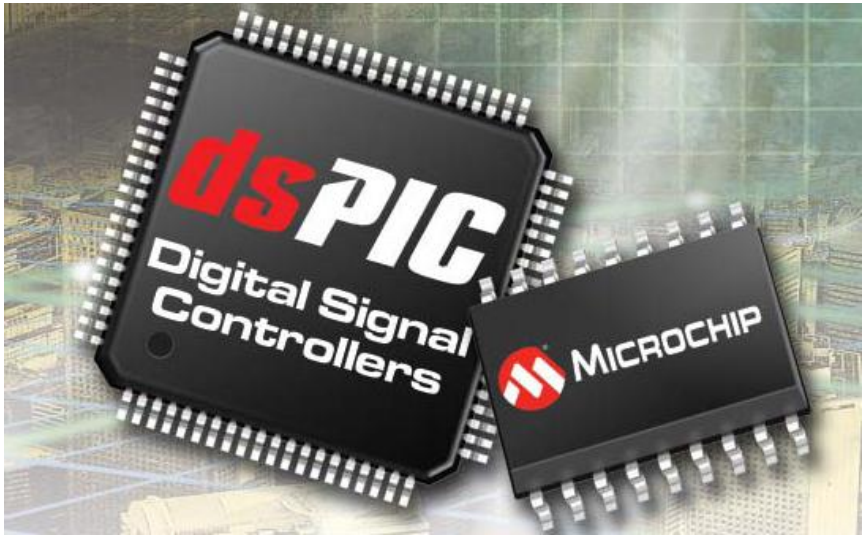
EE427 Advanced Microcontrollers



Review of Microprocessors and Microcontrollers

Evolution

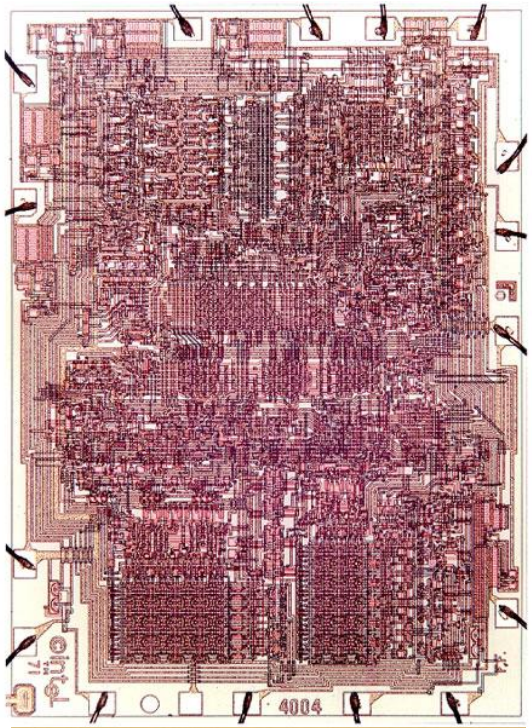
- Mid 19th Century – Concept of Computer by Charless Babbage
- 1930 - development of vacuum tube electronics
- 1942 – 1946 : John W. Mauchly and J. Presper Eckert, University of Pennsylvania's Moore School of Electrical Engineering developed first electronic computers
  - ENIAC (Electronic Numerical Integrator and Computer), used to calculate ballistic tables for the military
  - With 17,468 vacuum tubes and 100 feet of front panel, 30 tons mighty machine was capable of doing 5000 additions and 300 multiplications a second

Evolution (cont..)

- Tommy Flowers, an electronics engineer, British secret service, built first electronic computer during the Second World War
  - Colossus - deciphered German military codes

Development of microprocessors

- 1971, Intel introduced 4004 - a 4-bit CPU.
- same year Texas Instruments introduced TMS1802NC.
- TMS1802NC was not very flexible.
- Intel continued development and produced the 8008 in 1972, the 8080 in 1974, and the 8086 in 1978
- Later 80286, 80386, 80486, Pentium



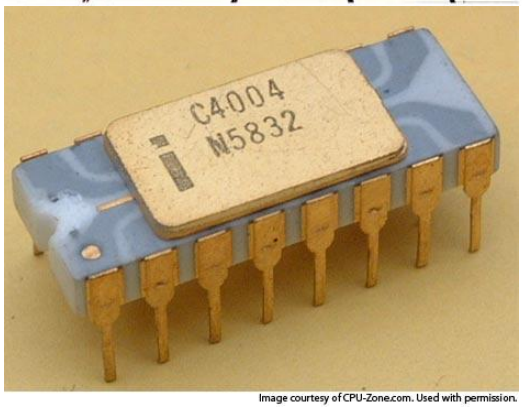


Image courtesy of CPU-Zone.com. Used with permission.

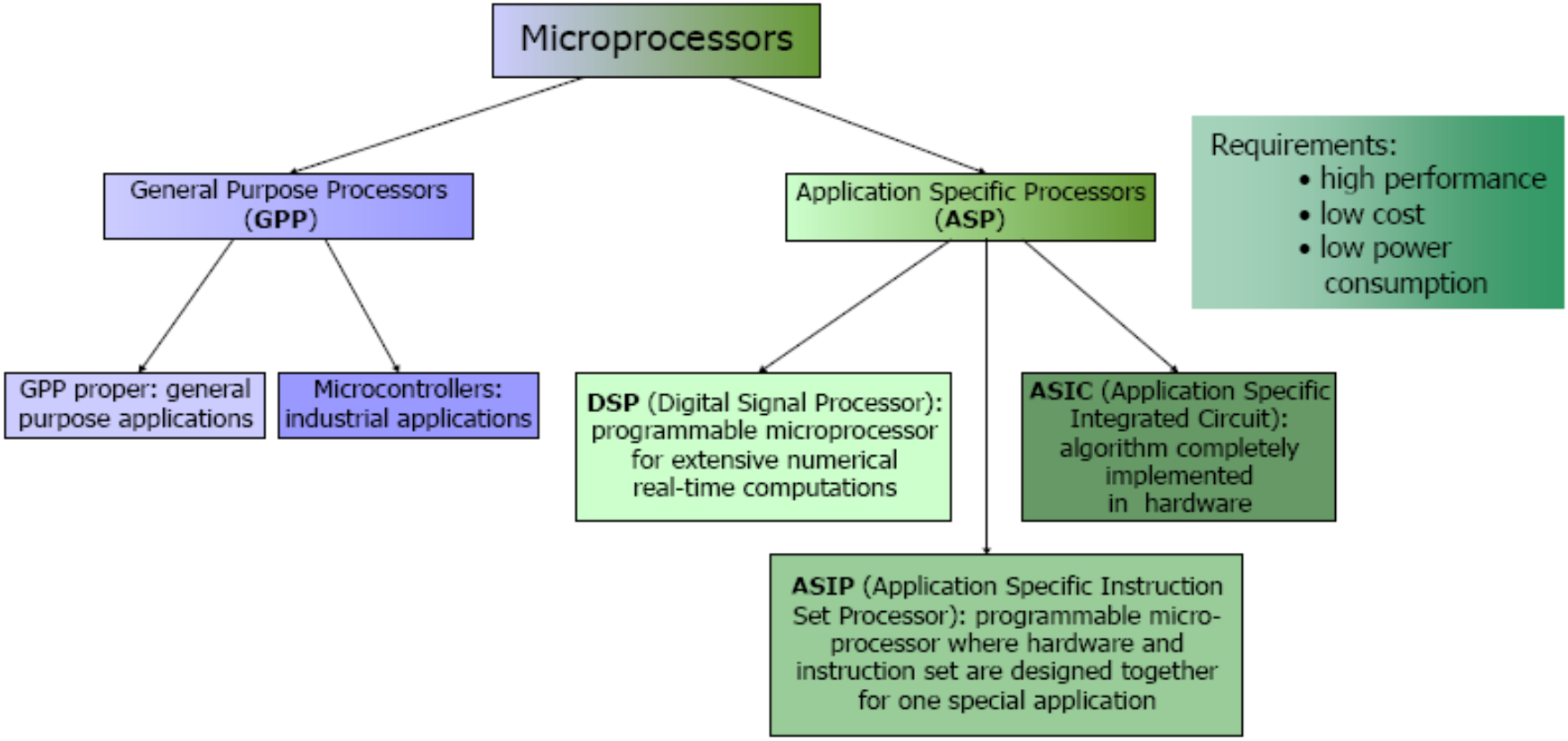
Development of microprocessors (contd..)

- Increased performance - specialized designs
- First micro-controller, TMS1000 Texas instruments in 1974
  - Processor, memory, I/O ports
- Digital Signal Processors
  - 1983 - TMS320C10 by Texas Instruments, specifically designed to solve digital signal processing problems

Applications and Types

- Computer system applications
  - General purpose microprocessors
- Embedded System applications
  - Microcontrollers
- Signal Processing applications
  - Digital Signal Processors (DSPs)

Classification



Types based on hardware characteristics

- **Complex Instruction Set Computer (CISC)**
  - many versions of instructions for different operands
  - large number of complex addressing modes
  - different execution times for instructions
  - few processor registers
  - Microprogrammed control logic
- **Reduced Instruction Set Computer (RISC)**
  - one instruction per clock cycle
  - memory accesses by dedicated load/store instructions
  - few addressing modes
  - hard-wired control logic

Types based on hardware characteristics

- **Very Long Instruction Word (VLIW)**
  - instruction-level parallelism
  - instructions are composed of different machine operations whose execution starts in parallel
  - many parallel functional units
  - large register sets
- **Superscalar Processors**
  - subclass of RISCs or CISCs
  - multiple instruction pipelines for overlapping execution of instructions

- VLIW

```
IF r1 iaddi(0x2) r0 -> r38, IF r1 isubi(0x4)r0 ->r7,
IF r1 isubi(0x3) r0 -> r8, IF r1 isubi(0x2) r0 -> r36,
IF r1 isubi(0x1) r0 -> r37;
```

- Classification criteria:
  - hardware characteristics
    - RISC
    - CISC
    - VLIW
    - Superscalar
  - characteristics of application areas
    - GPP (General Purpose Processor) / MCU (MicroController Unit)
    - SPP (Special Purpose Processor)
      - ASIC (Application-Specific Integrated Circuit)
      - ASIP (Application-Specific Instruction-set Processor)
      - DSP (Digital Signal Processor)