Lecture – 2

Introduction and Generation

Microprocessors are regarded as one of the most important devices in our everyday machines called computers. Before we start, we need to understand what exactly microprocessors are and their appropriate implementations. Microprocessor is an electronic circuit that functions as the central processing unit (CPU) of a computer, providing computational control. Microprocessors are also used in other advanced electronic systems, such as computer printers, automobiles, and jet airliners Typical microprocessors incorporate arithmetic and logic functional units as well as the associated control logic, instruction processing circuitry, and a portion of the memory hierarchy. Portions of the interface logic for the input/output (I/O) and memory subsystems may also be infused, allowing cheaper overall systems. While many microprocessors and single-chip designs, some high- performance designs rely on a few chips to provide multiple functional units and relatively large caches. When combined with other integrated circuits that provide storage for data and programs, often on a single semiconductor base to form a chip, the microprocessor becomes the heart of a small computer, or microcomputer. Microprocessors are classified by the semiconductor technology of their design (TTL, transistor-transistor logic; CMOS, complementary-metal-oxide semiconductor; or ECL, emitter-coupled logic), by the width of the data format (4-bit, 8-bit, 16-bit, 32-bit, or 64-bit) they process; and by their instruction set (CISC, complex-instruction-set computer, or RISC, reduced-instruction-set computer; see RISC processor). TTL technology is most commonly used, while CMOS is preferred for portable computers and other battery-powered devices because of its low power consumption. ECL is used where the need for its greater speed offsets the fact that it consumes the most power. Four-bit devices, while inexpensive, are good only for simple control applications; in general, the wider the data format, the faster and more expensive the device. CISC processors, which have 70 to several hundred instructions, are easier to program than RISC processors, but are slower and more expensive.

The transistor technology led to the introduction of minicomputers of the 1960s and the personal computer revolution of the 1970s. Microprocessors evolution is categorized into 5 generations i.e. first, second, third, fourth, and fifth generations.

First Generation (1971-73)

Historically, the 4-bit microprocessor was the first general-purpose microprocessor introduced on the market. The basic design of the early microprocessors was derived from that of the desk calculator. The Intel 4004, a 4-bit design, was the grandfather of microprocessors. Introduced in late 1971, the 4004 was originally designed for a Japanese manufacturer as the processing element of a desk calculator; it was not designed as a general-purpose computer. The shortcomings of the 4004 were recognized as soon as it was introduced. But it was the first general-purpose computing device on a chip to be placed on the market. Many of the chips introduced at about the same time by other companies were, in fact, mere calculator chips. Some of them were even serial-by-bit devices, which performed calculations a single bit at a time.

The Intel 4004 chip took the integrated circuit down one step further by placing all the parts that made a computer think (i.e. central processing unit, memory, input and output controls) on one small chip. Programming intelligence into inanimate objects had now become possible**.** The 4004 was the world's first universal microprocessor. In the late 1960s, many scientists had discussed the possibility of a computer on a chip, but nearly everyone felt that integrated circuit technology was not yet ready to support such a chip. Intel's Ted Hoff felt differently; he was the first person to recognize that the new silicon-gated MOS technology might make a single-chip CPU (central processing unit) possible**.**

In 1971, Intel Corporation introduced the first 4-bit 4004 microprocessor at 108 k Hz. In 1972, Intel made 8-bit 8008 and 8080 microprocessors.

Second Generation (1974-78)

The second generation microprocessor makes the use of newer semiconductor technology to fabricate the chips. They were manufactured using NMOS technology. Some of the popular processors are Motorola's 6800 and 6809 and Intel's 8085, Zilog's Z80.

Today, 8-bit microprocessors coexist with 16-bit microprocessors as the design standard. Although 16-bit chips provide higher performance computationally, 8-bit designs have more than adequate power for many applications—plus the advantage of lower cost. As originally design, most 16-bit microprocessors were limited to packages with a maximum of 40 to48 pins. This was not due to physical, but rather to economic, constraints: industrial tester of the time was generally limited to 40-pin DIPs. The ancestor of today's 8-bit microprocessors was the Intel 8008, introduced in 1972- 1973. The 8008 was not intended to be a general-purpose microprocessor.

IT was to be a CRT display controller for Data point. Taking into account all of its design in adequacies and its limited performance, the 8008 was an overwhelming success.

The 8080, designed as a successor to Intel's 8008, was the first powerful microprocessor introduced on the market. Several other microprocessors of similar performance were introduced on the market within a year after the 8080 appeared, and several additional powerful designs were introduced later. Technically, however, the 8080 long remained the most powerful product on the market. Furthermore, Intel was the first company to invest in the development of support chips and software for its products. This ensured the continued success of the 8080 because its performance was then sufficient for many applications. The early 8080 competitors were introduced with at least a nine-month delay and failed to dislodge it. The 8080 is still sold today thought It has been largely eclipsed by successor products—most notably the 8085 microprocessor. Today, the 8085 accounts for roughly one of every four 8-bit microprocessors sold.

Third Generation (1979-80)

The third-generation microprocessors were dominated by Intel's 8086 and Zilog Z8000, which were 16-bit processors, 16-bit arithmetic and pipeline instruction processing.

Fourth Generation (1981-95)

In fourth generation microprocessors, Intel introduced 32 bit processors, 80386 and Motorola 68020/68030.

These are fabricated using low-power version of the HMOS technology called HCMOS.

Fifth Generation (1995 - till date)

In fifth generation microprocessors, Intel introduced 64 bit processors. These carry on-chip functionalities and improvements in the speed of memory and I/O devices. Their design surpassed 10 million transistors per chip.

Some examples are Pentium, Celeron and dual and quad core processors working with up to 3.5GHz speed.