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Lesson 14

Microprocessors & Microcontrollers

A **microprocessor** is a rather versatile electronic integrated circuit that has a fixed set of instructions that allow it to do several things:

- It contains a Central Processing Unit (CPU) that performs basic mathematical computations (add, subtract, multiply, divide).
- It has the capability of interacting with a Basic Input Output System (BIOS) that starts a computer up by communicating with all the other functions within the computer. In particular, it can load and prepare for use the Operating System (OS) of the computer. In the PC world, the best known OS is Microsoft Windows, while in the Apple world the OS is the proprietary Apple Snow Leopard (OS-X).
- It can access external memory that stores the data used by the computer.
- It can access peripherals through the BIOS such as keyboards, printers, pointing devices (mice, trackballs, and tablets), sound devices, disk and CD players/recorders, input/output ports such as serial (RS-232) ports, universal serial bus (USB) ports, wireless ports, and all the other external hardware devices that a computer can have.

The history of the microprocessor starts in 1971when the Nippon Calculating Company asked Intel to design a chip set for their new adding machine. Intel responded that they would prefer to put all the functions that NCC wanted on a single chip, which they called a microprocessor. Thus was born the Intel 4004, which was a 4-bit device that operated at the blinding speed of 100 kHz. and contained 2,300 transistors. The 4004 could only provide two functions: addition and subtraction, but it did them at a speed that nobody had ever seen before.

The following year, Intel introduced the 8008, an 8 bit chip that processed 8 times faster than the 4004 and contained 3500 transistors. Two years later came the 8080, also an 8 bit machine with a 2 MHz. clock speed and 4500 transistors. Four years later (1978) produced the 8086, also an 8 bit machine, 3 times faster than the 8080 and 29,000 transistors.

From this data and extrapolating, Gordon Moore postulated that the number of transistors that could be placed on a microprocessor chip would double every two years. The law has been uncannily accurate for nearly 40 years. In 2010, the Intel Xeon 64 bit microprocessor runs at 3.3 GHz. with 781 million transistors.

Here is a history of the Intel microprocessors:

http://download.intel.com/pressroom/kits/IntelProcessorHistory.pdf

A **microcontroller** on the other hand is a specialized integrated circuit that contains all the peripheral devices described above (bios, memory, operating system, CPU, input/output ports) all on a single chip. Microcontrollers are generally dedicated to a specific task as opposed to a microprocessor that can be adapted to many different tasks. You would use a microprocessor in a personal computer; you would use a microcontroller to run a smart microwave oven.

There are several microcontroller manufacturers in the market today, but perhaps the best known is the Microchip Corporation with their venerable PIC line of microprocessors. Microchip started business in 1989 with a relatively unsophisticated 8-bit microcontroller operating at 20 MHz. What REALLY kicked Microchip off was the invention of what is called RISC (Reduced Instruction Set Code) that made programming the chips relatively simple and fast. That and keeping pricing WAY down was Microchip's secret weapon. While a fairly sophisticated microprocessor might run $150 or so, a fairly sophisticated PIC can be had in the range of $2 - $5.

Here is a link to the Microchip site:

http://www.mcuspace.com/History.html