

Introduction to the Personal Computer

2.1 Describe a computer system

A computer system consists of hardware and software components. Hardware is the physical equipment such as the case, storage drives, keyboards, monitors, cables, speakers, and printers. The term software includes the operating system and programs. The operating system instructs the computer how to operate. These operations may include identifying, accessing, and processing information. Programs or applications perform different functions. Programs vary widely depending on the type of information that will be accessed or generated. For example, instructions for balancing a checkbook are very different from instructions for simulating a virtual reality world on the Internet.

2.2 Identify the names, purposes, and characteristics of cases and power supplies

The computer case provides protection and support for the internal components of the computer. All computers need a power supply to convert alternating-current (AC) power from the wall socket into direct-current (DC) power. The size and shape of the computer case is usually determined by the motherboard and other internal components.

You can select a large computer case to accommodate additional components that may be required in the future. Other users may select a smaller case that requires minimal space. In general, the computer case should be durable, easy to service, and have enough room for expansion.

The power supply must provide enough power for the components that are currently installed and allow for additional components that may be added at a later time. If you choose a power supply that powers only the current components, it may be necessary to replace the power supply when other components are upgraded.

2.2.1 Describe cases

A computer case contains the framework to support the internal components of a computer while providing an enclosure for added protection. Computer cases are typically made of plastic, steel, and aluminum and are available in a variety of styles.

The size and layout of a case is called a form factor. There are many types of cases, but the basic form factors for computer cases include desktop and tower. Desktop cases may be slimline or full-sized, and tower cases may be

mini or full-sized.

Computer cases are referred to in a number of ways:

- Computer chassis
- Cabinet
- Tower
- Box
- Housing

In addition to providing protection and support, cases also provide an environment designed to keep the internal components cool. Case fans are used to move air through the computer case. As the air passes warm components, it absorbs heat and then exits the case. This process keeps the components of the computer from overheating.

There are many factors that must be considered when choosing a case:

- The size of the motherboard
- The number of external or internal drive locations called bays
- Available space

In addition to providing protection from the environment, cases help to prevent damage from static electricity. Internal components of the computer are grounded by attachment to the case.

NOTE: You should select a case that matches the physical dimensions of the power supply and motherboard.

2.2.2 Describe power supplies

The power supply, shown in Figure 1, converts alternating-current (AC) power coming from a wall outlet into direct-current (DC) power, which is a lower voltage. DC power is required for all of the components inside the computer.

A computer can tolerate slight fluctuations in power, but a significant deviation can cause the power supply to fail. An uninterruptible power supply (UPS) can protect a computer from problems caused by changes in power. A UPS provides power for a computer using a power inverter. A power inverter provides AC power to the computer from a built-in battery by converting the DC current of the UPS battery into AC power.



Figure (1): Power Supply

2.3 Identify the names, purposes, and characteristics of internal components

This section discusses the names, purposes, and characteristics of the internal components of a computer.

2.3.1 Identify the names, purposes, and characteristics of motherboards

The motherboard is the main printed circuit board and contains the buses, or electrical pathways, found in a computer. These buses allow data to travel between the various components that comprise a computer. A motherboard is also known as the system board, the backplane, or the main board.

The motherboard accommodates the central processing unit (CPU), RAM, expansion slots, heat sink/fan assembly, BIOS chip, chipset, and the embedded wires that interconnect the motherboard components. Sockets, internal and external connectors, and various ports are also placed on the motherboard.

The form factor of motherboards pertains to the size and shape of the board. It also describes the physical layout of the different components and devices on the motherboard. The form factor determines how individual components attach to the motherboard and the shape of the computer case.

An important set of components on the motherboard is the chipset. The chipset is composed of various integrated circuits attached to the motherboard that control how system hardware interacts with the CPU and motherboard. The CPU is installed into a slot or socket on the motherboard. The socket on the motherboard determines the type of CPU that can be installed.

The chipset of a motherboard allows the CPU to communicate and interact with the other components of the computer, and to exchange data with system memory, or RAM, hard disk drives, video cards, and other output devices. The chipset establishes how much memory can be added to a motherboard. The chipset also determines the type of connectors on the motherboard.

Most chipsets are divided into two distinct components, Northbridge and Southbridge. What each component does varies from manufacturer to manufacturer. In general, the Northbridge controls access to the RAM, video card, and the speeds at which the CPU can communicate with them. The video card is sometimes integrated into the Northbridge. AMD and Intel have chips that integrate the memory controller onto the CPU die, which improves performance and power consumption. The Southbridge, in most cases, allows the CPU to communicate with the hard drives, sound card, USB ports, and other I/O ports.



Figure (2): Variety of Mother Boards

2.3.2 Identify the names, purposes, and characteristics of CPUs

The central processing unit (CPU) is considered the brain of the computer. It is sometimes referred to as the processor. Most calculations take place in the CPU. In terms of computing power, the CPU is the most important element of a computer system. CPUs come in different form factors, each style requiring a particular slot or socket on the motherboard. Common CPU manufacturers include Intel and AMD.

The CPU socket or slot is the connector that interfaces between the motherboard and the processor. Most CPU sockets and processors in use today are built around the pin grid array (PGA) architecture, in which the pins on the underside of the processor are inserted into the socket, usually with zero insertion force (ZIF). ZIF refers to the amount of force needed to install a CPU into the motherboard socket or slot. Slot-based processors are cartridge-shaped and fit into a slot that looks similar to an expansion slot. Figure 1 lists common CPU socket specifications.

The CPU executes a program, which is a sequence of stored instructions. Each model of processor has an instruction set, which it executes. The CPU executes the program by processing each piece of data as directed by the program and the instruction set. While the CPU is executing one step of the program, the remaining instructions and the data are stored nearby in a special memory called cache. There are two major CPU architectures related to instruction sets:

- Reduced Instruction Set Computer (RISC) – Architectures use a relatively small set of instructions, and RISC chips are designed to execute these instructions very rapidly.
- Complex Instruction Set Computer (CISC) – Architectures use a broad set of instructions, resulting in fewer steps per operation.

Some CPUs incorporate hyperthreading to enhance the performance of the CPU. With hyperthreading, the CPU has multiple pieces of code being executed simultaneously on each pipeline. To an operating system, a single CPU with hyperthreading performs as though there are two CPUs.

The power of a CPU is measured by the speed and the amount of data that it

can process. The speed of a CPU is rated in cycles per second. The speed of current CPUs is measured in millions of cycles per second, called megahertz (MHz), or billions of cycles per second, called gigahertz (GHz). The amount of data that a CPU can process at one time depends on the size of the processor data bus. This is also called the CPU bus or the front side bus (FSB). The wider the processor data bus width, the more powerful the processor is. Current processors have a 32-bit or a 64-bit processor data bus.

The latest processor technology has resulted in CPU manufacturers finding ways to incorporate more than one CPU core onto a single chip. These CPUs are capable of processing multiple instructions concurrently:

- Single Core CPU – One core inside a single CPU that handles all of the processing capability. A motherboard manufacturer may provide sockets for more than one single processor, providing the ability to build a powerful, multi-processor computer.
- Dual Core CPU – Two cores inside a single CPU in which both cores can process information at the same time.
- Triple Core CPU – Three cores inside a single CPU that is actually a quad-core processor with one of the cores disabled.
- Quad Core CPU – Four cores inside a single CPU in which all cores can process information simultaneously for enhanced software applications.

2.3.3 Identify the names, purposes, and characteristics of cooling systems

Electronic components generate heat. Heat is caused by the flow of current within the components. Computer components perform better when kept cool. If the heat is not removed, the computer may run slower. If too much heat builds up, computer components can be damaged.

Increasing the air flow in the computer case allows more heat to be removed. A case fan is installed in the computer case to make the cooling process more efficient.

2.3.4 Identify the names, purposes, and characteristics of ROM and RAM

ROM

Read-only memory (ROM) chips are located on the motherboard. ROM chips contain instructions that can be directly accessed by the CPU. Basic instructions for booting the computer and loading the operating system are stored in ROM. ROM chips retain their contents even when the computer is powered down. The contents cannot be erased or changed by normal means.

RAM

Random access memory (RAM) is the temporary storage for data and programs that are being accessed by the CPU. RAM is volatile memory, which means that the contents are erased when the computer is powered off. The more RAM in a computer, the more capacity the computer has to hold and process large programs and files, as well as enhance system performance.

Memory Modules

Early computers had RAM installed on the motherboard as individual chips. The individual memory chips, called dual inline package (DIP) chips, were difficult to install and often became loose on the motherboard. To solve this problem, designers soldered the memory chips on a special circuit board called a memory module.

The speed of memory has a direct impact on how much data a processor can process because faster memory improves the performance of the processor. As processor speed increases, memory speed must also increase. For example, single-channel memory is capable of transferring data at 64 bits. Dual-channel memory increases speed by using a second channel of memory, creating a data transfer rate of 128 bits.

Cache

SRAM is used as cache memory to store the most frequently used data. SRAM provides the processor with faster access to the data than retrieving it from the slower DRAM, or main memory.

Error Checking

Memory errors occur when the data is not stored correctly in the RAM chips. The computer uses different methods to detect and correct data errors in memory.

2.3.5 Identify the names, purposes, and characteristics of adapter cards

Adapter cards increase the functionality of a computer by adding controllers for specific devices or by replacing malfunctioning ports. Adapter cards are used to expand and customize the capability of the computer:

- Network Interface Card (NIC) – Connects a computer to a network using a network cable
- Wireless NIC – Connects a computer to a network using radio frequencies
- Sound adapter – Provides audio capability
- Video adapter – Provides graphic capability

- TV tuner – Provides the ability to watch and record TV signals on a PC by connecting a TV source, such as cable TV, satellite, or an antenna, to the installed tuner card
- Modem adapter – Connects a computer to the Internet using a phone line
- Universal Serial Bus (USB) port – Connects a computer to peripheral devices

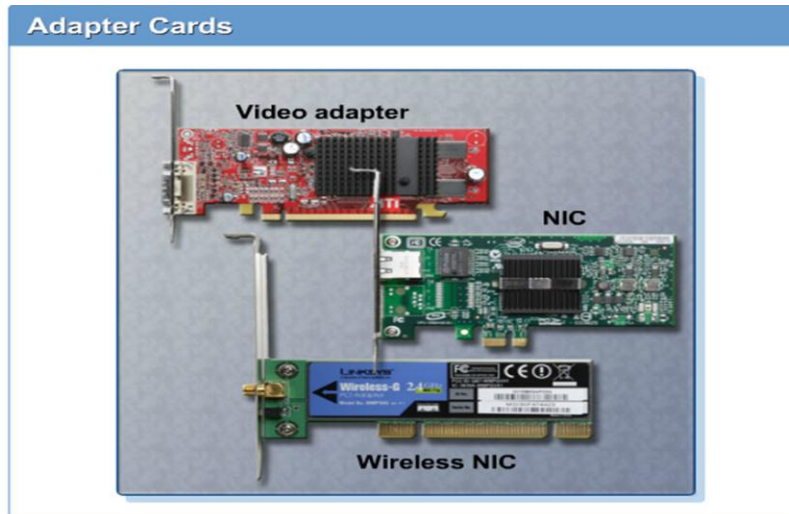


Figure (3): Adapter Cards

2.3.6 Identify the names, purposes, and characteristics of storage drives

Storage drives, read or write information to magnetic or optical storage media. The drive can be used to store data permanently or to retrieve information from a media disk. Storage drives can be installed inside the computer case, such as a hard drive. For portability, some storage drives can connect to the computer using a USB port. These portable storage drives are sometimes referred to as removable drives and can be used on multiple computers. Here are some common types of storage drives:

- Floppy drive
- Hard drive
- Optical drive
- Flash drive

Floppy Drive

A floppy drive, or floppy disk drive, is a storage device that uses removable 3.5-inch floppy disks. These magnetic floppy disks can store 720 KB or 1.44 MB of data. In a computer, the floppy drive is usually configured as the A: drive. The floppy drive can be used to boot the computer if it contains a bootable floppy disk. A 5.25-inch floppy drive is older technology and is seldom used.

Hard Drive

A hard drive, or hard disk drive, is a magnetic storage device that is installed inside the computer. The hard drive is used as permanent storage for data. In a Windows computer, the hard drive is usually configured as the C: drive and contains the operating system and applications. The hard drive is often configured as the first drive in the boot sequence. The storage capacity of a hard drive is measured in billions of bytes, or gigabytes (GB). Multiple hard drives can be added to increase storage capacity.

Optical Drive

An optical drive is a storage device that uses lasers to read data on the optical media. There are three types of optical drives:

- Compact Disc (CD)
- Digital versatile Disc (DVD)
- Blu-ray Disc (BD)

CD, DVD, and BD media can be pre-recorded (read-only), recordable (write once), or re-recordable (read and write multiple times). CDs have a data storage capacity of approximately 700 MB. DVDs have a data storage capacity of approximately 4.3 GB on a single-layer disc, and approximately 8.5 GB on a dual-layer disc. BDs have a storage capacity of 25 GB on a single-layer disc, and 50 GB on a dual-layer disc.

2.4 Explain system resources and their purposes

System resources are used for communication purposes between the CPU and other components in a computer. There are three common system resources:

- Interrupt Requests (IRQ)
- Input/Output (I/O) Port Addresses
- Direct Memory Access (DMA)

Interrupt Requests

IRQs are used by computer components to request information from the CPU. The IRQ travels along a wire on the motherboard to the CPU. When the CPU receives an interrupt request, the CPU determines how to fulfill this request. The priority of the request is determined by the IRQ number assigned to that computer component. Older computers only had eight IRQs to assign to devices. Newer computers have 16 IRQs, which are numbered 0 to 15. As a general rule, each component in the computer must be assigned a unique IRQ. IRQ conflicts can cause components to stop functioning and even cause the computer to crash. Today, most IRQ numbers are assigned automatically with plug and play (PnP) operating systems and the implementation of PCI slots, USB ports, and FireWire ports. With the numerous components that can be installed in a computer, it is difficult to assign a unique IRQ to every component. PCI devices can now share IRQs without conflict.

Input/Output (I/O) Port Addresses

Input/output (I/O) port addresses are used to communicate between devices and software. The I/O port address is used to send and receive data for a component. As with IRQs, each component will have a unique I/O port assigned. There are 65,535 I/O ports in a computer, and they are referenced by a hexadecimal address in the range of 0000h to FFFFh.

Direct Memory Access

DMA channels are used by high-speed devices to communicate directly with main memory. These channels allow the device to bypass interaction with the CPU and directly store and retrieve information from memory. The main idea of direct memory access (DMA) is to enable peripheral devices to cut out the “middle man” role of the CPU in data transfer. It allows peripheral devices to transfer data directly from and to memory without the intervention of the CPU. Having peripheral devices access memory directly would allow the CPU to do other work, which would lead to improved performance, especially in the cases of large transfers.