# MICROPROCESSOR BASED PERSONAL COMPUTER SYSTEM

The introduction of microprocessors had a huge impact in the way we use computers. Computers that once took large areas where reduced to the size of small desktops. Although these desktop computers are small and compact, they possess computing power more than that of the large size computers of the previous generation.

Here, in this section, we are going to learn about the structure of a microprocessor based personal computer system. The block diagram of a personal computer system is shown in the figure.

This block diagram also applies to any computer system, from the early mainframe computers to the modern microprocessor based systems. The block diagram consists of three main blocks, connected to each other with the help of buses.

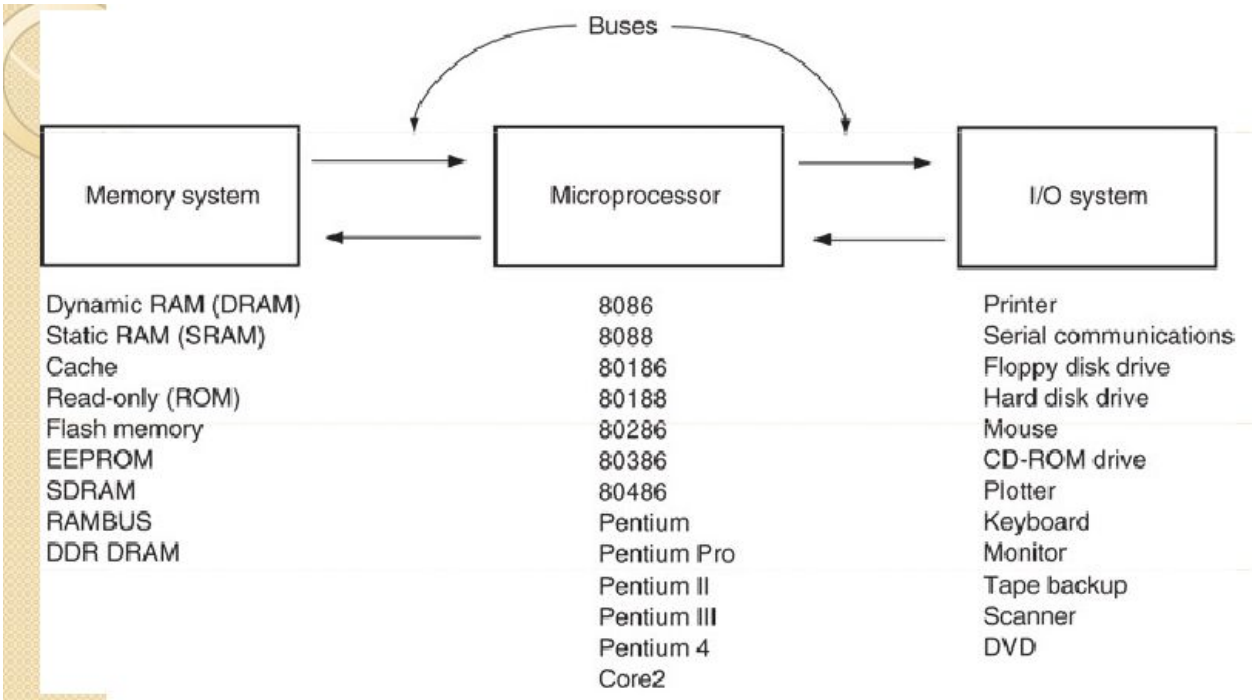


**Figure 1.1** block diagram of a microprocessor--based computer system.

What is a bus? A bus is a series of common connections that carry the same kind of information. Example- An address bus is a bus with 20 connections that carry the memory address to the memory.

### 1.2.1 The memory and the input/output system

The memory structure of all Intel 80x86 to Pentium 4 based personal computer systems are similar. This includes the first computers based on 8088 introduced in 1981 by IBM to the most modern computers based on Pentium 4. The memory structure of microprocessor based computer systems can be divided into three main regions. These are

1. Transient program area (TPA)
2. System area
3. Extended memory system (XMS)

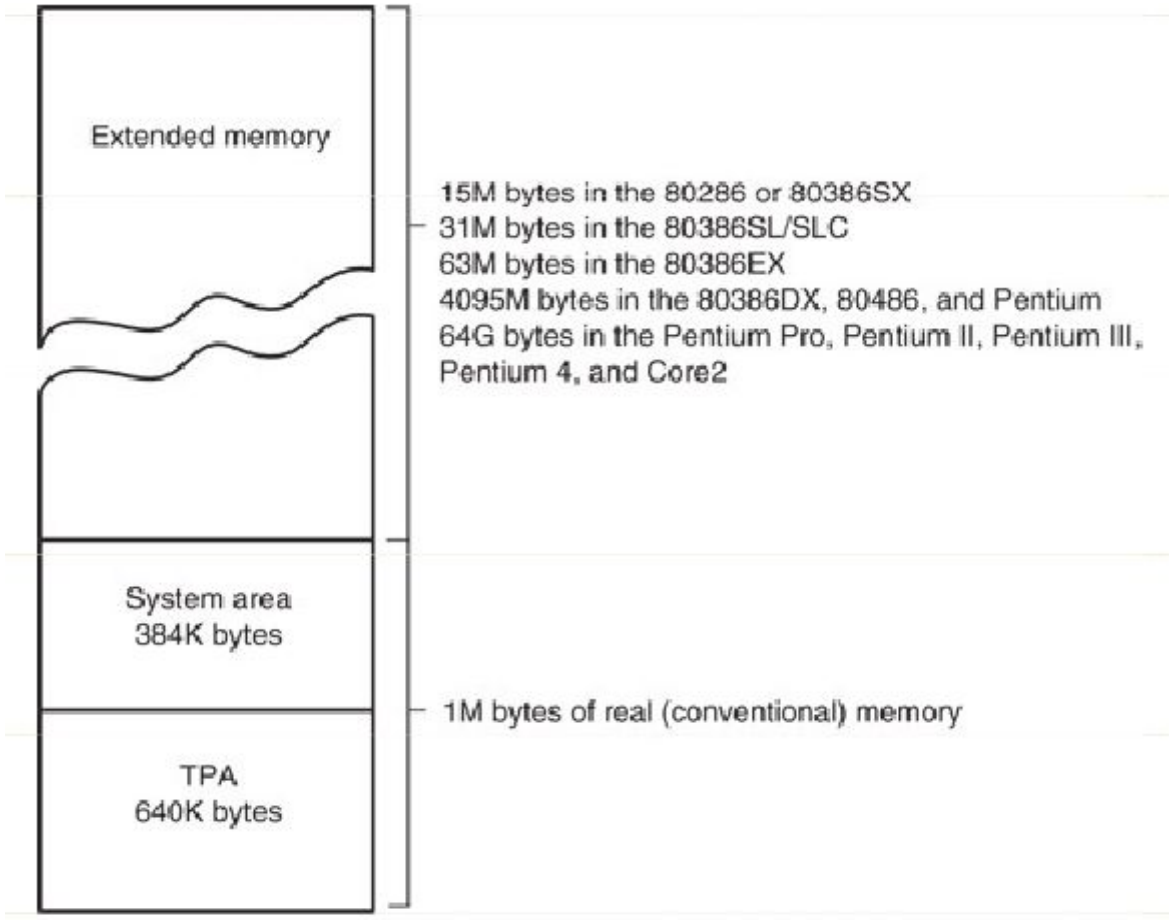


**Figure 1.2** The memory map of a personal computer.

It should be noted that the Extended memory system is not available in those computers based on 8086 or 8088. In these old computers the TPA and System area exists but not the Extended memory system. The TPA is of size 640 Kb and System area is of size 384Kb. The TPA and System area together forms the real or conventional memory which is of size 1024Kb or 1 Mb. It's called as real or conventional memory because each Intel microprocessor is designed to function in this area using its real mode of operation.

Those computer systems that uses the any of the microprocessors, Intel 80286 through Pentium 4, has the 640 Kb of TPA and 384 Kb of system area, In addition , these systems also have an Extended memory. Hence IBM designates these systems as AT class machines (AT- Advanced class computer systems). These systems are also called as ISA (Industry standard architecture) or EISA (Extended ISA).

The extended memory available in the computer systems using the 80286- 80386SX microprocessors is 15Mb. While the amount of extended memory available in the computer systems using 80386DX - Pentium microprocessors are 4095Mb, excluding the 1Mb real or conventional memory. The Computer systems having Pentium pro - Pentium 4 microprocessors can have 1Mb less than 4Gb to 64GB extended memory. (Note- Modern day computer systems based on Pentium 4 systems have an extended memory more than 180Gb.)

Recently, a new bus known as the Peripheral Component Interconnect (PCI) bus has been introduced in the Pentium- Pentium 4 based systems. The older computers based on 8086/8088 used an 8 bit peripheral bus to interface with 8 bit devices. The ISA machines or AT class machines which used 80286 or above microprocessors used 16 bit peripheral bus for interface. The EISA machines that used 80386DX and 80486 microprocessors used 32 bit peripheral bus for interface. All the new buses were compatible with the older devices. That is, an 8 bit interface card is compatible with an 8-bit bus , 16-bit bus or a 32 bit bus. Similarly a 16 bit interface card is compatible with a 16 bit bus and 32 bit bus.

Another bus type found in the 80486 based computer systems is the VESA local bus or VT bus. This local bus helps to interface disk and video to the microprocessor. Two new buses have also been introduced, one is the USB or Universal Serial Bus and the other is the AGP ( Advanced graphics port)- The Advanced graphics port transfers data between the video card and the microprocessor at very high speeds.

**The Transient Program area (TPA)**

The transient program area or TPA holds the DOS operating system and other programs that control the computer system. The TPA also holds other active or inactive application programs. We know that the TPA is 640Kb and since it holds DOS on it a part of this 640 Kb is used up by DOS operating system. The size of the TPA available for other application programs is 628Kb if MS-DOS version 7.X is used as the operating system. The older versions of DOS used to take up large spaces of TPA leaving only less than 530Kb for other applications. PC-DOS is another operating system that is found in computer systems. Both PC-DOS and MS-DOS are compatible with each other, hence both functioned similarly with application programs. Windows and OS/2 are other operating systems compatible with DOS and allows DOS programs to execute.

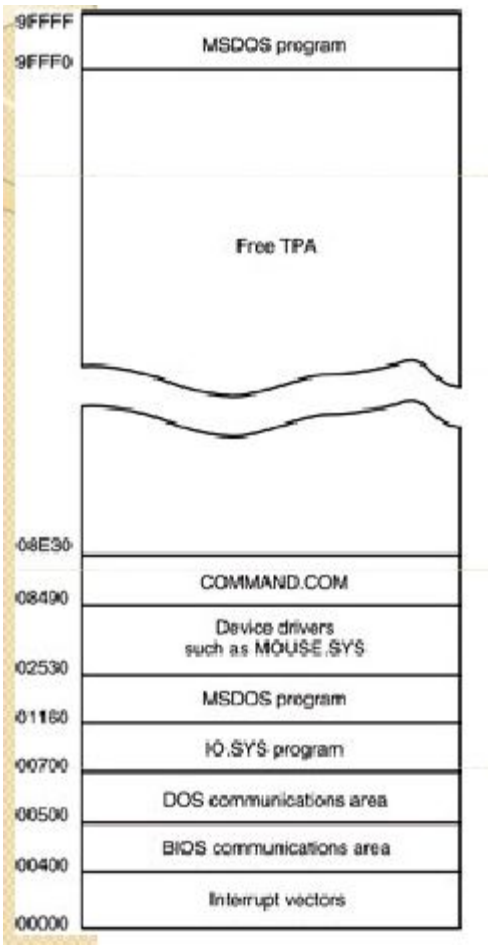

**Figure 1.3** The memory map of the TPA in a personal computer.

The memory map of the TPA is shown in the figure. The memory map shows how different areas of the TPA are allotted to the system programs, data and drivers. To the left of each area is a hexadecimal number that shows the memory address that begin and end each data area.

**1. Interrupt Vectors** - The interrupt vectors which occupy the area between 00000 and 00400 is responsible for accessing various features of the DOS, BIOS and other application programs.

**2. BIOS communication area and DOS communication area -** BIOS is nothing but Basic Input/Output System. BIOS is a collection of programs that is stored in the ROM or flash memory that is used to control the Input/Output devices that is connected to the computer system. The BIOS and DOS communication areas have transient data that can be used by programs to access the I/O devices or other parts of the computer system.

**3. IO.SYS -** The IO.SYS is a program that loads into the TPA from the disk when the computer system using MSDOS or PCDOS are switched ON. The programs in the IO.SYS enables the DOS programs to use the keyboard, the display, printer and other I/O devices.

**4. MSDOS -** MSDOS occupies two parts of the TPA. One is at the top of TPA which is considerably small and 16 bytes in length. The other is at the bottom and is larger. The memory size occupied by the DOS depends on the version of the DOS installed. Older versions usually needed larger areas of TPA compared to the newer versions.

**5. Device Drivers-** Drivers are those files with an extension .SYS such as MOUSE.SYS. Drivers are programs that control the installable devices like mouse, hand scanner and also other installable application programs. The size of the driver and the number of drivers vary from one computer to the another.

**6. COMMAND.COM**- The COMMAND.COM helps to control the computer system using the keyboard when operated in DOS mode. The COMMAND.COM program processes the DOS commands as they are typed from the keyboard.

**7. Free TPA-** The free TPA holds the active DOS application programs. These DOS application programs can be exemplified as the word processor , spreadsheet and CAD programs. In addition to these, free TPA also holds the TSR (Terminate and Stay Resident) programs. These remain in the free TPA in an inactive state until initiated by a hot-key or an interrupt. An example of TSR is the calculator program that is activated upon the ALT+C hotkey.

## SYSTEM AREA

The System area which is smaller than the TPA is considerably important. It contains programs for data storage and these programs are stored in ROM or flash memory and also in some areas of the RAM. The system area map is shown in the figure.

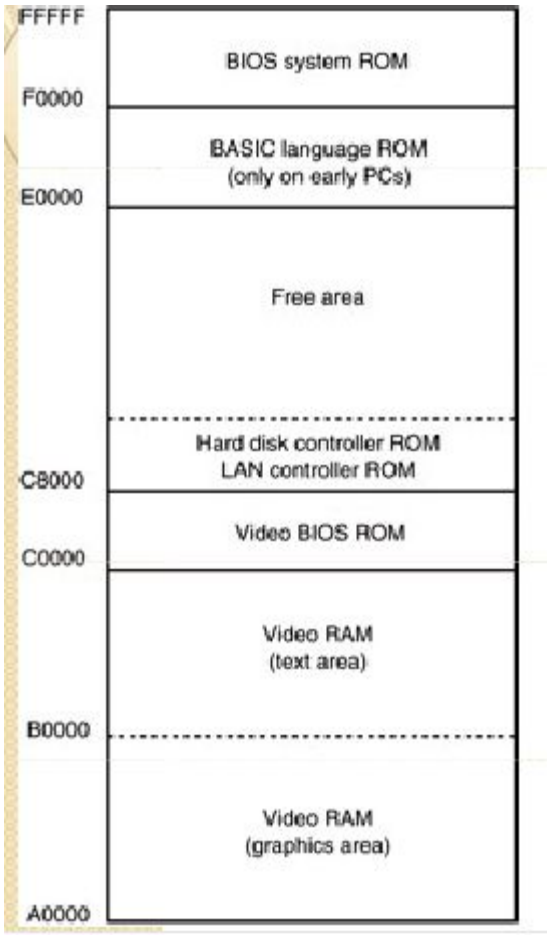


**Figure 1.4**The system area of a typical personal computer.

On the left side memory addresses of the particular regions are given in hexadecimal format. The first area of the system space extends from A0000H to C7FFFH and has the video display RAM and video control programs. The Video display RAM is stored in two parts, first from A0000H to A7FFFH and is for the graphical data, second from B0000H to B7FFFH and stores the text data. The video BIOS contains programs that control the video display of the computer and is located on ROM or falsh memory. It's area in system space is from C0000H to C7FFFH. The size and amount of the memory used depends upon the type of video display adapter used.

The area C8000H - DFFFFH is free system area and is called the open system area. It is mostly used as the extended memory system in PC and XT machines ( PC and XT machines means those computers based on 8086/8088 microprocessor) and as an upper memory system in AT class machines (Computers using 80286 or above microprocessors).

Memory locations E0000H-EFFFFH contains the cassette BASIC language on ROM found in the older IBM based systems. In almost all the newer systems this particular area is kept open or free and is also used as RAM to aid the faster operation of DOS application programs.

The system area F0000H to FFFFFH is used by the System BIOS ROM, but this System BIOS ROM only operates the I/O devices and is not responsible for the controlling of the video display system which is done by the separate system BIOS ROM at the location C0000H. The system BIOS at the top is divided into two parts, first part is in the area F0000H to F7FFFH and contains programs that set up the computer. The second part contains procedures that control the I/O devices.

## MICROPROCESSOR

Microprocessor can be called as the heart of the microprocessor based personal computer system. The microprocessor is also known by the names CPU or Central Processing Unit and controls the working of the computer system. The microprocessor connects to the memory and I/O devices through the buses.

The microprocessor follows three simple steps in its working-

1. Transfers data from memory to itself or to the I/O devices.
2. Performs arithmetic and logical calculations.
3. Performs a program via simple decisions.

Even though these processes are simple, the microprocessor is able to solve all types of problems using this approach. The strength of the microprocessor lies in its ability to execute millions of instructions per second from the software or programs. Software and programs are nothing but a collection of instructions. These software or program is stored in the memory. This stored program concept makes the microprocessor or in the main, a computer system itself very efficient.

The arithmetic and logical instructions executed by the microprocessor are

1. Addition
2. Subtraction
3. Multiplication
4. Division
5. AND
6. OR
7. NOT
8. NEG
9. Shift
10. Rotate

Data is stored in the memory or the internal registers. The width of the data is either a byte (8-bits), word (16-bits) or a double word (32-bits). Only the 80386 and above versions are able to execute all three. 8086 to 80286 could directly manipulate 8-bit and 16-bit data but not 32-bit data.

A Co-processor called the numeric processor is with the 80486 to aid in arithmetic calculations dealing with floating point arithmetic. This numerical processor was an additional component in the older 8086- 80386 processors.