COMPUTER ORGANIZATION (IS F242)

LECT 02: INTRODUCTION

Year	Model	Transistor Count
1971	4004	2300
1972	8008	3500
1974	8080	6000
1978	8086	29000
1982	80286	134000
1985	80386	275000
1989	80486	1,2 million
1993	Pentium	3,1 million
1995	Pentium Pro	5,5 million
1997	Pentium II	7.5 million
1999	Pentium III	9.5 million
1999	Celeron	18.9 million
2000	Pentium 4	42 million
2002	Itanium II	220 million
2003	Pentium M	77 million
2005	Pentium D	230 million
2006	Dual Core	376 million
2006	Quad Core	1328 million
2007	Core 2 Duo	410 million
2008	Core 2 Quad	820 million

http://www.intel.com/pressroom/kits/quickreffam.htm

Intel Processor Transistor Size Trends

Year	Model	Transistor Size
1971	4004	10um
1972	8008	10um
1974	8080	6um
1978	8086	3um
1982	80286	1,5um
1985	80386	1,5um
1989	80486	1um
1993	Pentium	0,8um
1995	Pentium Pro	0,6um
1997	Pentium II	0,35um
1999	Pentium III	0,25um
1999	Celeron	0,25um
2000	Pentium 4	0,18um
2002	Itanium 2	0,18um
2003	Pentium M	0,13um
2005	Pentium D	90nm
2006	Dual Core	65nm
2007	Core 2 Duo	65nm
2008	Core 2 Quad	45nm

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Generations

- System – on – a – Chip (SoC or SOC)?
  - All the components needed for a computer or other system are included on a single chip
  - Can be complex and costly
  - Lower manufacturing & assembling cost
  - Lower power consumption (signal among the components are kept on die)
- Three dimensional Integrated Circuit (3D – IC)?
  - Has two or more layers of active electronic components that are integrated both vertically and horizontally into a single circuit.

Generations

- Giga Scale Integration (GSI)?
  - Hierarchy of limits 1. fundamental, 2. material, 3. device, 4. circuit and 5. systems

Classification of Circuit Size

Small-Scale Integration	SSI	<100	1963
Medium-Scale Integration	MSI	100-300	1970
Large-Scale Integration	LSI	300 - 30000	1975
Very Large-Scale Integration	VLSI	30000 - 1million	1980
Ultra-Large Scale Integration	ULSI	>1million	1990
Giga Scale Integration	GSI	>1billion	2010

System-on-a-Chip (SoC)

Three Dimensional Integrated Circuit (3D-IC)

Generations

- **1. fundamental**
  - Three critical fundamental limits derived
    - from thermodynamics,
    - from the uncertainty principle of quantum mechanics and
    - from electro magnetics
- **2. material**
  - three key material limits
    - switching energy limit,
    - transit time,
    - thermal conduction limit

Generations

- **3. device**
  - imposed by the MOSFET and are defined largely by its minimum allowable channel length L
  - response time of an interconnect
- **4. circuit**
  - four key generic circuit limits
    - logic gate static transfer characteristics
    - switching energy
    - propagation delay
    - global interconnect response time
- **5. systems**
  - Five key generic system limits involving
    - architecture, critical path switching energy, package cooling capacity, clock frequency and chip size

Von – Neumann Model

- Partitioning of the computing engine
  - CPU, Control Unit, Data path, Memory, Input / Output
- Stored Program Concept