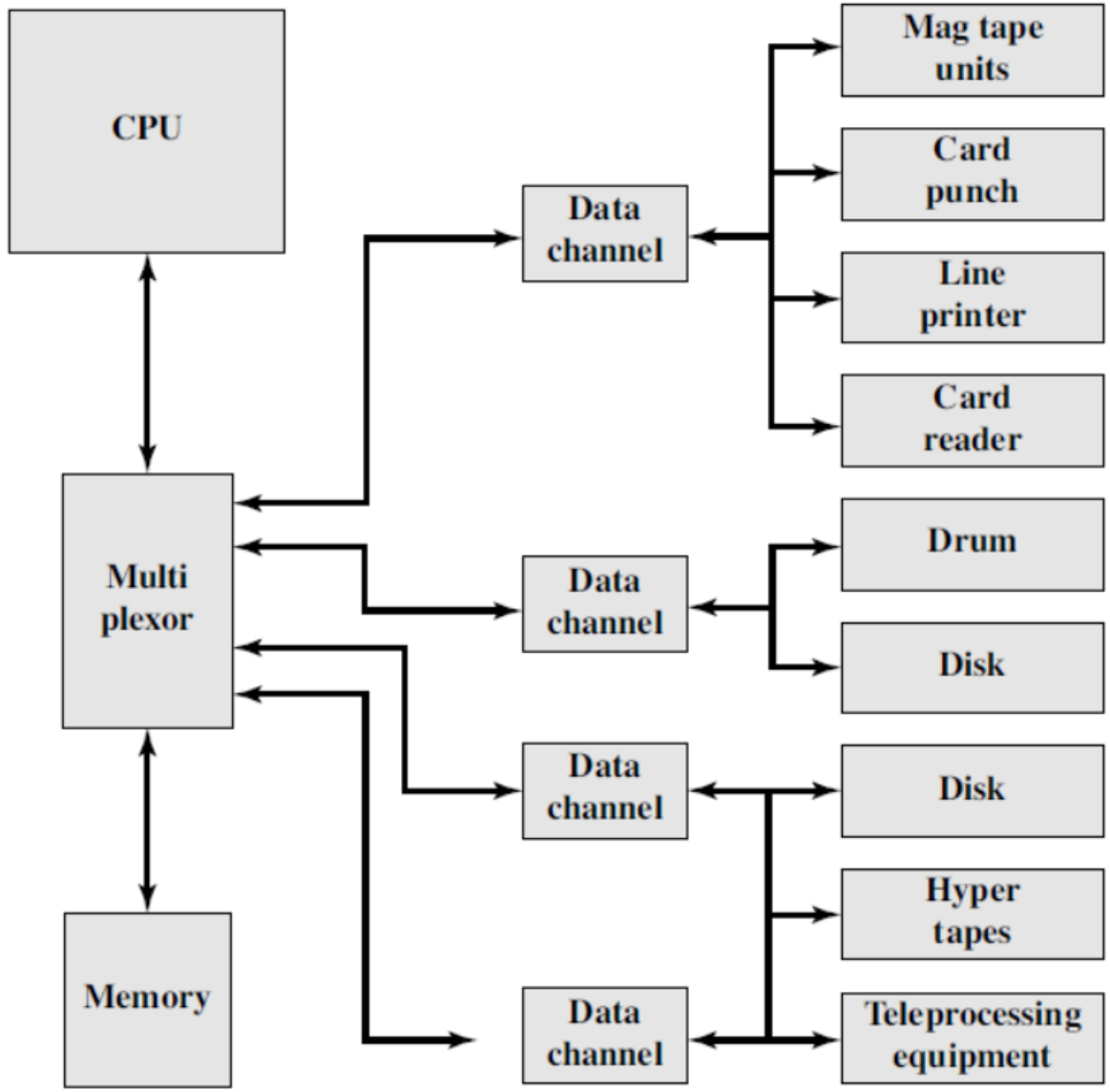


# Transistor Based Computers

- Second generation machines
- NCR & RCA produced small transistor machines
- IBM 7000
- DEC - 1957
  - Produced PDP-1

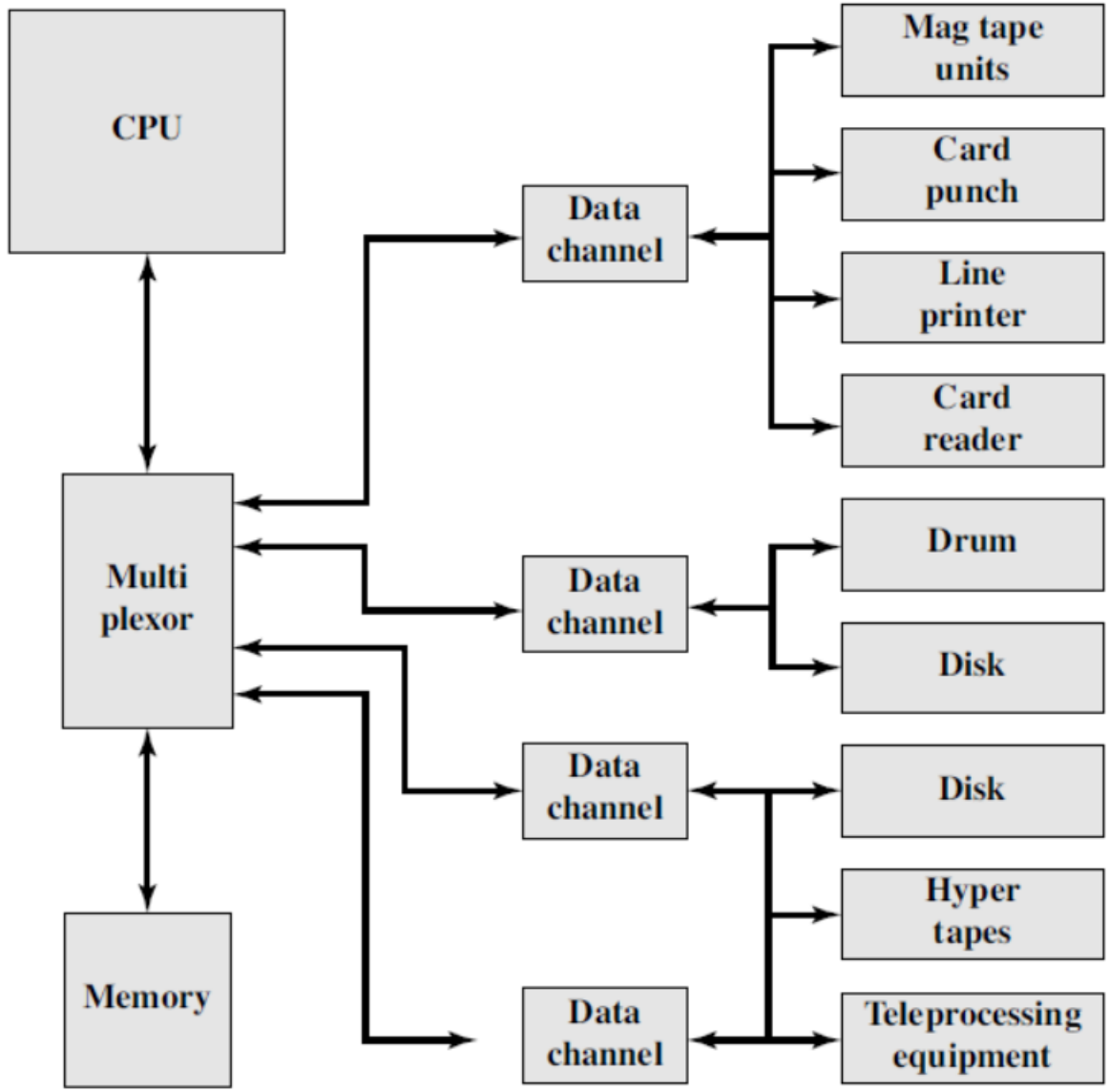
# IBM 7094 configuration

- A data channel is an independent I/O module with its own processor and its own instruction set
- In a computer system with such devices, the CPU does not execute detailed I/O instructions.
- Such instructions are stored in a main memory to be executed by a special-purpose processor in the data channel itself



# IBM 7094 configuration

- The CPU initiates an I/O transfer by sending a control signal to the data channel, instructing it to execute a sequence of instructions in memory.
- The data channel performs its task independently of the CPU and signals the CPU when the operation is complete.
- This arrangement relieves the CPU of a considerable processing burden

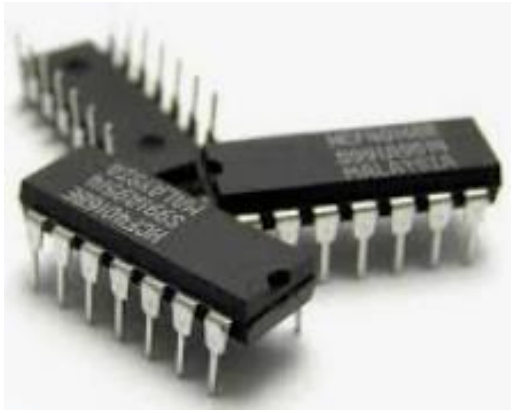


# Microelectronics

- Literally - “small electronics”
- A computer is made up of gates, memory cells and interconnections
- These can be manufactured on a semiconductor
- e.g. silicon wafer

# Generations of Computer

- Vacuum tube - 1946-1957
- Transistor - 1958-1964
- Small scale integration - 1965
  - Up to 100 devices on a chip
- Medium scale integration - to 1971
  - 100-3,000 devices on a chip
- Large scale integration - 1971-1977
  - 3,000 - 100,000 devices on a chip
- Very large-scale integration - 1978 to date
  - 100,000 - 100,000,000 devices on a chip
- Ultra large-scale integration
  - Over 100,000,000 devices on a chip



# IC complexity classification

- **Small Scale Integrated Circuit (SSI)**
  - It describes fixed-function ICs that have up to ten equivalent gate circuits on a single chip, and they include basic gates and flip-flops
- **Medium-scale integration (MSI)**
  - It describes integrated circuits that have from 10 to 100 equivalent gates on a chip. They include logic functions such as encoders, decoders, counters, registers, multiplexers, arithmetic circuits, small memories, and others
- **Large-scale integration (LSI)**
  - It is a classification of ICs with complexities of from more than 100 to 10,000 equivalent gates per chip, including memories.

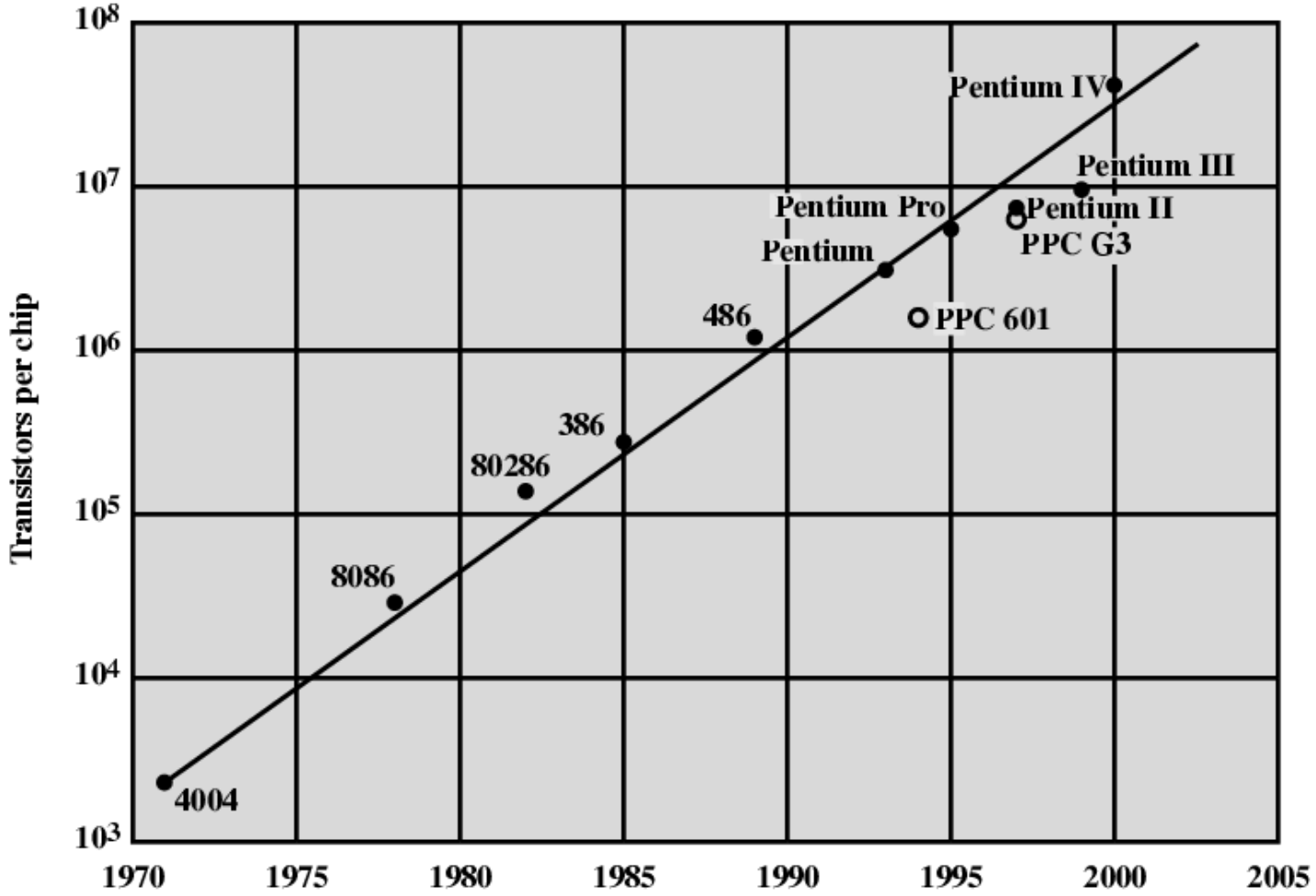
# IC complexity classification

- **Very large-scale integration (VLSI)**
  - It describes integrated circuits with complexities of from more than 10,000 to 100,000 equivalent gates per chip
- **Ultra-large-scale integration (ULSI)**
  - 100,000 - 100,000,000 devices on a chip
  - It describes very large memories, larger microprocessors, and larger single-chip computers. Complexities of more than 100,000 equivalent gates per chip are classified as ULSI

# Moore's Law

- Increased density of components on chip
- Gordon Moore - cofounder of Intel
- Number of transistors on a chip will double every year
- Since 1970's development has slowed a little
  - Number of transistors doubles every 18 months
- Cost of a chip has remained almost unchanged
- Higher packing density means shorter electrical paths, giving higher performance
- Smaller size gives increased flexibility
- Reduced power and cooling requirements
- Fewer interconnections increases reliability

# Growth in CPU Transistor Count



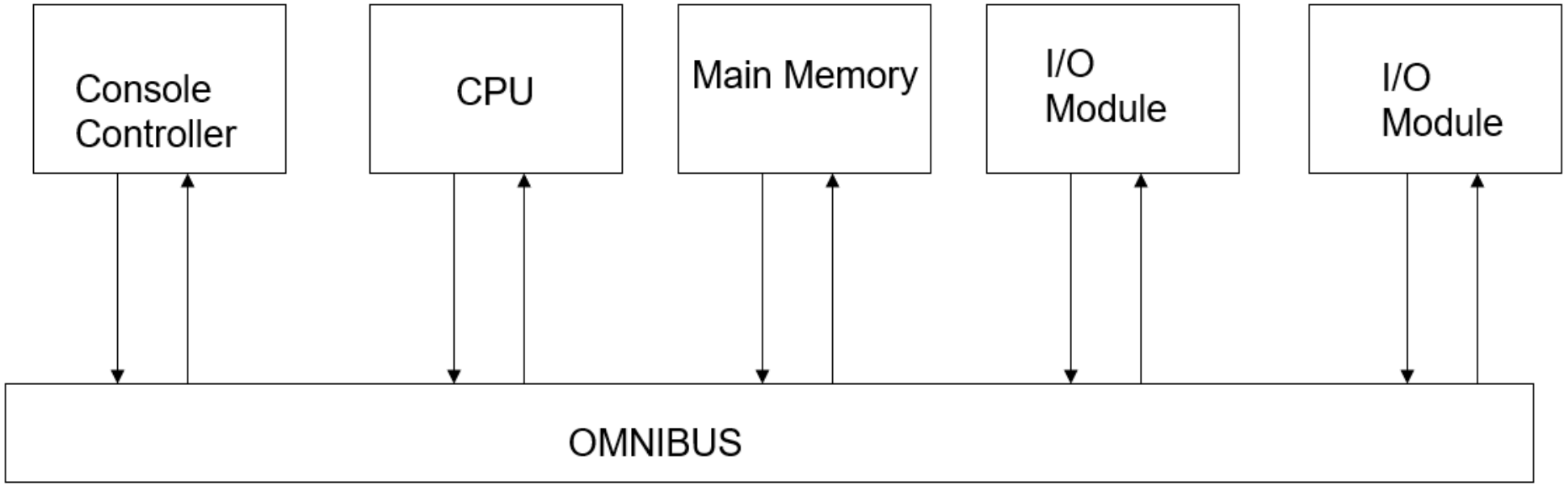
# IBM 360 series

- 1964
- Replaced (& not compatible with) 7000 series
- First planned “family” of computers
  - Similar or identical instruction sets
  - Similar or identical O/S
  - Increasing speed
  - Increasing number of I/O ports (i.e. more terminals)
  - Increased memory size
  - Increased cost
- Multiplexed switch structure

# DEC PDP-8

- 1964
- First minicomputer (after miniskirt!)
- Did not need air conditioned room
- Small enough to sit on a lab bench
- $16,000
  - $100k+ for IBM 360
- Embedded applications & OEM
- BUS STRUCTURE

# DEC - PDP-8 Bus Structure



# Semiconductor Memory

- 1970
- Fairchild
- Size of a single core
  - i.e., 1 bit of magnetic core storage
- Holds 256 bits
- Non-destructive read
- Much faster than core
- Capacity approximately doubles each year

# Intel

- 1971 - 4004
  - First microprocessor
  - All CPU components on a single chip
  - 4 bit
- Followed in 1972 by 8008
  - 8 bit
  - Both designed for specific applications
- 1974 - 8080
  - Intel’s first general purpose microprocessor

# Microprocessor

- Single, VLSI chip that contains programmable electronics components that perform arithmetic, logic communication and control function
- A common way of categorizing MP is by the number of bits that their ALU can work at a time
- In other words, a MP with a 4-bit ALU will be referred to as a 4-bit microprocessor, regardless of the number of address lines, or the number of data bus lines that it has