

Chapter 2: Hardware for Computer Operations

Overview

This chapter classifies computers into different types and describes the various types of hardware available. It is important that administrative professionals are familiar with this information so they can perform their job tasks using the appropriate equipment. Students should understand the various categories of hardware and then be able to describe the components that fall under each category.

Lecture Notes

A. Computer-Based Information System

Hardware refers to the equipment (CPU, input, output, and storage). The *digital computer* is used to organize numbers and alphabetic data; data is represented in bytes, which can be broken down into eight bits. A bit is a **binary digit** with two options: 0 (off) and 1 (on). The other computer classification is the analog computer; it is used as a measuring device.

1. **Input Devices** are used to enter raw data into the system. They include devices for human input (keyboard, mouse, trackball, touch screens) and source data automation (interactive touch screens, magnetic card readers, optical recognition, and voice recognition). Data may be stored for batch processing or processed immediately. Data may be in a form acceptable for another machine or usable by people.
2. **Processor Unit** includes primary storage and the CPU (control unit and arithmetic/logic unit).
 - a. Primary storage consists of semiconductor memory chips. It is divided into ROM, RAM, and cache memory.
 - *Read-only memory* (ROM) is nonvolatile memory; includes critical system instructions permanently stored by the manufacturer (firmware). Variations include programmable read-only memory (PROM), which can be programmed only once, and erasable PROM, which is common in robotics.
 - *Random access memory* (RAM) is temporary memory; also known as main memory or internal storage and volatile memory. RAM stores input data, program instructions, immediate processing results, and processed data that is ready for output.
 - *Cache memory* is placed close to the CPU; very fast, complements RAM for quick access during processing. It temporarily stores blocks of software instructions and data for access during processing.
 - b. The control unit includes instruction registers and control circuits. The control unit (along with the main memory) makes possible the stored program concept of computer operations. The control unit interprets program

instructions; control circuits are activated to complete operations and results are stored.

- c. The arithmetic/logic unit performs all mathematical computations and logical comparisons. Data are transferred as needed from main memory to the arithmetic/logic unit for manipulation and then returned to main memory for additional processing or output.
 - d. A microprocessor includes the control unit and arithmetic/logic unit mounted on a silicon chip. A multiprocessing operation mode is possible when a computer contains more than one microprocessor. The microprocessor determines computer's performance based on the following:
 - Clock speed is measured in megahertz or gigahertz.
 - Word length is the number of bits the CPU can process at a time.
 - Bus width is the size of the data bus used to transfer data and instructions between the CPU and primary storage.
3. **Output Devices** – Output that is printed is called a *hard copy*; output that can be viewed on a monitor or heard over speakers is called a *soft copy*.
 4. **Secondary Storage Devices** are also called auxiliary storage; this is used for data that are saved for future processing. Processed data are saved using unique file names to identify the information or program. Common devices include magnetic disk, optical disc, DVD, USB flash drive, and magnetic tape.

B. Types of Computers

1. **Mainframe Computers** are used by large organizations and government agencies to support thousands of computers or as superservers for very large client/server networks. They have processing speeds greater than 1 trillion instructions per second and primary storage ranging from hundreds of megabytes to gigabytes. Information systems personnel provide assistance to users of a mainframe system. Many organizations that moved away from the mainframe are now moving back because it provides high reliability, flexibility, and centralized administration.
2. **Mid-Range Computers** are less powerful than a mainframe, but they support computing requirements for small- to medium-sized organizations as well as e-commerce and networking environments.
 - a. Minicomputers have reduced processing capabilities compared to the mainframe, but they use the full range of input/output devices that are available for the mainframe. A minicomputer can provide on-site processing for users that are off-site. They can also be used as a front-end processor to a large mainframe system (host system).
 - b. A server is a smaller mid-range computer that typically supports computer networks or e-commerce activities. It allows users to share files, software, and peripheral devices. Multiple servers (server farms) are large groups of servers maintained by the organization or a commercial vendor.

3. **Microcomputers** are digital computers that use a microprocessor, an internal storage chip, an input/output chip, and others. The additional components used include visual display (monitor), mouse and keyboard, modem, magnetic disk drives, CD drives, speakers, printer (or networked), microphone for voice input, and camera for teleconferencing. There are five classifications of microcomputers based on size:
- a. Workstations – provide a high level of math and graphics capability, reduced instruction set computing (RISC) to enhance the speed of microprocessors by embedding the most used instructions on a chip.
 - b. Desktop PCs – powerful microcomputers with graphics, document management, and communications capabilities. Predominant microprocessor in the business environment.
 - c. Network computers – do not have full functionality of the desktop PC because most software, data, and storage are placed on the network server. Less expensive to operate and maintain than a desktop.
 - d. Notebook computers – light-weight, portable computing, but offer the same processing power and storage capabilities as a desktop PC.
 - e. Personal Digital Assistants (PDA) – mobile, hand-held computers use a touch-screen and pen-based handwriting to send and receive e-mail; use the Web, maintain a calendar and other lists with the desktop PC or Web server.

C. Input Devices and Interfaces

Input devices are necessary for human beings to be able to communicate with a computer.

1. **Input Devices for Human Input** are the most common devices.
 - a. Keyboard – most common input device, like a typewriter with additional function keys and cursor movement keys; ergonomic keyboards are now available; users should be very careful to use proper hand and wrist movements to avoid carpal tunnel syndrome.
 - b. Mouse – point-and-click device that lets the user move the device to move the cursor on the screen, point and click to make a choice, and point and drag objects in a graphical user interface environment (GUI).
 - c. Trackball – similar to a mouse, but the device doesn't move, a round ball rotates to move the cursor; found on notebook/laptop computers (in addition to touchpads where a finger is moved on a pad to move the cursor).
 - d. Stylus – a rubberized pen device on PDAs to allow the user to touch options or write on a sensitive screen.
 - e. Microphone – used for voice recognition input; important to have a strong and clear signal.
2. **Input Devices for Source Data Automation** improve the speed and accuracy of data input by capturing the data at the time of the transaction.
 - a. Magnetic recognition – includes magnetic ink character recognition (MICR), magnetic cards, and smart cards; used in the banking industry since the 1950s; used today on cards similar to credit cards, smart cards are enhanced with a microprocessor on the card to allow data to be stored.

- b. Touch-sensitive screens – allow a person to point with finger and touch certain parts of the screen; sensors make it an interactive device.
 - c. Optical recognition- scans the data for input; includes optical mark recognition (OMR), which is the simplest scanning technology, when a pencil mark is made in a predetermined grid; bar code, which is what the UPC code is on products; and optical character recognition (OCR) to recognized letters, numbers, or special characters.
 - d. Voice input-converts the human voice to digital impulses so the computer can process the data; takes a lot of practice for the computer to understand your voice accurately.
 - e. Visual input-pattern recognition systems that require a camera to be a computer's eye.
3. A **User Interface** is a combination of hardware and software that makes data input easier because the user responds to a message presented by the computer, controls the computer, or requests information from the computer.
- a. Function keys are programmed keys to carry out specific operations; found on the keyboard.
 - b. Screen prompts are messages displayed on the screen to help the user.
 - c. Menus are special screen prompts that offer users a list from which to choose the option they want.
 - d. Icons are pictures that represent text to show the users what program options are available.

Users should be aware of the features that interfaces should include:

- Messages displayed and actions the computer takes when a user enters data should be meaningful to the user.
- The simpler the response required from the user, the better the interface.
- Screen design should be simple and easily understood.
- When an error is made, the user should be notified so he or she can easily see how to correct the mistake.

D. Information Output

1. **Output Media** include paper, display, and voice.
 - a. Paper output – used often so people can readily use the information; referred to as a hard copy.
 - b. Display output – on a screen; must be saved on a secondary storage device to be permanent; includes microfilm and microfiche; often referred to as a soft copy.
 - c. Voice response system – sound chips embedded in the hardware; includes beeps and verbal responses to the user; prevalent in computer business applications; more advanced systems use speech synthesizers to convert data into speech.
2. **Output Devices**

- a. Monitors – vary in their quality; flat-panel monitors utilize newer technology.
 - Evaluate the viewable size of a monitor relative to the actual size.
 - The resolution includes pixels (short for picture element) and dot pitch (distance between centers of adjacent pixels); the lower the dot pitch, the greater number of pixels in the display and the higher the resolution.
 - Flat-panel monitors use LCD (tiny transistors to reflect light through the liquid crystal to produce high resolution output) and plasma technology (tiny light bulbs to ignite the phosphor to produce high-resolution output with little trailing edge blur).
- b. Printers – chosen based on print quality, speed, and cost.
 - Impact printers are noisy, slow, and low-quality for graphics. When used for multi-part forms, dot matrix is most common; inexpensive.
 - Non-impact printers include ink jet types that use fast-drying ink sprayed in droplets to form the characters; relatively low cost and offer many features to make them popular in office environments.
 - Non-impact printers also include laser printers, which use intense low-power light beam capable of carrying millions of characters; very high-resolution for text and graphics, very fast; capable of duplexing and using different paper sizes; costs coming down, making them more attractive in the office.
- c. Plotters-used for large drawings; drum and table plotters move the paper past a stylus bi-directionally; use roll-feed paper up to 4 feet wide and 50 feet long; popular in engineering, drafting and graphic arts.
- d. Speakers-used with a voice-response system; can be an additional peripheral or built-in.

E. Long-Term Storage for the Computer-Based Information System

Long-term storage must be secure and readily available. Secondary storage is also known as auxiliary storage.

1. **Characteristics of Secondary Storage** – must be attached to the CPU in order for data to be transmitted; devices are chosen based on channels, type of access, transfer rate, access time, and storage capacity.
 - a. Channel – the necessary communication link that controls the flow of data between the primary storage in the processor unit and the secondary storage device; uses a port (connection point on the computer where the device is connected).
 - b. Type of access – sequentially or direct.
 - Sequential access is a method of retrieving data where the first records are read, and then the next, and so on; magnetic tape is accessed sequentially, similar to a cassette tape or VCR tape.
 - Direct access relates to the ability to go directly to the information that is needed; used for magnetic disks and optical discs (can also be sequential).

- c. Transfer rate – the speed at which data is transferred from secondary storage to main memory, measured in bytes per second (Bps).
- d. Access time – amount of time required to locate data needed from the storage location and transfer it to internal storage; wide range of times measured in milliseconds.
- e. Storage capacity – usually stated in the number of bytes.

Kilobytes (KB)	1 thousand bytes
Megabytes (MB)	1 million bytes
Gigabytes (GB)	1 billion bytes
Terabytes (TB)	1 trillion bytes
Petabytes (PB)	1 quadrillion bytes

2. **Secondary Storage** – nonvolatile, long-term; data is not lost when the power is turned off; auxiliary to primary storage and is outside the processor unit; most common types:

- a. Hard disk – fixed disk, nonremovable; range in size from 20 GB to 250 GB.
- b. Magnetic disk – common for microcomputers; removable from disk drive, data transported from place to place; size varies with disk density and quality; protect disk to keep data safe, a disk with a bad sector cannot be used any longer. USB flash drive is an external, portable storage drive that can be carried in your pocket; can hold 250 MB of data.
- c. Optical disc – uses laser beam of light to store and read data instead of magnetic processes, burns microscopic pits onto the disk tracks as data are stored; shelf life of 30 years. Includes CD-ROM (read-only, holds approximately 650 MB of data), CD-R (recordable CD, can write to one time and then read only), CD-RW (rewritable CD, can store, access, and reuse discs the same as a magnetic disk; rewritable nearly a million times without a decline in accuracy), DVD (digital video disk provides high resolution, true color, and no flicker output; can be read only, recordable, or rewritable like CDs).
- d. RAID – redundant arrays of independent disks; combine 10-100 small hard disks drives into a single unit, specialized microcontroller coordinates the hard drives' microprocessors so it appears as a single drive.
- e. Magnetic tapes – first form of secondary storage to be widely used; sequential access only, storage capacity greater than 200 MB, transfer rate of 50,000-400,000 bps; popular backup medium.
- f. Storage area network – a high-speed fiber channel local area network dedicated to storage that interconnects different storage devices; expensive and difficult to manage; enterprise-wide infrastructure provides rapid sharing and access to the organization's stored data.

A storage service provider (SSP) is a professional service that assists with storage assessment, design, management, and operations. Service available 24/7, but there is a risk of having data off-site.

Additional Resources for Students

Recommended readings (no texts should be more than two years old):

- Fuller, Floyd and William Manning. *Computers and Information Processing*.
- Groneman, N. and J. Meroney. *Information Systems Applications, Evaluation, and Selection*. South-Western Publishing Co.
- Long, Larry and Nancy Long. *Introduction to Computers and Information Systems*. Prentice-Hall, Inc.
- Meyer, Marilyn and Roberta Baber. *Computers in Your Future*.
- Norton, Peter. *Introduction to Computers*.
- O'Leary, Timothy J. and Linda L. O'Leary. *Computing Essentials*. McGraw-Hill.
- Regan, Elizabeth A. and Bridget N. O'Connor. *Automating the Office – Office Systems and End-User Computing*. Macmillan City.
- Ricks, B., A. Swafford, and K. Gow. *Information and Image Management*. South-Western Publishing Co.
- Robek, Brown, and Stephens. *Information and Records Management*.
- Shelly, Gary and Thomas Cashman. *Learning to Use: Microcomputer Applications*. Boyd and Fraser Publishing Co.
- Silver, G. A. and M. L. Silver. *Data Communications for Business*.
- Tilton, R., J. Jackson, and S. Rigby. *The Electronic Office: Procedures and Administration*. South-Western Publishing Co.

Current issues of periodicals or business publications are also an excellent resource. Some of the following periodicals have an accompanying Web site.

Current Periodical	Web Address
<i>Gregg Reference Manual</i>	
<i>IAAP Complete Office Handbook</i>	http://www.iaap-hq.org/products/handbook.htm
<i>Modern Office Technology</i>	

Network Computing <http://www.networkcomputing.com/>
Networking Management

OfficePro <http://www.iaap-hq.org/officepro/toc.htm>
PC Computing

PC Magazine <http://www.pcmag.com>

The Office

Windows Magazine <http://www.winmag.com>

Additionally, the following Web sites may provide up-to-date information:

Computer World <http://www.computerworld.com>

C-Net <http://news.com.com/>

Intranet Journal <http://news.com.com/>

Wired <http://www.wired.com/>

ZDNet <http://www.zdnet.com/zdnn/>