# TABLE OF CONTENTS

# INFORMATION COMMUNICATION TECHNOLOGY

## DEFINITION OF TERMS

### i) Computer

A **computer** is an **electronic device** that **accepts** and **processes** **data** into **information** and under the control of instructions stored in its own memory and **output** or **store** the results for future use.

NB: An electronic device is a device that depends on the principles of electronics and uses the manipulation of electron flow for its operation.

### ii) Data

**Data** are raw, unprocessed and unorganized (unstructured) facts and figures that are relatively meaningless to the user. E.g. number of hours worked by an employee.

### iii) Information

Information is derived from data. This is data that is processed, organized/structured and presented in a given context so as to make it useful. e.g., multiplying the hours worked by the hourly rate to get each employee's gross earning. Information is an important component in decision making.

For example from a students test scores, the following information can be derived:

a) Class' average score

b) Most improved student

c) Median Score etc.

**USES OF INFORMATION**

**(a) Decision-making**

When managers are ready to make choices (decisions) they need good, accurate and up-to-date information. If they act without relevant information it could lead to disaster, and failure.

**(b) Performance Monitoring and control**

Businesses will compare actual performance against its predicted (budgeted) performance. Then they will act upon it.

**(c) Historical Evidence**

**iv) Information Communication Technology/Technologies (ICT)**

ICT is an umbrella term that covers any **software or hardware product** that can store, retrieve, manipulate, transmit or receive information electronically in a digital form. Examples include personal computers, digital television, email, robots, radio, cellular phones and networking hardware.

For our study, we are concerned with computer (hardware and software) and telecommunications technology (data, image, and voice networks).

**v) Information System (IS)**

An **Information System** (IS) is a combination of hardware, software, personnel, data and procedures that interact to support and improve day-to-day operations in an organization. These elements of an Information System are also known as the components of an Information System.

## Characteristics of High Quality Data

The Audit Commission has identified six key characteristics of good quality data.

**a) Accurate**

Data should be sufficiently **accurate** for the intended use and should be captured only once, although it may have multiple uses. Data should be captured at the point of activity.

**b) Valid, consistent and reliable**

Data should be recorded and used in compliance with relevant requirements, including the correct application of any **rules or definitions**. This will ensure consistency between periods and with similar organizations, measuring what is intended to be measured.

**c) Timely**

Data should be captured as quickly as possible after the event or activity and must be available for the intended use within a reasonable time period. Data must be available quickly and frequently enough to support information needs and to influence service or management decisions.

**d) Relevance and up-to-date**

Data captured should be relevant to the purposes for which it is to be used. This will require a periodic review of requirements to reflect changing needs.

**e) Complete**

Data requirements should be clearly specified based on the information needs of the organization and data collection processes matched to these requirements.

**f) Unique**

In order to add value to an organization, information must be unique and distinctive.

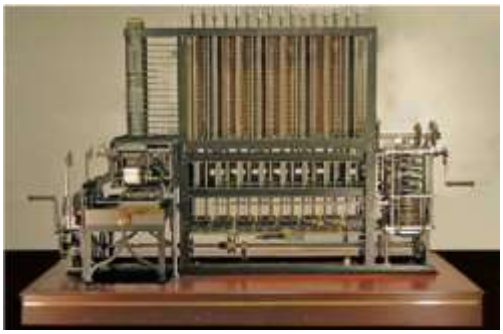
## A BRIEF COMPUTER HISTORY

The abacus, which emerged about 5,000 years ago in Asia Minor and is still in use today, may be considered the first computer. This device allows users to make computations using a system of sliding beads arranged on a rack; it was simply a counting device.

The Abacus

In 1642, **Blaise Pascal** (1623-1662), the 18-year-old son of a French tax collector, invented what he called a **numerical wheel calculator** to help his father with his duties but which used eight movable dials to add sums up. It was not until the 1940s that the electronic computers emerged.

In the 1820s, **Charles Babbage** designed the '**Difference Engine'**, a machine which could perform mathematical calculations. It consists of 8,000 parts, weighs 5 tons, and measures 11 feet long. The engine is operated by a crank handle and can evaluate trigonometric and logarithmic functions with 31 digits of precision. Its printer (on the left) stamps the results on paper and on a plaster tray, which could be used to create lead type for printing books of mathematical tables.



He also worked on another invention, the more complex **Analytical Engine**, a revolutionary device which was intended to be able to perform any arithmetic calculation using punched cards that would deliver the instructions, as well as a memory unit to store numbers and many other fundamental components of today's computers. **Lady Ada Lovelace** produced programs to be used by the analytical machine. She is claimed to be possibly the first programmer.

**Five Generations of Modern Computers - Digital Computers**

Modern computers can be classified into five generations.

**First generation: 1946-1959 - Characteristics**

i. First generation of computers started with using vacuum tubes as the **basic components for memory and circuitry** for CPU (Central Processing Unit).
ii. These tubes like electric bulbs **produced a lot of heat** and were prone to frequent fusing of the installations.
iii. They were, therefore, were **very expensive** and could be afforded only by very large organizations. The computer contained 17,468 vacuum tubes and consumed 150 kW of electricity. The **Electronic Numerical Integrator and Computer** (ENIAC) was announced in 1946. It cost almost $500,000 (approximately $6,000,000 today).

iv. In this generation mainly batch processing of data was done. In this generation Punched cards, **Paper tape, Magnetic tape Input & Output** devices were used. It is said that this computer **weighed 30 tons**, and had 18,000 vacuum tubes which were used for processing.
v. They consumed a lot of power. When this computer was turned on for the first time lights dimmed in sections of Philadelphia.
vi. Computers of this generation could only perform a **single task** at a time, and they **had no operating system**.

The first commercially available electronic computer, UNIVersal Automatic Computer I (UNIVAC I), was designed by Eckert and Mauchly. The computer used 5200 vacuum tubes and weighed 13 metric tons. It consumed 125 kW, and could perform about 1,905 operations per second.

Vacuum Tubes

NB: Batch processing- Executing a series of non-interactive jobs all at one time.

**Second generation: 1959-1965**.

i. Computers in this generation used the **transistor**
ii. They were **cheaper**
iii. **They consumed less power**
iv. **They were more compact in size, more reliable and faster** than the first generation machines made of vacuum tubes.

v. In this generation, **magnetic cores** were used as primary memory and magnetic tape and magnetic disks as secondary storage devices.

A Transistor

vi. In this generation assembly languages and high level programming languages like FORTRAN and COBOL were used. Examples of computers in this generation include IBM 300 series and the ATLAS.

*NB: A transistor is a semiconductor device used to amplify and switch electronic signals and electrical power.*

*The difference between a transistor and a vacuum tube is that a transistor uses a sandwich of silicon instead of tube filled with gas to do the switching. Silicon falls into a family of elements that are neither conductor nor insulator; they're called semiconductors. This type of element will be either a conductor or an insulator depending on some condition. In the case of transistors, an electrical current will cause the silicon to be a conductor.*

**Third Generation:** 1965-1971.

i. The third generation of computers is marked by the use of **Integrated Circuits (IC's)** in place of transistors. A single I.C has many transistors, resistors and capacitors along with the associated circuitry. The I.C was invented by Jack Kilby.
ii. This development made computers **smaller** in size, **reliable** and **efficient**.
iii. In this generation **Remote processing, Time-sharing, Real-time, Multi-programming Operating System were used**. High level language (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation

NB:

- *A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element.*

- *A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electrostatically in an electric field.*

**Fourth Generation: 1971-1980**.

i. The fourth generation of computers is marked by the use of **Very Large Scale Integrated (VLSI) circuits**. VLSI circuits having about 5000 transistors and other circuit elements and their associated circuits on a single chip made it possible to have microcomputers of fourth generation.
ii. Fourth Generation computers became more powerful, compact, reliable, and affordable. As a result, it gave rise to **personal computer (PC) revolution**: individuals could afford computers.
iii. In this generation Time sharing, Real time, Networks, Distributed Operating System were used.
iv. All the High level languages like C and C++, DBASE etc. were used in this generation

**Fifth Generation: 1980-todate.**

i. In the fifth generation, the VLSI technology became ULSI (Ultra Large Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components or more.
ii. This generation is based on **parallel processing hardware** and **AI (Artificial Intelligence)** software. AI is an emerging branch in computer science, which interprets means and methods of making computers think like human beings.
iii. All the high level languages like C and C++, Java, .Net etc. are used in this generation

**THE TREND IN THE COMPUTER'S TECHNOLOGICAL REVOLUTION**

- Continual decrease in computer size
- Improved speed and power of processing
- Decrease in computer's power consumption
- Decrease in initial and maintenance costs
- Increase in the number of components per circuit (IC).

## ADVANTAGES OF USING COMPUTERS

- *Processing capability*/*Speed* – Computers have higher processing speeds than other means of processing, measured as number of instructions executed per second.

- *Accuracy* – Computers are not prone to errors. So long as the programs are correct, they will always give correct output. A computer is designed in such a way that many of the inaccuracies, which could arise due to the malfunctioning of the equipment, are detected and their consequences avoided in a way, which is completely transparent to the user.
- *Consistency* – Given the same data and the same instructions computers will produce exactly the same answer every time that particular process is repeated.
- *Reliability* – Computer systems are built with fault tolerance features, meaning that failure of one of the components does not necessarily lead to failure of the whole system.
- *Memory capability* – A computer has the ability to store and access large volumes of data.
- Computers can operate in risky environments e.g. volcanic sites, lethal chemical plants, where it's risky for humans to operate.
- Computers help to reduce paper work significantly.
- Computers can work continuously without getting bored or tired.
- Helps to cut on wage bills by reducing manpower.

**DISADVANTAGES OF USING COMPUTERS**

- Initial cost of installation and maintenance is high
- Can result to retrenchment of staff
- Computerization projects are not always cost-effective
- In case the computers break down or malfunction, it might be extremely difficult to revert back to the old manual system. For this reason, stand-by procedures are necessary, but expensive.
- Can compromise security of data stored or being transmitted.
- Computerization leads to cyber-crime e.g. pornography etc
- They present a health hazard for example eye strain, trigger-finger syndrome and addiction
- Due to the rapid change in the computer technology, the computer and related facilities can become outdated very fast, hence posing a risk of capital loss and cost of upgrading.

## CLASSIFICATION OF COMPUTERS

Computers can be classified in different ways as shown below:

### *Classification by size and capability*

a) Supercomputers. The largest and most powerful. **Used to process large amounts of data very quickly**. They use **extremely fast processors** that are built for **speed** and are used for **processor-intensive calculations** such as **nuclear reaction simulations** and **global weather pattern modeling**. Useful for **meteorological** or **astronomical applications**. Examples include Cray and Fujitsu.

b) Mainframe computers. Large computers in terms of **price**, **power** and **size**. Require a carefully controlled environment and **specialist staff** to operate and used for **centralized processing** for large commercial organizations. They are designed to provide **maximum throughput** for a **simultaneous variety of workloads**. They can also support a large number of terminals and have large on-line secondary storage capacities. Manufacturers include International Business Machine (IBM).

c) Minicomputers. Their size, speed and capabilities lie somewhere between mainframes and microcomputers. Used as **departmental computers** in large organizations or as the **main computer** in medium-sized organizations. Manufacturers of minicomputers include IBM and International Computer Limited (ICL).

**d)** Microcomputers. These are the **personal computers** commonly used for **office** and **leisure** activities i.e. they are designed for an individual. Examples include Hewlett Packard (HP), Compaq and Dell. They include desktops, laptops, palmtops and notebooks.
Examples of computers in this category include:

*Figure 1: Mainframe Computer*

## OTHERS

I. LAPTOPS

- Are among the smallest in modern world and have very large-scale circuit integration.
- The main difference between the microcomputers and the laptop is the size. They are more **portable** than desktops.
- Expandability and the number of devices supported by the laptops are also limited
- They run on battery power, but can also be plugged into a wall outlet.
- They typically have a built-in LCD display that folds down to protect the display when the computer is carried around.
- They also feature a built-in keyboard and some kind of built-in pointing device (such as a touch pad).

### II. PERSONAL DIGITAL ASSISTANT (PDA)

- It is a handheld microcomputer that trades off **power** for **small size** and greater **portability.**
- They typically use a touch-sensitive LCD screen for both output and input (the user draws characters and presses icons on the screen with a stylus).
- PDAs communicate with desktop computers and with each other either by cable connection, infrared (IR) beam, or radio waves.
- PDAs are normally used to **keep track of appointment calendars**, **to-do lists, address books, and for taking notes.**

### III. **PALMTOP** OR **HANDHELD PC**

- It is a very small microcomputer that also sacrifices power for small size and portability. These devices typically look more like a tiny laptop than a PDA, with a flip-up screen and small keyboard.
- They may use Windows CE or similar operating system for handheld devices.
- Some PDAs and palmtops contain wireless networking or cell phone devices so that users can check e-mail or surf the web on the move.

## *Classification by way of processing data (Type of data handled)*

This is by how the computer represents and processes the data.

a) **Digital computers**

Digital computers process data represented in binary format using the numbers 0 and 1. They are used for both business data processing and scientific purposes since digital computation results in greater accuracy than analog computers. They also can perform complex computations. They are the most commonly used type of computers.

b) **Analog computers**

These are used for scientific, engineering, and process-controlled purposes. Outputs are represented in the form of graphs. *Analogue computers* process data represented by physical variables and output physical magnitudes in the form of smooth graphs. These physical changes include changes in electronic voltages, pressure changes, temperature changes etc. Analog values, unlike digital values, are typically many values in a range. Examples of analogue devices include car speedometer and the slide rule.

c) **Hybrid computers** are computers that have the combined features of digital and analog computers; **hybrid computing offers both speed and precision**. They offer an efficient and economical method of working out special problems in science and various areas of engineering.

Consider the difference between two common types of light switches: a standard light switch and a dimmer switch. The standard light switch has only two values: on and off. As a rule, at any one time the switch will be in either one position or the other. This is similar to digital electrical signals, which have discrete values (like on and off). By way of comparison, the dimmer switch starts at off , but can be changed gradually to stronger and stronger intensities, up to the full on setting. At any one instant, a dimmer switch can have a setting almost anywhere between on and off. This is similar to an analog electrical signal, which may be on or off or somewhere in between.

**Classification by purpose**

This is a classification by the use to which the computer is put.

a) **Special purpose/ Dedicated** computers are used for a certain specific function e.g. in medicine, engineering, manufacturing. **Embedded systems are examples of special purpose computers.**

b) **General-purpose** computers can be used for a wide variety of tasks e.g. accounting, word processing etc.

## ROLE OF ICT IN A BUSINESS ENVIRONMENT

The use of ICT and technology has affected every aspect of business, transforming not only the way that business is conducted but also creating new business sectors and jobs. Examples are companies like Google, Amazon, Safaricom M-Pesa and e-Bay.

Some examples of the nature of this change include:

**Marketing and eCommerce:** The use of websites has allowed companies to develop new and cheaper ways of reaching new markets, offering customers the opportunity of buying goods and services whenever they want and often at reduced cost, while also enhancing the level of customer service.

**Finance:** Practically all companies now use software programmes e.g. Sage, QuickBooks and Excel to manage their accounts. This has allowed them to look at financial information when required, monitor and respond to their customers purchasing patterns. The result of this has been for many companies a reduction in their accountancy fees.

**Out of office working:** For many businesses the need for staff to be away from the office attending meetings or to be based in another geographical location has grown alongside employee demands for more flexible working patterns. However effective communication and ability to access information remains critical to the productivity of these staff members. Therefore through the use of technology many companies now use a range of technologies to enable this. These include mobile phones, e-mail, broadband, laptops, etc, thus ensuring that companies are able to be flexible and adaptive depending on their business needs.

**Networks:** Virtually all businesses now have or have access to a computer. The existence of two or more computers in an office almost always leads to the creation of a network. The main advantage of doing so is that resources can be shared e.g. printers, internet access, files/information can be managed and shared amongst workstations and the security of information can be better managed through a network. Increasingly, networks are not just confined to the office but are being adopted so that they allow home/remote working that supports changing business needs.

**Inventory management**

Inventory management systems track the quantity of each item a company maintains, triggering an order of additional stock when the quantities fall below a predetermined amount

**Customer Relationship Management**

Customer Relationship Management systems store every interaction a company has with a customer for future reference. The customer has a better, more focused experience and the company benefits from improved productivity.

**Payroll Systems**

A payroll system is used to maintain pay accounts of employees, easily and quickly.

**Human Resource Management**

**HRIS** help in recruitment, Human Resource Planning, wage and salary planning, personnel record keeping and training and development.

## POSITIVE USE OF ICT IN THE SOCIETY

1. Industry and commerce
   - It has made the industry and commerce more efficient, productive and reliable
   - Leading companies use computer technology as a competitive tool to develop new products and services
   - They are used in manufacturing to schedule operations and process control

2. Health care
   - Used in medical automation in the areas of automatic diagnosis, electro-cardiogram screening and monitoring
   - Storage of medical records on patients
   - Used in inter-country aided surgeon operations

3. Government Institutions
   - Used heavily in government ministries such as finance, planning & education to store records and improve work efficiency
4. Education and research

- Used in education as training aid, and in research institutions. Long distance learning (e-learning) has replaced the old international correspondence courses offered by postage.
- It is used in aviation to train pilots using flight simulators.
- Engineers and architects use computers to design, test and re-design.

5. Communication Industry
   - In telecommunication industry, it is used in control of exchange switches
   - Railway corporations rely heavily on computers to co-ordinate the movement of their wagons and goods
   - Air traffic controllers use it for airspace surveillance using radar equipment

6. Police and defense
   - Computers are currently used in fighting crime
   - Police are capable of keeping database of finger prints which are automatically analyzed by computers
   - Integration of computer technology and defense has produced modern military

7. Home and leisure (entertainment)
   - Computers can be used for home shopping
   - There are also entertainment information for those looking for leisure as well as a host of games
   - They have also been used to help the handicapped e.g. instant speech is turned into text on the screen to help the deaf, while text is turned into simulated speech for the blind.

8. Employment
   - Employment in the computer industry worldwide has increased.
   - In South East Asia countries, 60% of employment opportunities are today in the computing industry.

## Negative Effects of ICT in the Society – Social challenges posed by computers

1. Impairement of Social Skills

   The use of online social media outlets causes us to meet face-to-face with much less frequency resulting in a lack of much needed social skills. We lose the ability to read body language and social cues in other people.
2. Excessive use of ICT poses a health hazard

Technology creates the perfect recipe for depression with the lack of human contact, overeating and lack of exercise. This will lead to depression, obesity, sleep disorders, eye strain, back pains etc

Other resultant disorders include **Internet addiction disorder (IAD)** also called **problematic internet use (PIU) or compulsive internet use (CIU). Other overlapping terms include internet overuse, problematic computer use** or **pathological computer use** – and even **iDisorder**. These terms refer to excessive computer use that interferes with daily life.

Internet addiction includes

a) **Cybersexual addiction:** compulsive use of adult websites for cybersex and cyber porn.
b) **Cyber-relationship addiction:** Over-involvement in online relationships.
c) **Net compulsions:** Obsessive online gambling, shopping or day-trading.
d) **Information overload:** Compulsive web surfing or database searches.
e) **Computer addiction:** Obsessive computer game playing.

3. Pollution

   E-waste is not always disposed off properly, causing deadly chemicals to leach into the ground. Plants that manufacture the electronics are emitting toxic fumes into the air.

4. Higher energy consumption

   People don't turn their devices off; they keep computers on or plugged in, mobile devices charging and televisions plugged in. Also manufacturing all of these high tech toys causes an increase in greenhouse gas emissions.

5. Lack of Social Boundaries

   Much in the same way that people over-share on social media sites, there is an increasing tendency to cross social boundaries. Cyber stalking someone or sending unsolicited nude photos are examples of crossing social boundaries.

6. Encourages the culture of violence

   After people lose empathy and are accustomed to violence, it becomes the social norm.

# COMPUTER HARDWARE

Hardware refers to the physical, tangible computer equipment and devices, which provide support for major functions such as input, processing (computation and control), output, secondary storage (for data and programs), and communication.

## System Unit

The system unit is the core of a computer system. Usually it's a rectangular box placed on or underneath your desk. Inside this box are many electronic components that process data. The most important of these components is the central processing unit (CPU), or microprocessor, which acts as the "brain" of your computer. Another component is random access memory (RAM), which temporarily stores information that the CPU uses while the computer is on. The information stored in RAM is erased when the computer is turned off.

Almost every other part of your computer connects to the system unit using cables. The cables plug into specific ports (openings), typically on the back of the system unit. Hardware that is not part of the system unit is sometimes called a **peripheral device.** Peripheral devices can be **external** such as a mouse, keyboard, printer, monitor, external Zip drive or scanner or **internal**, such as a CD-ROM drive, CD-R drive or internal modem. Internal peripheral devices are often referred to as **integrated peripherals.**

There are two types of system units according to shape: **tower** and **desktop**.

A **motherboard** (**mainboard**, **system board**, **planar board** or **logic board**) is the main printed circuit board found in computers and other expandable systems. It holds many of the crucial electronic components of the system, such as the central processing unit (CPU) and memory, and provides connectors for other peripherals.

The Accelerated Graphics Port (**AGP**) is a high speed connection to the motherboard for video cards. The AGP port is faster than a PCI card and doesn’t use the system memory.

### The Power Supply

Power supplies, often referred to as "switching power supplies", use switcher technology to convert the AC input to lower DC voltages, a form that is usable by the Personal computer. The typical voltages supplied are:

- 3.3 volts

- 5 volts
- 12 volts

The 3.3- and 5-volts are typically used by digital circuits, while the 12-volt is used to run motors in disk drives and fans. The main specification of a power supply is in **watts**.

**Uninterruptible Power Supply**

An **uninterruptible power supply**, also **uninterruptible power source**, **UPS** or **battery/flywheel backup** is an electrical apparatus that provides emergency power to a load when the input power source, typically mains power, fails. The device allows the computer to keep running for at least a short time when the primary power source is lost. It also provides protection from power surges. A UPS contains a battery that "kicks in" when the device senses a loss of power from the primary source.


## HARDWARE CATEGORIES (Functional Parts)

A computer system is a set of integrated devices that input, output, process, and store data and information. Computer systems are currently built around at least one digital processing device. There are five main hardware components in a computer system: Input, Processing, Storage, Output and Communication devices.

### 1. INPUT DEVICES

Most computers cannot accept data in forms customary to human communication such as speech or hand-written documents. It is necessary, therefore, to present data to the computer in a way that provides easy conversion into its own electronic pulse-based forms. This is commonly achieved by typing data using the keyboard or using an electronic mouse or any other input device.

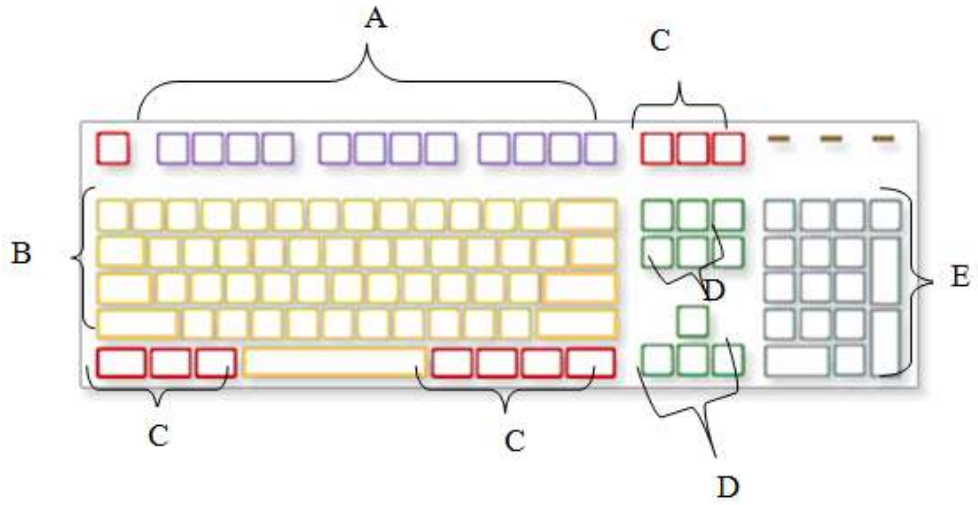
## a) THE KEYBOARD

Keyboard (similar to a typewriter) is the main input device of a computer (refer to figure 2.2). It contains three types of keys-- alphanumeric keys, special keys and function keys. **Alphanumeric keys** are used to type all alphabets, numbers and special symbols like $, %, @, A etc. **Special keys** such as <Shift>, <Ctrl>, <Alt>, <Home>, <Scroll Lock> etc. are used for special functions. **Function keys** such as <Fl>, <F2>, <F3> etc. are used to give special commands depending upon the software used e.g.F5 reloads a page of an internet browser. The function of each and every key can be well understood only after working on a PC. When any key is pressed, an electronic signal is produced. This signal is detected by a keyboard encoder that sends a binary code corresponding to the key pressed to the CPU. There are many types of keyboards but 101 keys keyboard is the most popular one.

## How the keys are organized

The keys on your keyboard can be divided into several groups based on function:

- **Typing (alphanumeric) keys.** These keys include the same letter, number, punctuation, and symbol keys found on a traditional typewriter.
- **Special (Control) keys.** These keys are used alone or in combination with other keys to perform certain actions. The most frequently used control keys are CTRL, ALT, the Windows key, and ESC.
- **Function keys.** The function keys are used to perform specific tasks. They are labelled as F1, F2, F3, and so on, up to F12. The functionality of these keys differs from program to program.
- **Cursor Movement (Navigation) keys.** These keys are used for moving around in documents or WebPages and editing text. They include the arrow keys, HOME, END, PAGE UP, PAGE DOWN, DELETE, and INSERT and ARROW KEYS.
- **Numeric keypad.** The numeric keypad is handy for entering numbers quickly. The keys are grouped together in a block like a conventional calculator or adding machine for quick entry of data.




**Key names**

A – Function keys

B – Alphanumeric keys

C – Control keys

D – Navigation keys/cursor movement keys

E – Numeric keypad

The above illustration shows how these keys are arranged on a typical keyboard. Your keyboard layout may differ.

**Exercise:** With the help of your tutor, identify all the keys in each of the categories listed above and their general tasks.

## b) THE MOUSE

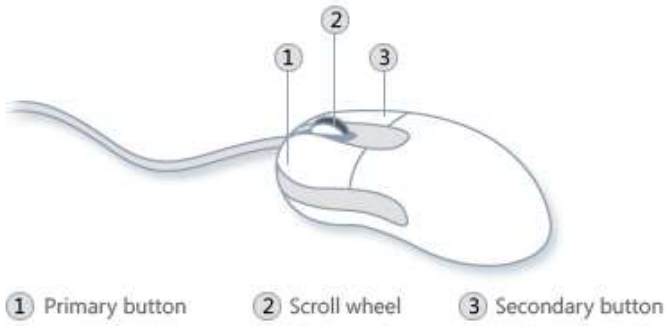
A mouse is a small device used to point to and select items on your computer screen. Although mice come in many shapes, the typical mouse does look a bit like an actual mouse. It's small, oblong, and connected to the system unit by a long wire that resembles a tail and the connector which can either be PS/2 or USB. Some newer mice are wireless.

A mouse usually has two buttons: a primary button (usually the left button) and a secondary button. Many mice also have a wheel between the two buttons, which allows you to scroll smoothly through screens of information.

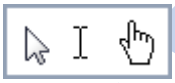
When you move the mouse with your hand, a pointer on your screen moves in the same direction. (The pointer's appearance might change depending on where it's positioned on your screen.) When you want to select an item, you point to the item and then click (press and release) the primary button. Pointing and clicking with your mouse is the main way to interact with your computer. There are several types of mice: Mechanical mouse, optical mouse, optical-mechanical mouse and laser mouse.

## Basic parts

A mouse typically has two buttons: a primary button (usually the left button) and a secondary button (usually the right button). The primary button is the one you will use most often. Most mice also include a scroll wheel between the buttons to help you scroll through documents and WebPages more easily. On some mice, the scroll wheel can be pressed to act as a third button. Advanced mice might have additional buttons that can perform other functions.




Holding and moving the mouse



### Pointing, clicking, and dragging

Pointing to an item on the screen means moving your mouse so the pointer appears to be touching the item. When you point to something, a small box often appears that describes the item. For example, when you point to the Recycle Bin on the desktop, a box appears with this information: "Contains the files and folders that you have deleted."


Pointing to an object often reveals a descriptive message about it

The pointer can change depending on what you're pointing at. For example, when you point to a link in your web browser, the pointer changes from an arrow to a hand with a pointing finger.

Most mouse actions combine pointing with pressing one of the mouse buttons. There are four basic ways to use your mouse buttons: clicking, double-clicking, right-clicking, and dragging.

**Clicking (single-clicking)**

To click an item, point to the item on the screen, and then press and release the primary button (usually the left button).

Clicking is most often used to select (mark) an item or open a menu. This is sometimes called single-clicking or left-clicking.

**Double-clicking**

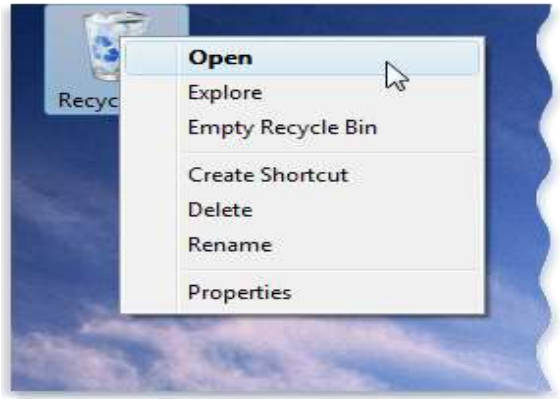
To double-click an item, point to the item on the screen, and then click twice quickly. If the two clicks are spaced too far apart, they might be interpreted as two individual clicks rather than as one double-click.

Double-clicking is most often used to open items on your desktop. For example, you can start a program or open a folder by double-clicking its icon on the desktop.

**Right-clicking**

To right-click an item, point to the item on the screen, and then press and release the secondary button (usually the right button).

Right-clicking an item usually displays a list of things you can do with the item. For example, when you right-click the Recycle Bin on your desktop, Windows displays a menu allowing you to open it, empty it, delete it, or see its properties. If you are unsure of what to do with something, right-click it.




Right-clicking the Recycle Bin opens a menu of related commands

**Dragging**

You can move items around your screen by dragging them. To drag an object, point to the object on the screen, press and hold the primary button, move the object to a new location, and then release the primary button.

Dragging (sometimes called dragging and dropping) is most often used to move files and folders to a different location and to move windows and icons around on your screen.

**Using the scroll wheel**

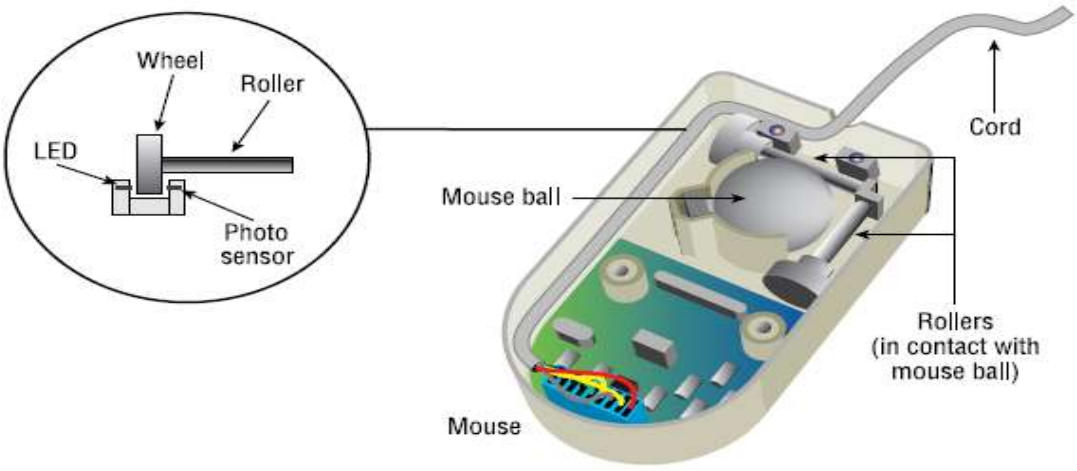
If your mouse has a scroll wheel, you can use it to scroll through documents and WebPages. To scroll down, roll the wheel backward (toward you). To scroll up, roll the wheel forward (away from you).

**The mouse** as an input device- every movement or click you make with the mouse sends a specific input signal to the computer. These commands allow you to open programs, drag objects, and perform many other functions on your computer.

**Mouse Types**

i. **Opto-Mechanical Type**

This type of mouse contains a round ball that makes contact with two rollers—one for the x-axis (the horizontal) and one for the y-axis (the vertical). Moving the mouse causes the ball to roll, and because the ball is in contact with the two rollers, it causes them to turn. These rollers are connected to wheels with small holes in them. Each wheel rotates between the arms of a U-shaped optical sensor. The holes allow a light to shine through the wheel onto the optical sensor in flashes as the wheel turns. By the speed and patterns of the light pulses, the mouse senses the speed and direction it is moving and sends its interpretation of those movements to the computer and the mouse control software.




### ii. Optical Mouse

An optical mouse looks the same as any other computer mouse, except there is no mouse "ball." Instead, the optical mouse uses a special mouse pad and a beam of laser light. The beam of light shines onto the mouse pad and reflects back to a sensor in the mouse. The mouse pad has small lines crossing it that can reflect the light into the sensor in different ways. It is in this fashion that the optical mouse detects direction and speed of movements.

### iii. Infrared (IR) or radio frequency cordless mouse:

With both these types, the mouse relays a signal to a base station wired to the computer's mouse port. The cordless mouse requires power, which comes in the form of batteries.

## c) Trackball Mouse

A trackball is basically an opto-mechanical mouse turned upside down. Instead of moving the mouse on a table, you move the mouse ball (or, properly, the trackball), which otherwise remains stationary.

**c) COMPUTER TERMINAL**. A terminal is a form of input and output device. A terminal can be connected to a mainframe or other type of computers called a host computer or server. There are four types of terminals namely dumb, intelligent, network and Internet.

- **Dumb Terminal**
  - Used to receive input, display, send, and receive text.
  - It cannot process data independently.
  - No processing unit, memory or secondary storage

  E.g. a terminal used by an airline reservation clerk to access a mainframe computer for flight information is an example of a dumb terminal
- **Intelligent/Smart Terminal**
  - Includes a processing unit, memory, and secondary storage. It has a processor and does its own processing. It can also submit jobs to be processed by a server or mainframe, but it can stand alone as a non-connected machine
  - It uses communications software and a telephone hookup or other communications link.

  E.g. a microcomputer connected to a larger computer by a modem or network link is an example of an intelligent terminal.
- **Network Terminal/Thin Client**
  - It is a low cost alternative to an intelligent terminal.
  - Most network terminals do not have storage devices i.e. a hard drive.
  - This type of terminal relies on a host computer or server for application or system software and for storage.
- **Internet Terminal**
  - It is also known as a web terminal.
  - It provides access to the Internet and displays web pages on a standard television set.
  - It is used almost exclusively in the home.
- **Point-of-Sale (P.O.S) terminals** also known as **electronic cash registers.** They use both keyboards and direct entry devices. POS software records each sale when it happens, so that inventory records are always up-to-date.
  - **Keyboard Entry** can be used to type in information.
  - **Direct Entry** can be used to read special characters on price tags.

Point-of-sale terminals can use wand readers or platform scanners as direct entry devices.

- Wand readers or scanners reflect light on the characters.
- Reflection is changed by photoelectric cells to machine-readable code.
- Encoded information on the product's barcode e.g. price appear on terminal's digital display.

Bar code readers

## d) Direct data entry devices

Direct entry creates **machine-readable data that can go directly to the CPU**. It **reduces human error** that may occur during keyboard entry and **improves speed of data capture**. Direct entry devices include **pointing, scanning, voice-input devices and gaming devices.**

(i) **The mouse** as an input device - every movement or click you make with the mouse sends a specific input signal to the CPU. These commands allow you to open programs, drag objects, and perform many other functions on your computer.

(ii) **Pen input devices** e.g. Light pen, stylus pen etc

Pen input devices are used to select or input items by touching the screen with the pen. Light pens accomplish this by using a **white cell at the tip of the pen**. When the light pen is placed against the monitor, **it closes a photoelectric circuit**. The photoelectric circuit identifies the spot for entering or modifying data. It allows the user to **point** to displayed objects or **draw** on the screen in a similar way to a touch screen but with **greater positional accuracy**. Engineers who design microprocessor chips or airplane parts use light pens.

A **stylus** (or **stylus pen**) is a small pen-shaped instrument that is used to input commands to a computer screen, mobile device or graphics tablet. With touch screen devices, a user places a stylus on the surface of the screen to draw or make selections by tapping the stylus on the screen

Stylus pen

### (iii) Touch sensitive screen

Touch sensitive screens, or touch screens, allow the user to execute programs or select menu items by touching a portion of a special screen. Behind the plastic layer of the touch screen are crisscrossed invisible beams of infrared light. Touching the screen with a finger can activate actions or commands. Touch screens are often used in ATMs, information centers, restaurants, and convenience stores. They are popularly used at gas stations for customers to select the grade of gas or request a receipt at the pump (in developed countries), as well as in fast-food restaurants to allow clerks to easily enter orders.

### (iv) Scanning Devices

Scanning devices, or scanners, can be used to input images and character data directly into a computer. The scanner digitizes the data into machine-readable form. **The scanning devices used in direct-entry include the following:**

a) **Image Scanner** – converts images on a page to electronic signals.

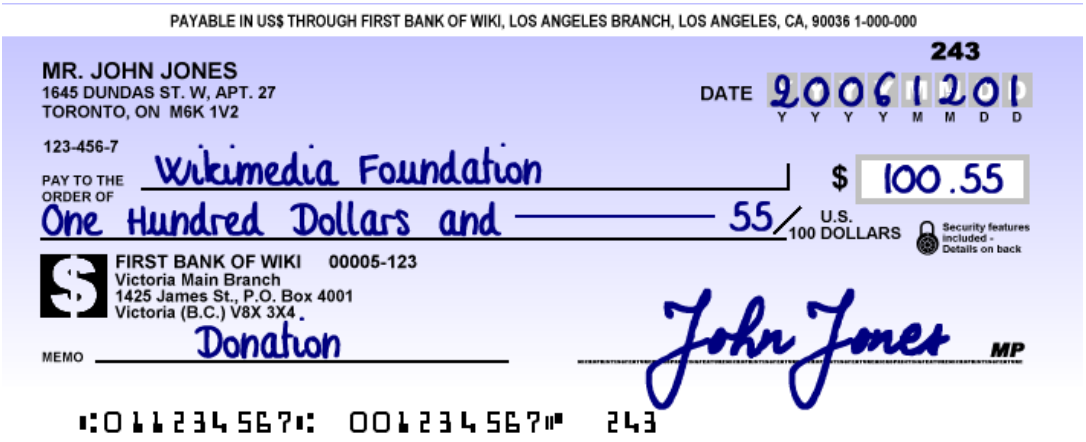
b) **Fax Machine** – converts light and dark areas of an image into a format that can be sent over telephone lines (analog signals).

c) **Character and Mark Recognition Devices** – scanning devices used to read characters and marks on documents.

There are three types of character and mark recognition devices:

- **Magnetic Ink Character Recognition (MICR)**

Magnetic ink character recognition, or MICR, readers are used to read the numbers printed at the bottom of cheques in special magnetic ink. These numbers are an example of data that is both machine readable and human readable. The technology allows MICR readers to scan and read the information directly into a data-collection device. The use of MICR readers increases the speed and accuracy of processing checks.




- **Optical-Character Recognition (OCR)**

It is the **electronic conversion of scanned images of handwritten, typewritten or printed text** into machine-encoded text. It is widely used as a form of data entry from **original paper data source** such as **documents, sales receipts, mail**, or any number of printed records. It is a **common method of digitizing printed texts** so that they can be electronically searched, stored more compactly, displayed on-line, and used in machine processes.

- **Optical-Mark Recognition (OMR)**

This is the process of **capturing human-marked data** from document forms such as **surveys** and **tests**. Optical mark recognition readers are often **used for test scoring** since they can read the location of marks on what is sometimes called a **mark sense document**. This is how, for instance, standardized tests, such as the KCPE, SAT or GMAT are scored.

- **Optical Bar-Code Recognition**

These are photoelectric scanners that read vertical striped marks printed on items.

**NB/** Scanners are generally classified into two: **flatbed** scanners and **handheld** scanners. Flatbed scanners are named after the flat bed of glass that the item to be scanned would lie upon, they resemble the top half of a photocopier

## (v) Voice–input devices

Voice-Input Devices can also be used for direct input into a computer. **Speech recognition** can be used for data input when it is necessary to keep your hands free. For example, a doctor may use voice recognition software to **dictate medical notes** while examining a patient. Voice recognition can also be used for **security purposes** to allow only authorized people into certain areas or to use certain devices.

- Voice-input devices convert speech into a digital code.
- The most widely used voice-input device is the **microphone.**
- A **microphone, sound card,** and **software** form the **voice recognition system.**

### (vi) Gaming Equipment

Games players have a wide range of hardware available to them to help them drive, fly, score, and shoot more realistically than by using a mouse. The most common are **joysticks** but they can also choose **steering wheels**, **gamepads**, and **headsets**.

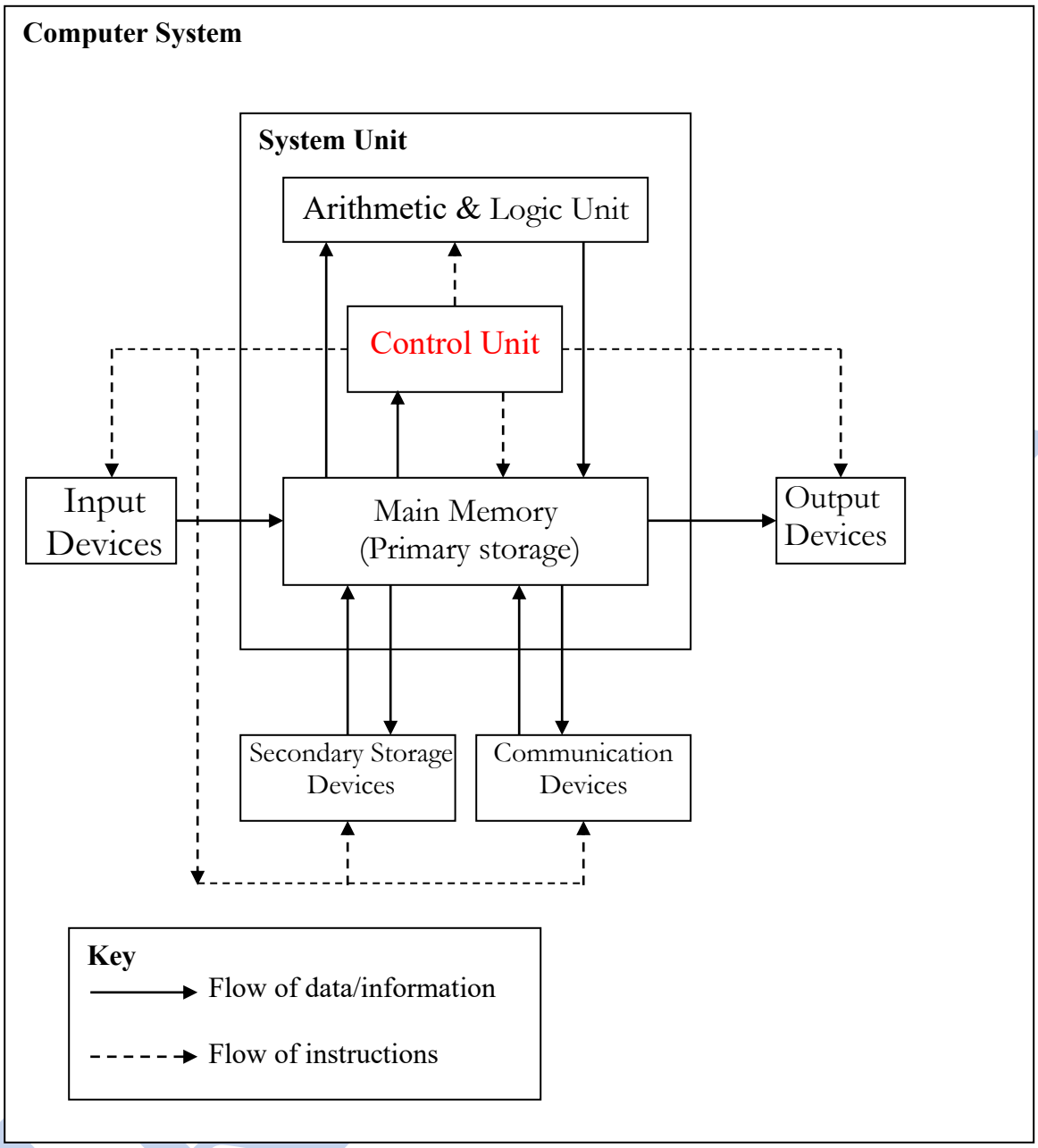
Joystick

Gamepad

## 2. PROCESSING DEVICES

## FUNCTIONAL/LOGICAL PARTS OF A DIGITAL COMPUTER (Block Diagram)

The system unit houses the processing components of the computer system. All other computer system devices are called peripherals, and are connected directly or indirectly into the system unit.




**(i) Input devices** – Enters program instructions and data into the computer system.

**(ii) The CPU (Central Processing Unit):** The CPU (Central Processing Unit) controls and executes the processing of instructions.

**(iii) Main Memory –** Temporary storage to hold programs and data during execution/ processing.

**(iv) Output devices** – Display information processed by the computer system.

**(v) Storage devices –** Permanent storage of data and programs before and after it is processed by the computer system.

**(vi) Communication devices –** Enable communication with other computers.

# (i) Central Processing Unit (CPU)

This is the part of the computer that processes data. It consists of the control unit and the arithmetic and logic unit, registers and the buses.

- **Control Unit**
    - Controls execution of programs.
    - It fetches instructions from memory, interprets and sends the instructions to other components. Instructions to the CPU are stored in the main memory, and the CPU functions by following a cycle of fetching an instruction, decoding it and executing it. This process is known as the *fetch-decode-execute cycle*.
    - Maintains order and controls activity in the CPU
    - Directs sequence of operations
    - Communicates with Input-Output devices for transfer of data/results between the various hardware components.

      **NB: The Control Unit does not process or store data.**

- **Arithmetic Logic Unit (ALU)** – Performs actual processing of data using program instructions i.e. **arithmetic** and **logical operations**. The arithmetic/logic unit can perform four kinds of arithmetic operations, or mathematical calculations: addition, subtraction, multiplication, and division. As its name implies, the arithmetic/logic unit also performs logical operations. A logical operation is usually a **comparison**. It also does **branching/decision making** in conditional statements.

- **Registers: Temporary Storage Areas**

  **Registers are temporary (volatile) storage areas for instructions or data inside the CPU and that can keep up with the processor.** Registers work under the direction of the control unit to accept, hold, and transfer instructions or data and perform arithmetic or logical comparisons at high speed.

  Computers usually assign special roles to certain registers, including these registers:

    - **An accumulator**, which collects the result of computations.

- **An address register**, which keeps track of where a given instruction or piece of data is stored in memory. The memory address of an instruction is incremented with every fetch-execute cycle so that no instruction is fetched twice. Each storage location in memory is identified by an address, just as each house on a street has an address.
- **A storage register**, which temporarily holds data taken from or about to be sent to memory.
- A general-purpose **register**, which is used for several functions

- **CPU Buses:** Buses are bundles of tiny wires that carry data and instructions between components. These components are the information highway for the CPU. The three most important buses are the address, the data, and the control buses.

  An **address bus** is a computer bus that is used to relay a physical address. When a processor or a device needs to read or written to a memory location, it relays that memory location via the address bus.

  A **control bus** is (part of) a computer bus, used by CPUs for communicating with other hardware components within the computer. While the **address bus** carries the information on which device the CPU is communicating with, the **data bus** carries the actual data being passed along. The **control bus** carries/**relays** instructions/commands from the CPU and **returns** status signals from the devices.


**64-bit Athlon Microprocessor by AMD**

## (ii) Main Memory

Primary storage, also called main memory, although not a part of the CPU, is closely related to the CPU. The main memory holds **portions of the operating system**, **program instructions** and **data** before and after processing by the CPU. All instructions and data pass through main memory. Memory is located physically close to the CPU to reduce **access time**, that is, the time it takes the CPU to retrieve data from memory. Memory access time is often measured in milliseconds, or one thousandths of a second.

**iii) CACHE MEMORY**

A CPU cache is a type of memory used by the central processing unit of a computer to reduce the average time to access memory. The cache is a smaller, faster memory which **stores copies of the data from frequently used main memory locations**. Most CPUs have an internal cache memory (in-built in the processor) which is referred to as *Level 1* (L1) cache. This can be supplemented by external cache memory fitted on the motherboard and referred to as *Level-2* cache memory or *secondary cache* and recently, Level 3 cache.

Cache memory uses SRAM chips.

Some computers come equipped with **COPROCESSORS**. A coprocessor is a special-purpose processing unit that assists the CPU in performing certain types of operations. For example, a **math coprocessor** performs **mathematical computations**, particularly **floating-point operations**. Math coprocessors are also called numeric or floating-point coprocessors.

In addition to math coprocessors, there are also graphics coprocessors for manipulating graphic images. These are often called **accelerator boards**.

# (ii) Graphics Processing Unit (GPU)

A graphics processing unit (GPU), also occasionally called **visual processing unit** (VPU), is a specialized electronic circuit designed to rapidly manipulate and alter memory to accelerate the creation of images for output to a display.

Modern GPUs are very efficient at manipulating computer graphics and image processing, and their highly parallel structure makes them more efficient than general-purpose CPUs for algorithms where the processing of large blocks of data is done in parallel. As GPUs are extremely memory intensive, the video cards normally come with their own RAM chips which operate at very high speeds and are **dual ported**, meaning that the system can read from them and write to them at the same time.

In a personal computer, a GPU can be present on a **video card**, or it can be embedded on the motherboard (**onboard**) or—in certain CPUs—**integrated** in the CPU die.

Used primarily for 3-D applications, a graphics processing units create lighting effects and transforms objects every time a 3D scene is redrawn. These are mathematically-intensive tasks, which otherwise, would put quite a strain on the CPU. Lifting this burden from the CPU frees up cycles that can be used for other jobs.


**Types of computer buses are as follows:**

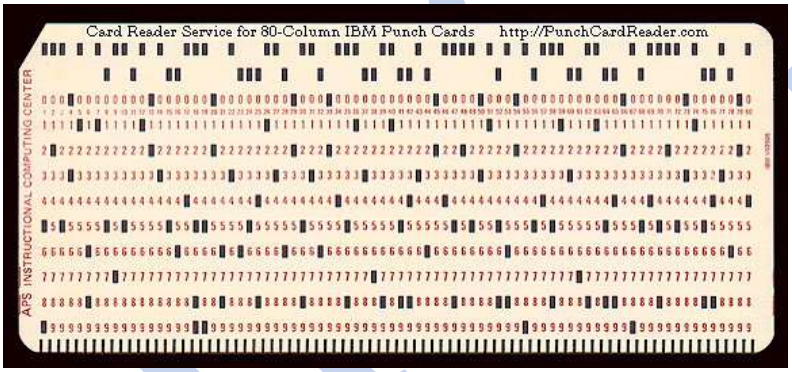
- **System Bus**: A parallel bus that simultaneously transfers data in 8-, 16-, or 32-bit channels and is the primary pathway between the CPU and memory.
- **Internal Bus**: Connects a local device, like internal CPU memory.
- **External Bus**: Connects peripheral devices to the motherboard, such as scanners or disk drives.
- **Expansion Bus**: Allows expansion boards to access the CPU and RAM.
- **Frontside Bus**: Main computer bus that determines data transfer rate speed and is the primary data transfer path between the CPU, RAM and other motherboard devices.
- **Backside Bus**: Transfers secondary cache (L2 cache) data at faster speeds, allowing more efficient CPU operations.

## 3. OUTPUT DEVICES

Results are taken from main storage and fed to an output device. This may be a printer, in which case the information is automatically converted to a printed form called **hard copy** or to a monitor screen for soft **copy** information.

**Output is human-readable information**. Input (data) is processed inside the computer's CPU into meaningful output (information). Output devices translate the machine-readable information into human-readable information.

**a) PUNCHED CARDS**: A punched card is a piece of stiff paper that contained either commands for controlling a computer or data for data processing applications. Both commands and data were represented by the presence or absence of holes in predefined positions. Characters are coded onto an 80-column card in columns by combining punches in different locations; a special card reader reads the cards and translates them into transactions for the computer. These are now used only for older applications. Early digital computers also used punched cards, often prepared using **keypunch** machines, as the primary medium for input of both computer programs and data.




### b) PRINTERS

– Outputs printouts on paper often referred to as **hard-copy** output.

Categorized according to:

(I) **Printing Capacity**

- Character printers – Print one character at a time.
- Line printers – Print one line at a time.

- Page printers – Print a whole page at a time.

(iii) **Mode of Printing**

- Impact Printers
- Non-Impact Printers

**Impact Printers**

Impact printers create an image by using some mechanism to physically press an inked ribbon against the page, causing the ink to be deposited on the page in the shape desired. These printers are typically loud, but remain in use today because of their unique ability to function with **multipart/multi-copy forms**. Multipart forms are sheets of paper with embedded carbon paper so that printing on the top sheet provides several copies simultaneously when the multiple parts are split.

a) Dot matrix printers

Dot matrix printers which use a print head that runs back and forth, or in an up and down motion, on the page and prints by impact, striking an ink-soaked cloth ribbon against the paper, much like the print mechanism on a typewriter. The print head typically has 9 or 24 pins. Each character is made from a matrix of dots. The images are relatively of **poor quality** since dots are visible upon close inspection. They are **inexpensive** to buy compared to other types and have one of the **lowest printing costs** per page. They are also very durable and last a long time. They are, however, **noisy** and low-end models are **slow** (speed varies with price).

b) Daisy-Wheel Printer

The daisy wheel is a disk made of plastic or metal on which characters stand out in relief along the outer edge. To print a character, the printer rotates the disk until the desired letter is facing the paper. Then a hammer strikes the disk, forcing the character to hit an ink ribbon, leaving an impression of the character on the paper. You can change the daisy wheel to print different fonts.

Daisy-wheel printers **cannot print graphics**, and in general they are **noisy** and **slow**, printing from 10 to about 75 characters per second. As the price of laser and ink-jet printers has declined, and the quality of dot-matrix printers has improved, daisy-wheel printers have become obsolete.


A daisy wheel

**Non-Impact Printers**

This type of printers print by "shooting" or burn tiny droplets of ink or toner onto paper.

a) Ink jet printers

These form images by "**shooting" tiny droplets of ink on paper**. They offer relatively good image quality with so many small dots that they are not noticeable, even upon close inspection. They are relatively quiet compared to dot matrix and most can print colour images. They are the most commonly used.

b) Laser jet printers

They form images using **copier technology**. When a document is sent to the printer, a laser beam "draws" the document on a **selenium-coated** drum using **electrical charges**. After the drum is charged, it is rolled in toner, a dry powder type of ink. The toner adheres to the charged image on the drum. The toner is transferred onto a piece of paper and fused to the paper with heat and pressure. After the document is printed, the electrical charge is removed from the drum and the remaining toner is collected. These printers have excellent image quality – so many small dots that they are not noticeable, even upon close inspection. They are quieter than ink jet printers.

c) Thermal Printers

Thermal printing produces a printed image by selectively heating coated thermo-chromic paper (paper that is coated with a chemical that changes color when exposed to heat), or **thermal paper** as it is commonly known, when the paper passes over the thermal print head. The coating turns black in the areas where it is heated, producing an image. It is very quiet and not widely used by home PC users. Some very expensive colour models are available. “Ink” in these computers is wax crayons. They are commonly used to print labels and barcodes.

## C) PLOTTERS

Printers make images one line at a time and move from top to bottom during the printing process. **Plotters**, on the other hand, **draw the image** as humans would, **with a pen; one shape at a time.** Plotters are most often used with CAD software to produce blueprints or technical diagrams. It would be quite expensive to make a printer that can print on paper as wide as these drawings require. Because a plotter uses a pen (or several pens in a holder) on a cable carrier, it is easy (and relatively inexpensive) to make a very wide plotter.

Plotters are typically used for **design output**. They are special-purpose output devices used to produce **charts, maps, architectural drawings and three-dimensional representations**. They can produce high-quality multi-colour documents or large size documents. Plotters produce documents such as blueprints or schematics.

In the past, plotters were used in applications such as computer-aided design, though they have generally been replaced with wide-format conventional printers.

## D) MONITORS/VDU (Visual Display Unit)

Output device for **soft-copy output** (**temporal screen display** of output which lasts as long as the monitor's power is on). They are the most frequently used output devices. Some are used on the desktop; others are portable. Two important characteristics of the monitor are size and clarity.

A monitor displays information in visual form, using text and graphics. The portion of the monitor that displays the information is called the screen. Like a television screen, a computer screen can show still or moving pictures.

**The monitor forms images from tiny dots, called pixels**. **Pixels are arranged in a rectangular form. The sharpness of image (screen resolution) depends upon the number of pixels.** There are several types of monitors:

**CRT MONITORS**

The **Cathode Ray Tube** (**CRT**) technology uses a vacuum tube containing one or more electron guns (a source of electrons or electron emitter) and a fluorescent screen used to view images. It has a means to accelerate and deflect the electron beam(s) onto the screen to create the images.

**Disadvantages of CRT monitors**

**1. Sharpness**

CRT monitors produce images with softer edges that are not as sharp as an LCD at its native resolution. Imperfect focus and color registration also reduce sharpness.

**2. Interference from magnetic fields**

They are affected by magnetic fields from other equipment including other CRTs.

**3. Brightness**

Relatively bright but not as bright as LCDs. Not suitable for very brightly lit environments.

**4. Screen Shape**

Some CRTs have a rounded, spherical or cylindrical shape screen which distorts images when viewed from acute angles. Newer CRTs are flat.

**5. Emissions**

CRTs give off electric, magnetic radiations. There is considerable controversy as to whether any of these pose a health hazard, particularly magnetic fields. The most authoritative scientific studies conclude that they are not harmful but some people remain unconvinced.

**6. Physical**

They are large, heavy, and bulky.

**7. Electricity Consumption**

They consume a lot of electricity and produce a lot of heat.

**TFT MONITORS**

Short for ***t**hin **f**ilm **t**ransistor*, a type of LCD flat-panel display screen, in which each pixel is controlled by from one to four transistors. The TFT technology provides the best resolution of all the flat-panel techniques, but it is also the most expensive.

**LCD MONITORS**

Short for **l***iquid* **c***rystal* **d***isplay*, a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. Each crystal, therefore, is like a shutter, either allowing light to pass through or blocking the light.

**LED DISPLAY**

An LED display is a flat panel display, which uses light-emitting diodes as a video display.

**PLASMA DISPLAY**

A type of flat-panel display that works by sandwiching a neon/xenon gas mixture between two sealed glass plates with parallel electrodes deposited on their surfaces. The plates are sealed so that the electrodes form right angles, creating pixels. When a voltage pulse passes between two electrodes, the gas breaks down and produces weakly ionized plasma, which emits UV radiation. The UV radiation activates colour phosphors and visible light is emitted from each pixel.

### F) VOICE-OUTPUT DEVICES

Voice-output devices make sounds that resemble human speech. Voice-output devices use pre-recorded vocalized sounds to produce output. The computer "speaks" synthesized words. Voice output is not as difficult to create as voice input. Most widely used voice-output devices are **stereo speakers** and **headphones**. Devices are connected to a sound card in the system unit. Sound card is used to capture sound as well as play it back.

Examples of voice output uses:

- Soft-drink machines, the telephone, and in cars.
- Voice output can be used as a tool for learning: can help students study a foreign language.
- Used in supermarkets at the checkout counter to confirm purchases.
- Most powerful capability is to assist the physically challenged.

## 4. STORAGE DEVICES AND MEDIA

**Memory** refers to the physical devices used to **store programs** (sequences of instructions) or **data** on a **temporary or permanent** basis for use in a computer **or other** digital electronic **device**.

### Types of Memory

**1) Primary storage**, also known as **main** storage or memory, is the main working area in a computer in which data is stored for quick access by the computer's processor.

**2) Secondary storage**, sometimes called **auxiliary** storage, is all data storage that is not currently in a computer's primary storage or memory. The computer usually uses its input/output channels to access secondary storage and transfers the desired data using intermediate area in primary storage. Secondary storage does not lose the data when the device is powered down—it is non-volatile.

DIFFERENCE BETWEEN PRIMARY AND SECONDARY MEMORY

(a) Unlike primary memory, secondary memory is not **directly accessed** by the CPU.

(b) Primary memory is **volatile** in nature, while secondary memory is non volatile. The information that is stored in the primary memory cannot be retained when the power is turned off.

(c) The primary memory is much **faster** in terms of data access time than the secondary memory.

(d) Primary memory is **more expensive** than the secondary memory devices.

(e) The primary memory contains program and data that is currently being used by the CPU **(temporary)** while secondary memory is used for bulk storage of data **permanently**.

(f) Primary memory is much **smaller** than secondary memory.

# 1. PRIMARY MEMORY

Primary memory can be categorized into two: **volatile memory** and **non-volatile** memory. Volatile memory includes RAM and Cache memory while non-volatile memory includes the ROM and the CMOS memory

**a) RAM (Random Access Memory) /RWM (Read Write Memory)** – Also referred to as **main memory** or **primary storage.** Its contents can be read and can be changed and is the **working area** for the user. It is used to hold portions of the operating system, programs and data during processing. RAM chips are volatile, that is, they lose their contents during a **power cycle**. A power cycle is when a device is purposely or accidently powered off and then powered back on.

Typical sizes of RAM include 32MB, 64MB, 128MB, 256MB, 512MB, 1GB, 2GB, 4GB, 8GB etc.

There are several types of RAM:

- **DRAM** – Dynamic RAM

With Dynamic RAM the memory must be **constantly refreshed** (reenergized) or it will lose its contents which makes them slow. They provide more storage capacity as each memory cell is made of two components: a transistor and a capacitor.

- **EDO RAM** –**E**xtended **D**ata **O**ut **R**andom **A**ccess **M**emory

Unlike conventional DRAM which can only access one block of data at a time, EDO RAM can start **fetching the next block of memory** at the same time that it sends the previous block to the CPU.

- **SRAM** – Static RAM

Static RAM is **faster** and **less volatile** than dynamic RAM, but it **requires more power** and is **more expensive.** They are optimized for speed while DRAMs are optimized for space. Each memory cell is made up of 4 to 6 transistors, which reduces the density of memory cells. Cache memory chips are SRAM chips.

- **SDRAM** – Synchronous DRAM

This is a type of DRAM that can run at **much higher clock speeds** than conventional memory. SDRAM actually **synchronizes itself with the system clock** and is capable of running at 133 MHz about twice as fast EDO RAM. DDR (Double Data Rate), DDR2 and DDR3 are examples of SDRAM.

**b) Cache Memory** - Cache memory is high-speed memory that a processor can access more quickly than RAM and more expensive than RAM. Frequently used instructions are stored in cache since they can be retrieved more quickly, improving the overall performance of the computer. Most CPUs have an internal cache memory (in-built in the processor) which is referred to as Level 1 (L1) cache typically 2kb to 4kb and consist of both instruction cache and data cache. If the CPU is multi-core, then each core has its own cache. This can be supplemented by external cache memory fitted on the motherboard and referred to as Level-2 cache memory or secondary cache. L2 cache can be integrated or on the motherboard and is shared by all the cores in the CPU. Its memory size ranges between 2 and 12 kb. L3 cache has a memory range of 1MB to 8MB.

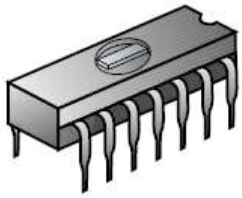
**c) ROM** (Read Only Memory) – Its contents can only be read and cannot be changed. ROM chips are **non-volatile**, so the contents aren't lost if the power is disrupted. **ROM provides permanent storage for unchanging data & instructions, such as data from the computer maker**. **It is used to hold instructions for starting the computer called the bootstrap program**.

ROM chips, the contents, or combination of electrical circuit states, are set by the manufacturer and cannot be changed. States are permanently manufactured into the chip.

### Types of ROM

**Programmable ROM (PROM):** This is a type of ROM that can be programmed using special equipment; it can be written to, but only once. Used mostly in electronic devices such as alarm systems.

**Erasable Programmable ROM (EPROM):** An *EPROM* is a ROM that can be erased and reprogrammed. A little glass window is installed on top of the ROM package, through which you can actually see the chip that holds the memory. Ultraviolet light of a specific frequency can be shined through this window for a specified period of time, which will erase the EPROM and allow it to be reprogrammed again. These chips are usually easily identified by their small, circular windows.



**Electrically Erasable Programmable ROM (EEPROM):** The next level of erasability is the *EEPROM*, which can be erased under software control. This is the **most flexible type of ROM**, and is now commonly used for holding BIOS programs. When you hear reference to a "flash BIOS" or doing a BIOS upgrade by "flashing", this refers to reprogramming the BIOS EEPROM with a special software program. This is not a contradiction of what "read-only" really means, but the rewriting is done maybe once a year or so, compared to real read-write memory (RAM) where rewriting is done often many times per second. Flash memory was derived from EEPROM.

It is very inconvenient to remove an IC every time it needs to have the software it contains upgraded. EEPROM chips can be erased by sending a special sequence of electric signals to the chip while it is still in the circuit. These signals then erase all or part of the chip.

**Volatile BIOS Memory - EEPROM**

This is a block of Read Only Memory (ROM) which is separate from the main system memory used for loading and running software. The Rom contains the PC's Basic Input/Output system (BIOS)

The BIOS performs the following routines and functions:

1. When the machine is powered on, it inspects the computer to determine what hardware is fitted and then conducts some simple tasks to see if everything is functioning normally - process known as the Power-On Self Test (POST).
2. If any of the peripherals are plug-and-play devices, the BIOS recognizes them and assigns them resources.
3. If all the tests are passed, the ROM boots the machine. This, it does by looking at the boot sector of either a hard disk or any other drive to find the boot loader program of the operating system. When it does find the file, it loads the file into RAM, and then the operating system takes charge of the computer.
4. It also allows the PC's set-up configuration to be viewed and edited.

NB/For the most part, PCs today use memory chips arranged on a small circuit board. These circuit boards are called Single Inline Memory Modules (SIMMs) or Dual Inline Memory Modules (DIMMs), depending on if there are chips on one side of the circuit board or on both sides, respectively.

**d) Non-Volatile CMOS (CMOS RAM)** It was traditionally called CMOS RAM because it used a small, low-power Complementary Metal-Oxide-Semiconductor (CMOS) battery when system power is off. The battery also keeps the Real-Time Clock (RTC) going. The CMOS RAM and the real-time clock have been integrated as a part of the Southbridge chipset and it may not be a standalone chip on modern motherboards. The CMOS is used to store basic information about the PC's configuration: **number of hard drives, how much memory etc. Boot order settings, date and** CMOS **password** are also stored in the CMOS memory.

## 1. SECONDARY STORAGE

### CLASSIFICATION OF SECONDARY STORAGE

## a) Internal Storage Media

Internal storage allows the data and applications to be loaded **very rapidly into memory, ready for use**. The data can be accessed much faster than data which is stored on an external storage device. This is because **internal storage devices are connected directly to the motherboard and its data bus** whereas **external devices are connected through a hardware interface such as USB,** which means they are considerably slower to access.

Internal storage also means that if the computer is moved around, it will still retain its most frequently used data. The main disadvantage of internal storage is that when the hard disk fails, all the data and applications may be lost.

This can be avoided to some extent by using more than one hard disk within the machine. Each hard disk has a copy of all the data, so if one fails the other can carry on. This is called a RAID array. An alternative is to use external media for backup. An example of internal storage media is an internal/fixed hard disk.

## b) External Storage Media

These media are normally used for data back-ups and are not permanently fixed inside a computer. To fulfill the large storage requirements of computers, magnetic disks such as diskettes and external hard disks, optical disks such as CDs and DVDs and flash drives are generally used. Advantages of external storage include:

- Data can be transported easily from one place to another- portable.
- It is useful to store software and data that is not needed frequently.
- External storage also acts as data back-up.
- External storage provides additional storage other than available in the computer.

## Magnetic Storage Media

## How Magnetic Storage Works

•A magnetic disk's medium contains iron oxide particles, which can be polarized—given a magnetic charge—in one of two directions.

•Each particle's direction represents a 1 (on) or 0 (off), representing each bit of data that the CPU can recognize.

•A disk drive uses read/write heads containing electromagnets to create magnetic charges on the medium. An **electromagnet** is a type of magnet in which the magnetic field is produced by electric current.

## The primary types of magnetic storage Media are:

•Diskettes (floppy disks)

•Hard disks

•High-capacity floppy disks

•Disk cartridges

•Magnetic tape

## 1. Diskettes/Floppy disks

•Diskette drives, also known as floppy disk drives, read and write to diskettes (called floppy disks or floppies).

•Diskettes are used to transfer files between computers, as a means for distributing software, and as a backup medium.

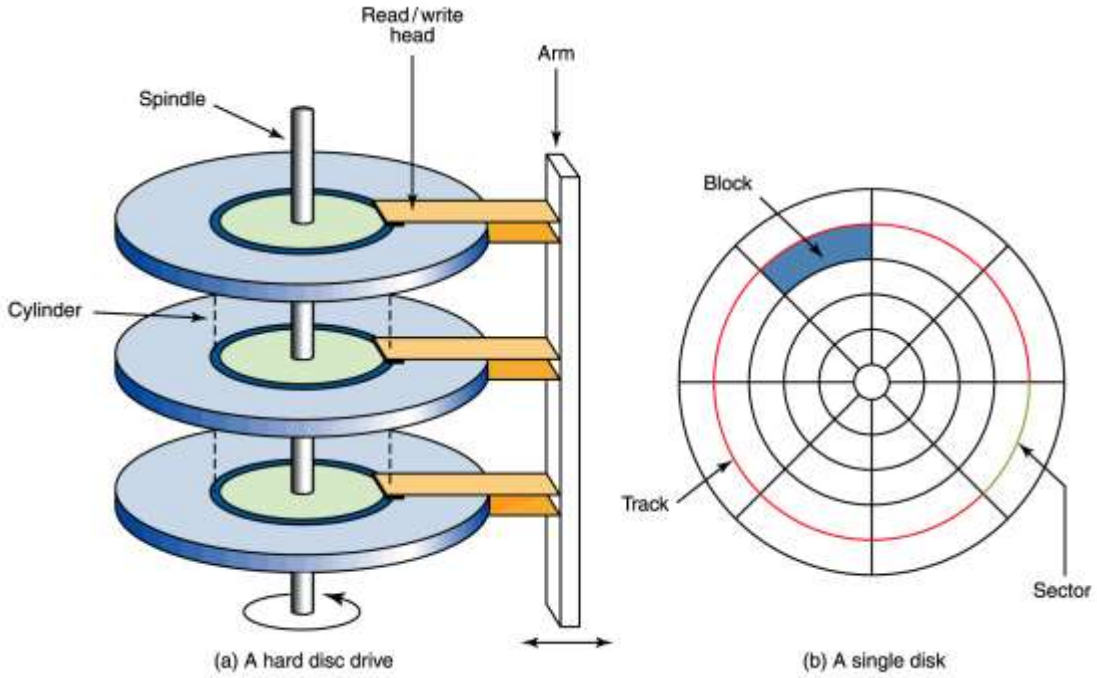
•Diskettes come in two sizes: **5.25**-inch and **3.5-inch**.

## 2. Hard Disks

•Hard disks use multiple platters, stacked on a spindle. Each platter has two read/write heads, one for each side.

•Hard disks use higher-quality media and a faster rotational speed than diskettes.

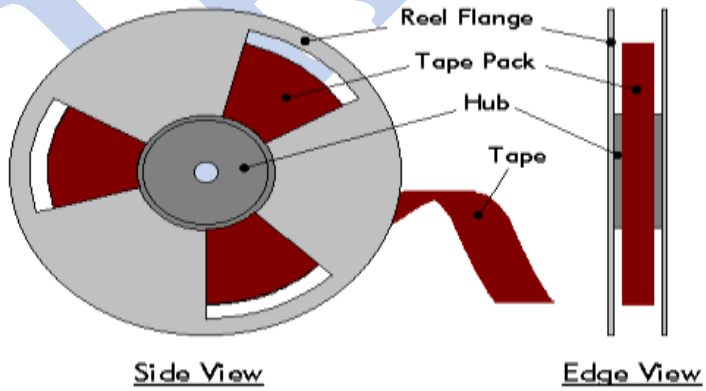
•Removable hard disks combine high capacity with the convenience of diskettes.




2. **Disk cartridges** are like small removable hard disks, and can store up to 2 GB

Disk cartridge

3. **Magnetic tapes** offer very **slow** data access, but provide **large capacities** and at **low cost**. They are **vulnerable to dust** and **interference from magnetic fields**.




Magnetic Tape

**Advantages of Magnetic Devices**

- They are very cheap for example floppy disks.
- They offer very fast data access speeds, about 1000kb/s
- Data can be read directly from any part of the hard disk
- Most of the devices store very large amounts of data e.g. hard disks.

**Disadvantages of Magnetic Devices**

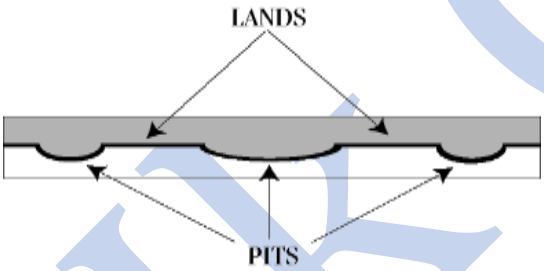
- Data can be altered or erased by magnetic fields, dust or mechanical problems
- They gradually lose their charge over time and therefore lose data
- Hard disks eventually fail (can no longer be magnetized) which stops the computer from working
- Regular clashes can damage the surface of the disk, leading to loss of data.

## b) Optical Storage Devices

•An optical disk is a high-capacity storage medium. An optical drive uses reflected light to read data.

•To store data, the disk's metal surface is covered with tiny dents (pits) and flat spots (lands), which cause light to be reflected differently.

•When an optical drive shines light into a pit, the light cannot be reflected back. This represents a bit value of 0 (off). A land reflects light back to its source, representing a bit value of 1 (on). Laser technology is used to record and read information from a CD's or a DVD's surface.




### Types of Optical Storage Devices

## 1. CD-ROM

•In PCs, the most commonly used optical storage technology is called Compact Disk Read-Only Memory (CD-ROM). CDs use microscopic indentations (Pits) and flat surfaces (Lands) to store information.

•A standard CD-ROM disk can store up to 650 – 700 MB of data, or about 70 minutes of audio.

•Once data is written to a standard CD-ROM disk, the data cannot be altered or overwritten.

**CD-R (Compact Disk - Recordable)**

A CD-R disk is blank when it is supplied. The user can write data to it just once. After data has been written to the disk it cannot be changed. CD-Rs are often used for making permanent backups of data and distributing software when only a small number of copies are required.

**CD-RW (Compact Disk - Rewriteable)**

CD-RW disks can be read from and written to many times

**CD-ROM Speeds and Uses**

•Early CD-ROM drives were called single speed, and read data at a rate of 150 KBps. (Hard disks transfer data at rates of 5 – 15 MBps).

•CD-ROM drives now can transfer data at speeds of up to 7800 KBps. Data transfer speeds are getting faster.

•CD-ROM is typically used to store software programs. CDs can store audio and video data, as well as text and program instructions.

## 2. DVD-ROM

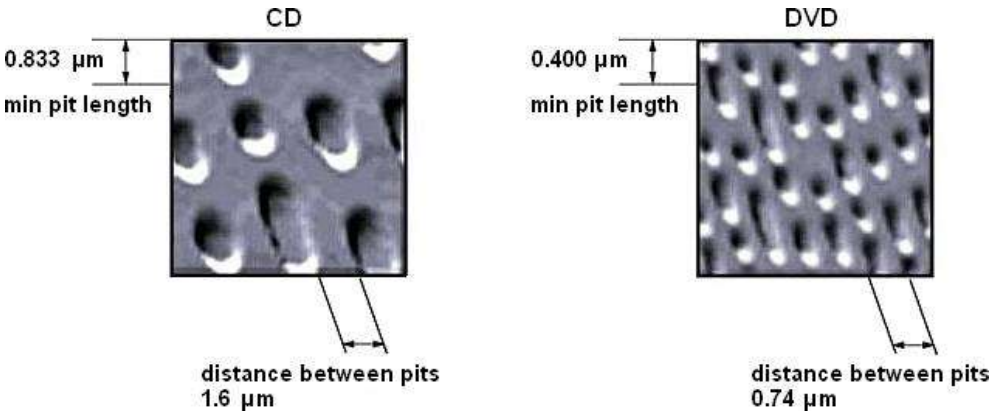
•A variation of CD-ROM is called **Digital Video Disk** Read-Only Memory (DVD-ROM), and is being used in place of CD-ROM in many newer PCs. Its **speed is much faster** than CD and has a **much higher storage capacity.** This is made possible by the reduction of the distance between the pits.

•Standard DVD disks storage capacity is 4.7GB of data—enough to store an entire movie. **Dual-layer** DVD disks can store up to 17 GB.

•Dual-layer DVD disks can store so much data because both sides of the disk are used, along with sophisticated data compression technologies.

**DVD-RW**

These disks can be read from and written onto many times.

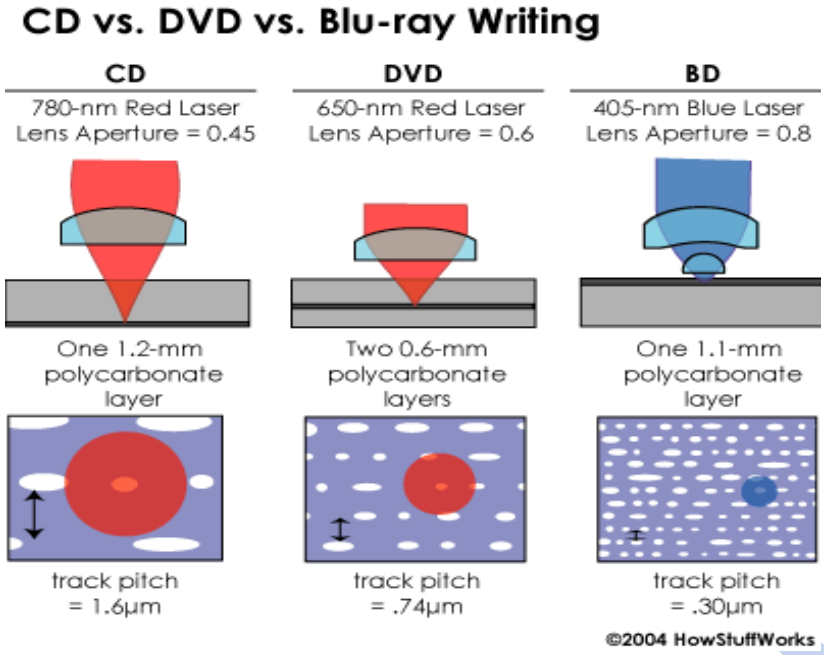



Difference between DVD and CD

## 3. **Blu-Ray Disc**

**Blu-ray Disc** (**BD**) is a digital optical disc data storage format designed to supersede the DVD format. The plastic disc is 120 mm in diameter and 1.2 mm thick, the same size as DVDs and CDs. Conventional (pre-BD-XL) Blu-ray Discs contain 25 GB per layer, with dual layer discs (50 GB) being the industry standard for feature-length video discs. Triple layer discs (100 GB) and quadruple layers (128 GB) are available for BD-XL re-writer drives. The name Blu-ray Disc refers to the blue laser used to read the disc, which allows information to be stored at a greater density than is possible with the longer-wavelength red laser used for DVDs. The major application of Blu-ray Discs is as a medium for video material such as feature films.

The Blu-ray disc overcomes DVD-reading issues by placing the data **on top of a 1.1-mm-thick polycarbonate layer**. Having the data on top prevents birefringence and therefore prevents readability problems. And, with the recording layer sitting **closer to the objective lens** of the reading mechanism, the problem of disc tilt is virtually eliminated. Because the data is closer to the surface, a hard coating is placed on the outside of the disc to protect it from scratches and fingerprints.




## Advantages of Using Optical Devices over Magnetic Disks

- In magnetic devices, data can be altered or erased by magnetic fields, dust or mechanical problems unlike in optical devices where data cannot be affected by dust, magnetic fields or fingerprints.
- Magnetic devices gradually lose their charge over time and therefore lose data whereas data written on optical devices is usually permanent.
- Hard disks, which are magnetic, eventually fail which stops the computer from working.
- Regular clashes of magnetic devices can damage the surface of the disk, leading to loss of data.
- Optical disks are more durable and last a long time. There is a greater distance between the media and the Read/Write element in a CD as compared to magnetic storage and therefore optical devices can be used repeatedly without wear or data damage.
- Optical devices are more portable in that they are small and lightweight.
- They are inexpensive i.e. they are cheaper to manufacture than magnetic devices.

# Flash/Electronic Memory

Flash memory is also known as a **solid state storage device** because there are no moving parts and therefore **less susceptible to mechanical damage**. They are also **small in physical size** and **light in weight** therefore **portable**. Flash memory also transfers data at a **faster rate** than optical and magnetic media. They are **useful in devices where frequent updating of data is required**. Flash memory is usually found in digital cameras, digital camcorders and mobile phones.

Examples of flash memory include:

- Memory sticks/flash disks
- Secure digital (SD Cards)


- MultiMedia card (MMC)
- Smart cards
- Solid State Drive(SSD)

  A **solid-state drive (SSD)** a solid-state storage device that uses integrated circuit assemblies as memory to store data persistently. Unlike a hard drive, an SSD has no moving parts, which gives it advantages such as accessing stored information **faster**, **no noise**, often **more reliable**, and **consume less power**. Their main disadvantage is cost; the drives are currently very expensive compared to the HDDs.

## SSD Vs HDD Comparison

| Attribute | SSD (Solid State Drive) | HDD (Hard Disk Drive) |
|---|---|---|
| **Power Draw / Battery Life** | Less power draw, averages 2 – 3 watts, resulting in 30+ minute battery boost ✔ | More power draw, averages 6 – 7 watts and therefore uses more battery |
| **Cost** | Expensive, roughly $0.20 per gigabyte (based on buying a 1TB drive) | Only around $0.03 per gigabyte, very cheap (buying a 4TB model) ✔ |
| **Capacity** | Typically not larger than 1TB for notebook size drives; 4TB max for desktops | Typically around 500GB and 2TB maximum for notebook size drives; 10TB max for desktops ✔ |
| **Operating System Boot Time** | Around 10-13 seconds average bootup time ✔ | Around 30-40 seconds average bootup time |
| **Noise** | There are no moving parts and as such no sound ✔ | Audible clicks and spinning can be heard |
| **Vibration** | No vibration as there are no moving parts ✔ | The spinning of the platters can sometimes result in vibration |
| **Heat Produced** | Lower power draw and no moving parts so little heat is produced ✔ | HDD doesn't produce much heat, but it will have a measurable amount more heat than an SSD due to moving parts and higher power draw |
| **Failure Rate** | Mean time between failure rate of 2.0 million hours ✔ | Mean time between failure rate of 1.5 million hours |
| **File Copy / Write Speed** | Generally above 200 MB/s and up to 550 MB/s for cutting edge drives ✔ | The range can be anywhere from 50 – 120MB / s |
| **Encryption** | Full Disk Encryption (FDE) Supported on some models ✔ | Full Disk Encryption (FDE) Supported on some models ✔ |
| **File Opening Speed** | Up to 30% faster than HDD ✔ | Slower than SSD |
| **Magnetism Affected?** | An SSD is safe from any effects of magnetism ✔ | Magnets can erase data |

**NB: Persistent storage** is any data storage device that retains data after power to that device is shut off. It is also sometimes referred to as non-volatile storage.

## Other Backup Options

- **Zip drive/disk** – It is a special diskettes that hold 100 MB, 250 MB or 750 MB

- **SyQuest drive** – Uses special cartridges that hold 200 MB

SyQuest drive

- **RAID** - RAID stands for Redundant Array of Independent or Inexpensive Disks. RAID technology is fault tolerant; that is, it allows data to be stored so that no data or transactions are lost in the event of disk failure. RAID involves using multiple hard disks in a special controller unit and storing data across all the disks in conjunction with extra reconstruction information that allows data to be recovered if a hard disk fails.

- **Storage Area Network (SAN) –** A storage area network connects servers and storage devices in a network to store large volumes of data. Data stored in a storage area network can be quickly retrieved and backed up. The storage devices are accessible to servers so that the devices appear like they are locally attached to the operating system.

- **Cloud Storage**

  This refers to saving data to an off-site storage system maintained by a third party i.e. the hosting company. People and organizations buy or lease storage capacity from the providers to store user, organizational or application data.

- **Computer Output Microfilm/Microfiche (COM) –** A microfilm is a film on which printed materials are photographed and stored at greatly reduced size for ease of storage. Companies that must store significant numbers of paper documents often use computer output microfilm. These devices transfer data directly from the computer onto the microfilm, thus eliminating the intermediate step of printing the document on paper. Newspapers and journals typically archive old issues in this manner, although some are now using optical storage devices. Data written on a microfilm is read using a **microfilm reader**.

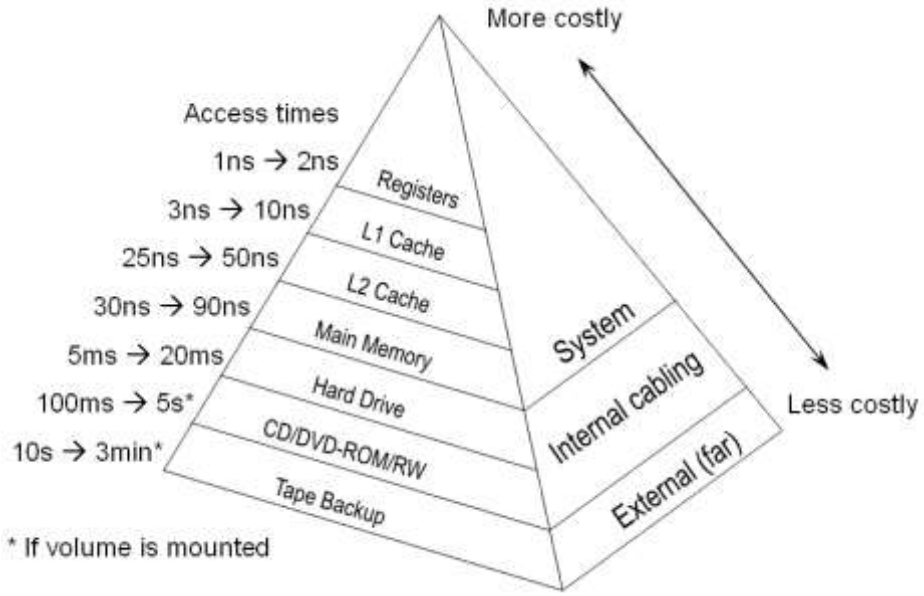
## Storage Capacity Abbreviations

- KB - kilobyte - 1000 (thousand bytes)
- MB - megabyte - 1,000,000 (million bytes)
- GB - gigabyte - 1,000,000,000 (billion)
- TB - terabyte - 1,000,000,000,000 (trillion)

## Difference between storage media and storage devices

A **storage medium** (media is the plural) is the physical material on which data items are kept. A **storage device** is the computer hardware that records and retrieves items to and from a storage medium. Storage devices can function as sources of input and output. When storage devices transfer items from a storage medium into memory – a process called **reading** – they function as sources of input. When storage devices transfer items from memory to a storage medium – a process called **writing** – they function as sources of output. Sometimes the storage medium is **removable** from the device, e.g. a CD-ROM can be taken out of a CD drive. Types of storage media include floppy disks, hard disks, compact discs, tape, PC Cards, microfilm, and microfiche.

# The Memory Hierarchy




## 5. COMMUNICATION DEVICES

A communication device is a piece of equipment or hardware designed to help computers or electronic devices communicate with each other.

- **Network Interface Card/Controller (Network Interface Card/Network Adapter/ LAN adapter/ Ethernet card)**

  In computer networking, a **NIC** provides the hardware interface between a computer and a network i.e. the network card acts as the **physical connection** between the computer and the network media. Every NIC has a unique **Media Access Control** (MAC) **address** and because an NIC's MAC address is permanent, it's often referred to as the **real, or physical**, address of a computer. NICs are built into the motherboard of most new computers integrated into the motherboard chipset or implemented via a **low-cost dedicated Ethernet chip**.

- **Modem**

Modems allow computers (digital devices) to **communicate via the phone system** (based on analog technology). It turns the computers digital data into analog, sends it over the phone line, and then another modem at the other end of the line turns the analog signal back into digital data.

- **Fax modem**

  A fax modem enables a computer to transmit and receive documents as faxes. Basic digital/analog modem enhanced with fax transmission hardware that enables faxing of information from computer to another fax/modem or a fax machine.

## TYPES OF COMPUTER CABLES

Connecting of peripheral devices or hardware component to a computer requires a specific type of cable.

### 1. VGA

VGA interface was created in the late 1980′s and until now remains a standard way for connection between a computer and monitor. Today, however, it is almost replaced by the digital interface DVI. VGA consists of 15 contacts arranged in three rows, each of which corresponds to three separate channels – red, green and blue. Although almost all video cards on the market are equipped with DVI, you will encounter many displays, allowing the connection to VGA, through VGA to DVI adapter.

### 2. Parallel ATA (IDE)

IDE-cable Parallel ATA (PATA) cables are used for the connection of **storage devices** such as hard disks, solid-state drives, and CD-ROM drives to the computer's motherboard. The Paralel ATA cable is a ribbon cable with two or three connectors, one of which plugs into the ATA connector mounted on the motherboard and the remaining connector(s) plug into drives. Each connector has 40 pins (44 pins for the smaller form-factor version used for 2.5″ drives). Note that if two drives are attached to a single cable, one must be configured as master and the other as slave.

## 3. SATA

The Serial ATA (Serial Advanced Technology Attachment), or SATA cables are designed to replace the older ATA cables used for connection of storage devices. Since SATA offers higher data transfer speeds, almost all modern desktop motherboards have integrated SATA host adapters. Unlike PATA, the same SATA connectors are used on both 3.5-inch SATA drives (used in desktop and server computers) and 2.5-inch drives (for portable computers). Each SATA cable has two 8-pin connectors (one on each end) and connects one motherboard socket to one hard drive.

## 4. USB

Today it is the most popular standard for connecting various peripheral devices to a computer. Using USB you can connect almost everything to your computer. There are 3 versions of USB:

USB 1.0/1.1 – offers data transfer speeds up to 12Mbit / s and uses four wires (2 for data and 2 for power supply)

USB 2.0 – This is the most commonly used version of this type of interface. It provides higher data transfer rates (480 Mbit / s) and compatibility with older versions of USB.

USB 3.0 – provides maximum data transfer rate up to 4.8 Gbit / s (600 MB / s theoretical speed) and backward compatibility with previous versions.


USB connectors

Each USB cable has two connectors (one on each end). In addition to standard USB connector, there are also smaller ones, such as Mini-USB and Micro-USB, which are used in mobile devices. There are different types of cables that combine different types of USB connectors.

## 5. e-SATA

E-SATA or External Serial Advanced Technology Attachment is an external interface for the new SATA technologies. The e-SATA port is very similar to the SATA ports inside the computer. It allows connection of external hard drives or optical drives, providing data transfer speeds, about three times faster than FireWire 400 and USB 2.0.

## 6. DVI

This is the successor of VGA designed to provide very high visual quality to digital display devices such as LCD computer displays. It allows you to transmit digital signals between the video source and display using a digital protocol in which the desired illumination of pixels is transmitted as binary data. There are 3 types of DVI connectors:

DVI-A used to transmit analog signals (compatible with VGA) to an analog display, such as a CRT monitor or budget LCD.

DVI-D can transmit only digital signals. It provides direct digital connection between any digital video source (such as PC videocard) and digital LCD monitor.

DVI-I can work with both types of signals (DVI-A and DVI-D). DVI-I cables are capable to transmit either a digital-to-digital signal or an analog-to-analog signal.

## 7. HDMI

HDMI or High-Definition Multimedia Interface is used for transmission of high-definition video between digital video sources (like PC graphic card or Blue ray player) and digital LCD monitors. HDMI provides the transmission of DVI video signals and audio signals simultaneously. HDMI is backward-compatible with DVI digital video (but only with DVI-D or DVI-I not DVI-A) used on modern computer monitors and graphics cards. There are 4 types of HDMI connectors:

Type A – This is the most popular type. The male connector outside dimensions are 13.9 mm x 4.45 mm and has 19 pins. It is also electrically compatible with single-link DVI-D.

Type B – This connector dimensions are 21.2 mm x 4.45 mm (it has 29 pins). Type B is electrically compatible with dual-link DVI-D

Type C – It is Mini connector intended for portable devices (10.42 mm x 2.42 mm) with 19 pins. Type C is used mostly for connecting digital cameras and camcorders.

Type D – A Micro connector with 19 pins and dimensions (2.8 mm x 6.4 mm) resembling a micro-USB connector.

## 8. FireWire

A FireWire is very similar but faster than USB (offers speeds up to 400Mbps and 800Mbps). It allows you to send data to and from high-bandwidth digital devices such as printers, scanners and digital camcorders. A single 1394 port can be used to connect up to 63 external devices at a maximum cable distance between devices of 4.5 meters.

## 9. RJ 45 (Radio Jack 45)

rj 45 cableRJ 45 cables are used to connect computers to local area networks. There are two basic types of RJ 45 cables – straight-trough and crossover. A straight-trough cable is required to connect a computer to hub/switch, while if you want to connect two computers directly you will need a crossover cable.

NB/

## Serial and Parallel Transmission

Digital data transmission can occur in two basic modes: serial or parallel. Data within a computer system is transmitted via parallel mode on **buses** with the width of the parallel bus matched to the word size of the computer system. Data between computer systems is usually transmitted in **bit serial mode**. Consequently, it is necessary to make a parallel-to-serial conversion at a computer **interface** when sending data from a computer system into a network and a serial-to-parallel conversion at a computer interface when receiving information from a network. The type of transmission mode used may also depend upon distance and required data rate.

**Parallel Transmission**

In parallel transmission, multiple **bits** (usually 8 bits or a byte/character) are sent simultaneously on different channels (wires, frequency channels) within the same cable, or radio path, and **synchronized** to a clock. Parallel devices have a wider data bus than serial devices and can therefore transfer data in words of one or more bytes at a time. As a result, there is a speedup in parallel transmission bit rate over serial transmission bit rate. However, this speedup is a trade-off versus cost since multiple wires cost more than a single wire, and as a parallel cable gets longer, the synchronization timing between multiple channels becomes more sensitive to distance. The timing for parallel transmission is provided by a constant clocking signal sent over a separate wire within the parallel cable; thus parallel transmission is considered **synchronous** .

**Serial Transmission**

In serial transmission, bits are sent **sequentially** on the same channel (wire) which reduces costs for wire but also slows the speed of transmission. Also, for serial transmission, some overhead time is needed since bits must be assembled and sent as a unit and then disassembled at the receiver.

## COMPUTER HARDWARE SELECTION CRITERIA

The following factors are considered when selecting hardware for use:

i) **Compatibility and Industry Standards:**

- Is the hardware compatible and futuristic in regard to other pieces of hardware in your technology plan;
- Are there industry standards for similar hardware components;

ii) **Ease of Operation:**

- Can hardware be installed, operated and maintained by local personnel;
- Are adult and student users able to access/use hardware with minimal additional technology competencies;

iii) **Support:**

- **Is technical support provided** by vendor at minimal cost and available in a variety of mediums;
- Are printed and electronic **manuals** written and understandable;
- Does the vendor have a strong Research and Development Department;
- Does the vendor have a strong commitment to the Educational Community?

iv) **Cost:** initial and maintenance

- Is the cost competitive within the market place for like specifications;
- Are the required/requested components included in the purchase price;
- Are detailed and renewal warranties available?

v) **Reputation of the manufacturer**.

- Financial stability
- Record of keeping promises

vi) **Technological Considerations:**

- Is the equipment networkable?
- Does the hardware include sound utilities, video input/output, etc;
- Is the built in memory sufficient and expandable;
- Is the hard drive storage adequate and expandable;
- Are computers and printers compatible;
- Are there adequate electronic devices available for backup and storage of data;
- Are printers adequate to handle current and future job loads;
- Are monitors and projection devices adequate for small and large groups;
- Do presentation systems have quality sound in and out capabilities

**HOW TO AQCUIRE ICT RESOURCES – PROCEDURE**

1. Conduct feasibility study: Economic, Operational, Technical etc.
2. Request for tender is prepared

   The request for tender outlines what is required, the contractual requirements and how you should respond.

   Types of tender opportunities

   i) **Open Tendering:** An open tendering process is an invitation to tender by public advertisement.

   ii) There are no restrictions placed on who can submit a tender, however, suppliers are required to submit all required information and are evaluated against the stated selection criteria.

iii) **Select Tendering:** A select tender is only open to a select number of suppliers. The suppliers may be a short list sourced from an open tender or be a compilation of businesses that the organization has worked with previously.

iv) **Multi-stage Tendering:** Multi-stage tendering is used when there are a large number of respondents. At each stage in the process, the suppliers are culled to those who are most suited to the specific contract requirements.

v) **Invited Tendering:** An organization contacts a select number of suppliers directly and requests them to participate in the tender process. It is generally used for specialist work, emergency situations or for low value, low risk and off the shelf options.

3. Tenders are invited
4. Receive response from suppliers
5. Evaluation and shortlist best suppliers

   Each tender will be checked for compliance, and if compliant, then evaluated against the criteria specified in the tender documentation.

   Once the evaluation process is completed and a tender submission is selected, the successful tenderer will be notified of the outcome and awarded a contract.
6. Call shortlisted suppliers for interview
7. Select one and sign a contract
8. Wait for delivery

**Ordering/Acquisition Suggestions:**

- Occasionally group purchases/bundles are available; investigate current or pending offers
- Hardware packages may not provide adequate memory for necessary program functions; consideration should be given to the savings of the package vs. the cost of additional memory upgrades.
- Consideration must be given to whether a line of equipment is being discontinued; what implications does the discontinuance have on issues such as maintenance.
- Review the type of warranty which is provided on the hardware.
- Maintain copies of all warranties.

# COMPUTER SOFTWARE – INTRODUCTION

A computer software/program is a sequence of instructions (machine-readable) that tell the computer hardware what to do.

There are two major categories of software: **system** and **application** software.

## SYSTEM SOFTWARE

Systems software consists of programs that co-ordinate the activities of hardware and other programs. System software is designed for a specific CPU and hardware class. **The combination of a particular hardware configuration and operating system** is called a **computer platform**. These programs manage the "behind the scenes" operation of the computer.

### TYPES OF SYSTEM SOFTWARE

1. **Operating systems** (**OS**) – This is a collection of software that manages computer hardware resources and provides common services for computer programs.

   **Examples of operating systems include:**

   - DOS – Disk operating system
   - Windows 3.1, 95, 98, NT, 2000, ME, XPLinux,Windows Server 2003
   - Unix
   - MAC OS X
   - System 7/Mac OS 7
   - Solaris

2. **Utility Programs** – This is system software designed to help the OS to analyze, configure and maintain a computer. Utility programs often come installed on computer systems or packaged with operating systems. Utilities can also be purchased individually. Examples of utility programs include:
   a. Language processors – Compilers and interpreters.
   b. Disk cloning software – This is software that is used to copy the contents of one computer hard disk to another disk or to an "image" file. Unlike standard copying functions, disk cloning involves copying hidden and in-use files, and thus presents special challenges, as those types of files are typically not available for copying. Examples include Disk Copy by Apple and DriveClone by Farstone Technology.

c. Disk Compression – A disk compression utility sits between the operating system and the disk drive. Whenever the operating system attempts to save a file to disk, the utility intercepts it and compresses it. Likewise, when the operating system attempts to open a file, the disk compression utility intercepts the file, decompresses it, and then passes it to the operating system.
d. Antivirus software
e. Backup software
f. Disk checkers for scanning operating hard drive.
g. Disk Defragmenter
h. Disk partitioning for dividing an individual drive into multiple logical drives
i. Disk Cleaner
j. Debuggers
k. Registry cleaners clean and optimize the Windows registry by removing old registry keys that are no longer in use.

3. **Firmware** - Firmware is a software program or set of instructions programmed on a hardware device. It provides the necessary instructions for how the device communicates with the other computer hardware.

## Types of Operating Systems

- **Multi-user:** Allows two or more users to run programs at the same time. Some operating systems permit hundreds or even thousands of concurrent users. All mainframes and minicomputers are multi-user systems, but most personal computers and workstations are not.
- **Multiprocessing:** Supports running a program on more than one CPU. The system has two or more processing units (multiple processors) each sharing the main memory and peripherals, in order to simultaneously process programs. This is also called **parallel processing** and is made possible by **multithreading** programs such that several threads of the same program run on the same CPU.
- **Multitasking/Multiprogramming (vs. Singletasking)**: Allows more than one program to run concurrently thereby ensuring that system resources are utilized effectively. A single-tasking system has only one running program.

- **Multithreading:** Allows different parts of a single program to run concurrently. The technology can be applied to a single process to enable parallel execution on a multiprocessor system. This means that a single process can have many different "functions" executing concurrently, allowing the application to better use the available hardware (multiple cores/processors).
- **Real time:** These Operating systems respond to input instantly. They are usually dedicated, embedded systems. They typically read from and react to sensor data. The system must guarantee response to events within fixed periods of time to ensure correct performance. Real-time responses are often understood to be in the order of milliseconds, and sometimes microseconds. The predictability of the system behaviour is the most important concern in these systems. General-purpose operating systems, such as DOS and UNIX, are not real-time.
  The main characteristics of this type of real time systems include:
    - Direct connection between input/output devices and the central processor.
    - Fairly fast response time

  Typical examples of real-time systems include Air Traffic Control Systems, Command Control Systems.

- **Distributed:** A distributed operating system is a system that manages a group of networked computers which have the same goal for their work. The components interact with each other in order to achieve a common goal such as solving a large computational problem. The computers are geographically dispersed but linked by communication lines. This seamless integration of individual nodes into a global system is referred to as *transparency.*
- **Embedded:** An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. Embedded operating systems are designed to be used in embedded computer systems and **dedicated to handle a particular task**. They are designed to operate on small machines like PDAs with limited resources. They are **very compact** and **extremely** efficient by design. Examples include Windows CE and Minix 3. Embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers and large complex systems like hybrid vehicles, MRI, and avionics.

- **Batch operating system**: these execute a series of programs ("jobs") on a computer without human interaction. Batch jobs are set up so they can be run to completion without human interaction i.e. **programs and data are collected together in a batch before processing starts**. This is in contrast to "online" or interactive systems which prompt the user for such input. Examples of areas where batch processing is used include:

    a. Producing bills
    b. payroll
    c. stock control
    d. processing bank cheques
    e. marking multiple choice examination papers

    **Spooling batch systems** use the concept of spooling which is an acronym for Simultaneous Peripheral Operations Online.

    Spooling refers to putting data in a buffer, a special area in memory or on a disk where an output device such as a printer can access them when it is ready. Spooling is useful because devices access data at much slower rates than the CPU. The buffer provides a waiting station where data can rest while the slower device catches up.

    The most common spooling application is print spooling. In print spooling, documents are loaded into a buffer and then the printer pulls them off the buffer at its own rate.

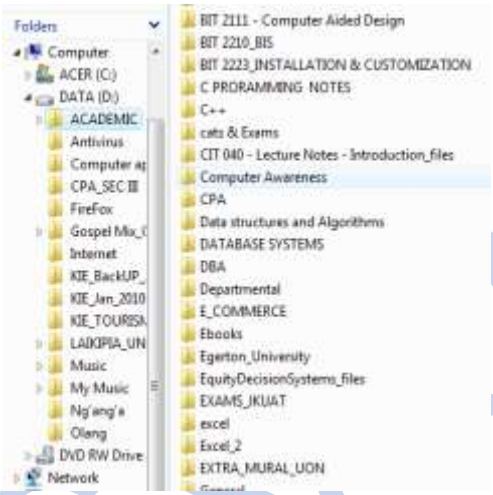
- **Interactive/on-line:** User is online with computer system and interacts with it via an interface and the results of data processing are available immediately. It is typically composed of many short transactions where the result of the next transaction may be unpredictable. Response time needs to be short since the user submits and waits for the result.

**Functions of an Operating System**

The main features of an operating system can be thought of as functions of the operating systems. They are the qualities that an operating system should strive to achieve.

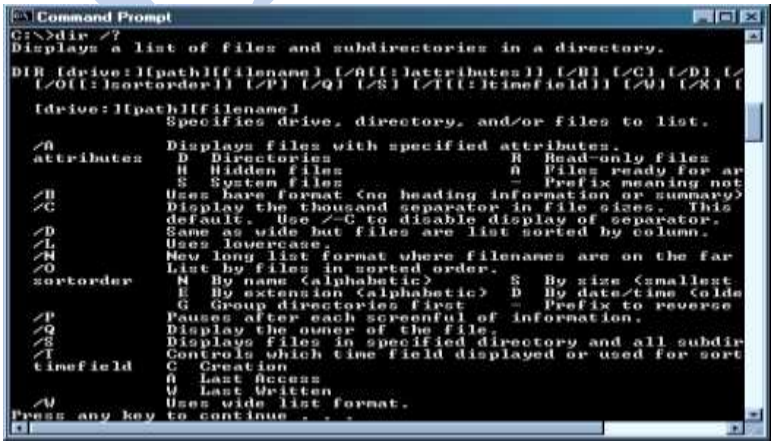
**i) Managing Resources –** These programs coordinate all the computer's resources including the processor, keyboard, mouse, printer, monitor, storage devices and memory.

An operating system creates a file structure on the computer hard drive where user data can be stored and retrieved. When a file is saved, the operating system saves it, attaches a name to it, and remembers where it put the file for future use. The way an operating system organizes information into files is called a **file system**. Most operating systems use a **hierarchical file system**, which organizes files into directories (*folders*) under a tree structure. The beginning of the directory system is called the root directory e.g. C:\. The figure below shows a screenshot of tree structure when using Windows Explorer.




b. **Providing a user interface** – Users interact with application programs and computer hardware through a user interface. **The user interface controls how you enter data or instructions and how information displays on the computer screen.**

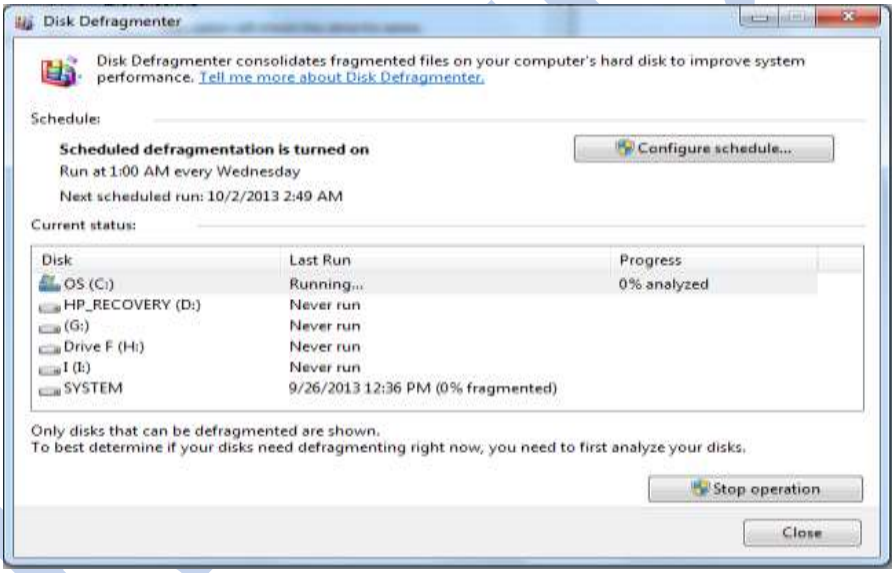
   Almost all operating systems today provide a windows-like **Graphical User Interface (GUI)** in which graphic objects called icons are used to represent commonly used features. Some operating systems, however, provide a **command-line** user interface such as MS-DOS, CP/M, Unix, and Apple DOS. System software serves as the interface between a user, the application software, and the computer's hardware.



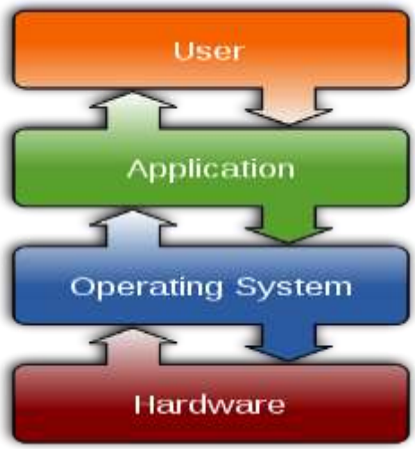
Screenshot of a sample MS DOS Console

iii) **Running applications** – These programs load and run applications such as word processors and spreadsheets. Most operating systems support multitasking, or the ability to run more than one application at a time. When a user requests a program, the operating system locates the application and loads it into the primary memory or RAM of the computer. **As more programs are loaded, the operating system must allocate the computer resources.**

iv) **Support for built-in utility programs** –The operating system uses utility programs for maintenance and repairs. *Utility programs* help identify problems, locate lost files, repair damaged files, and backup data. The figure here shows the progress of the Disk Defragmenter, which is found in Programs > Accessories > System Tools.




v) **Control of the computer hardware** – The operating system sits between the programs and the Basic Input Output System (BIOS). The BIOS controls the hardware. All programs that need hardware resources must go through the operating system. The operating system can either access the hardware through the BIOS or through the device drivers.




vi) **Security -** The operating system must be capable of distinguishing between requests that should be allowed to be processed, and others which should not be processed.

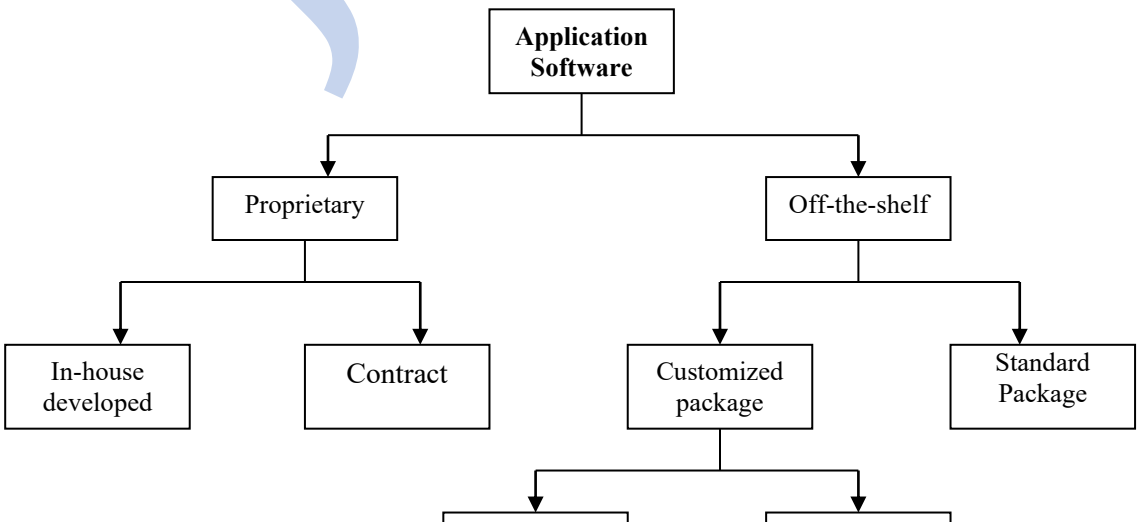
A computer being secure depends on a number of technologies working properly. A modern operating system provides access to a number of resources, which are available to software running on the system, and to external devices like networks via the kernel.

vii) **Reporting errors during program execution**

## APPLICATION SOFTWARE

Applications software includes programs designed to help end users solve particular problems using the computer or to perform specific tasks beyond the operation of the computer itself.

**Sources of application software**



**Advantages of proprietary software**

- You can get exactly what you need in terms of reports, features etc.
- Being involved in development offers a further level in control over results.
- There is more flexibility in making modifications that may be required to counteract a new initiative by a competitor or to meet new supplier or customer requirements. A merger with another firm or an acquisition will also necessitate software changes to meet new business needs.

**Disadvantages of proprietary software**

- It can take a long time and significant resources to develop required features.
- In-house system development staff may become hard-pressed to provide the required level of ongoing support and maintenance because of pressure to get on to other new projects.
- The software makes the business owner too heavily dependent upon the developer.
- It is difficult to adapt the software to changes in the marketplace.
- It is expensive to develop.

**Advantages of off-the-shelf software**

- The initial cost is lower since the software firm is able to spread the development costs over a large number of customers.
- There is lower risk that the software will fail to meet the basic business needs - you can analyze existing features and performance of the package
- Package is likely to be of high quality since many customer firms have tested the software and helped identify many of its bugs.

- Due to its wide distribution you may be able to gain help from a large number of users especially online.

**Disadvantages of off-the-shelf software**

- An organization may have to pay for features that are not required and never used.
- The software may lack important features, thus requiring future modifications or customisation. This can be very expensive because users must adopt future releases of the software.
- Software may not match current work processes and data standards.

Application software is further classified into **general-purpose software** and **special purpose applications**. General purpose application software is a type of software that can be used for a variety of tasks. It is not limited to one particular function. For example a word processor could be classed as general purpose software as it would allow a user to write a novel, create a restaurant menu or even make a poster.
Special purpose application software, on the other hand, is a type of software created to execute one specific task. For example a camera application on your phone will only allow you to take and share pictures.

**Functions of various General-purpose software**

- Word processing – Create, edit and print text documents. E.g. MS Word, Word Perfect, OpenOffice Writer.
- Spreadsheets – Provide a wide range of in-built functions for statistical, logical, financial, database, graphics, data and time calculations. E.g. Lotus 1-2-3, Excel, Quattro Pro.
- Database management systems (DBMS) – Store, manipulate and retrieve data. E.g. Access, FoxPro, dBase, Oracle, MySQL etc.
- Online Information Services – Obtain a broad range of information from commercial services. E.g. America Online, CompuServe
- Communications applications- Ms Outlook for email
- Browsers e.g. Internet Explorer, Mozilla Firefox, Eudora, Netscape's Navigator, Opera Browser, Torch, Google chrome.
- Graphics – Develop graphs, illustrations and drawings. E.g. PaintShop, FreeHand, Corel Draw etc.
- Project Management – Plan, schedule, allocate and control people and resources needed to complete a project according. E.g. Project for Windows, Time Line.

- Financial Management – Provide income and expense tracking and reporting to monitor and plan budgets. E.g. Quicken, Quick-books, Sage
- Desktop publishing - Used to create high-quality printed output including text and graphics; various styles of pages can be laid out; art and text from other programs can also be integrated into published pages. E.g. PageMaker, Publisher.
- Presentation packages like MS PowerPoint, Apple Keynote, Corel Presentations Lotus Freelance Graphics, OpenOffice, NeoOffice, StarOffice Impress

**Note:** Some application software come in suites. A software suite refers to related but independent programs and packages that have a common user interface or shared data format, such as Microsoft Office. The programs in a software suite are designed to be used together. In addition, the commands, the icons and procedures are the same for all programs in the suite.

## CHOOSING APPROPRIATE COMPUTER SOFTWARE

There are six key software evaluation criteria that should be considered in an organization's software decision.

(i) **Functionality** - Software should have the right functionality to fit your industry specific requirements. Just because the software is well known, does not mean the vendor has the specific functionality you need to run your business.

(ii) **Technology** - The software must be a match for the platform and database that you are running and the expertise of the IT staff that you have in-house.

(iii) **Software Vendor** - The software vendor is a critical part of the software selection process. You are not just buying a static software solution; you are actually buying a relationship with that software vendor. You will be paying annual maintenance so that they will continue to develop, enhance, and improve the product.

(iv) **Value Added Reseller (VAR)** – If you are acquiring software from a VAR, the company needs to have experience with the software product that you are implementing and the industry that you are in. You have many VAR/Implementation Partner options available to you. Make sure you get one that has a focus in your industry.

A Value Added Reseller is a company that adds features or services to an existing product and then resells it usually to end-users. The added value can come in form of integrating, customizing, consulting, training and implementation.

(v) **Maintenance & Support** - You can expect to pay between 18-25% of the license cost for maintenance. This entitles you to upgrades and some level of support. You should make sure that this investment you will be making on an annual basis will be appropriate.

(vi) **Total Cost of Ownership** - You need to consider the total cost of ownership of the software solution and not just the big discount that the vendor may be offering for the up-front **license cost**. There are 3 main components of out-of-pocket cost that should be considered. These components include the software **license**, software **maintenance**, and **implementation services**. You should look at the cost for the next 5-7 years in order to get a good idea of the long term cost to your organization.

# BASIC COMPUTER NETWORKING

## Definition of a Computer Network

A computer network refers to a **group** of two or more **computers or other hardware devices connected/linked** together for purposes of sharing resources, such as files, programs, printers etc. The computers on a network may be linked through cables, radio waves, satellites, or infrared light beams.

Computers on a network use protocols which define a common set of rules and signals to communicate.

NB/ Computers that are not connected to one another are known as **stand-alone** computers.

## ADVANTAGES OF COMPUTER NETWORKING

i) **Facilitating communications.** Using a network, people can communicate efficiently and easily via e-mail, chat rooms, telephony, video telephone calls, and videoconferencing.

ii) **Sharing resources and reducing costs.** In a networked environment, each computer on a network can access and use hardware and software on the network. If several computers and a printer are connected to a network, each user can access the printer on the network, as they need it instead of buying as many printers.

Network resources include:

- Printers and other peripherals
- Files, data and information
- Applications/programs
- Disk Storage

iii) It enables **distributed processing** which allows a user at one computer to use a program on another computer as a "back end" to process and store the information. The user's computer is the "front end," performing the data entry.

iv) **Centralized data administration and support.** Data from all the user systems can be stored on one machine where it can be managed in an easy and more secure way.

v) Users can store **more information**, because they can now store data on other computers on the network. They allow users to use programs that would otherwise be too large for their computer to run by itself.

## DISADVANTAGES

i. The cost of hardware, software and cabling might be quite high
ii. Complexity of many LANs means that it is often necessary to employ someone to look after the network and solve problems relating to the system.
iii. Security of data may be compromised if adequate procedures are not adopted.
iv. Any failure in the system often means that it becomes impossible for users to work.
v. Performance issues

## TYPES OF NETWORKS

Categorization can be based on the following criteria:

- Based on transmission media: Wired (Guided media) and Wireless (Unguided media)
  For guided media, there is a physical path such as a cable for signal propagation, while in unguided media; the electromagnetic wave is transmitted through air.
- Based on network size: e.g. LAN and WAN
- Based on management method: Peer-to-peer and Client/Server
- Based on topology (physical and logical layout): Bus, Star, Ring …

### Types of Networks based on Size

**i) Local Area Networks (LANs)**

The **smallest and simplest** networks are called local area networks (LANs), which extend over only a small area, typically within a single office, building or a part thereof. In addition to operating in a limited space, LANs are also typically **owned, controlled, and managed by a single person or organization**. They also tend to use certain connectivity technologies, primarily **Ethernet and Token Ring**.

*A home network is a type of LAN that is contained within a user's residence.*

**ii) Wide Area Networks (WANs)**

*Wide area networks* (WANs) can extend over a **large geographic area** e.g. across metropolitan, regional, national or continental boundaries and are connected via the telephone network or radio waves. A WAN is a geographically-dispersed collection of LANs. A network device called a router connects LANs to a WAN. In IP networking, the router maintains both a LAN address and a WAN address.

A WAN differs from a LAN in several important ways. Most WANs (like the Internet) are not owned by any one organization but rather exist under **collective or distributed ownership and management;** WANs are usually administered by **multiple service providers**.

**iii) Metropolitan Area Network (MAN) / Campus Area Network (CAN)**

A metropolitan area network (MAN) is **designed to serve a town or city**, and a campus area network is designed to serve a university, military base or an educational institution.

A metropolitan area spans a physical area **larger than a LAN but smaller than a WAN**, such as a city. A MAN is typically **owned and operated by a single entity** such as a government body or large corporation.

**iv) Intranet**

An intranet is a **private network** within an organization that **uses the same communications protocols as the Internet** (internet protocol). It is sometimes contrasted to extranets. An Intranet is used strictly within the confines of a company, university, or organization and is based on the internet standards (HTML, HTTP & TCP/IP protocols). An intranet's Web sites look and acts just like any other Web sites, but the firewall surrounding an intranet fends off unauthorized access.

**v) Extranet**

This is a private network that **allows controlled access from the outside**, for specific business or educational purposes. It uses Internet technology and the public telecommunication system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses. **An extranet requires security and privacy**. These can include firewall server management, the issuance and use of digital certificates or similar means of user authentication, encryption of messages, and the use of virtual private networks (VPNs) that tunnel through the public network.

**Virtual Private Network (VPN)?**

A virtual private network (VPN) is a network that uses a public telecommunication infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network. A virtual private network can be contrasted with an expensive system of owned or leased lines that can only be used by one organization. The goal of a VPN is to provide the organization with the same capabilities, but at a much lower cost

**vi) internet/internetwork**

An *internet* (spelt with a lower case *i*) is a network that is composed of a number of smaller computer networks.

**vii) The Internet**

The Internet (spelled with an upper case I) is the world-wide network of interconnected internets that operates using a standardized set of communications protocols called TCP/IP (transmission control protocol/Internet protocol), or *the Internet protocol suite*. This *ultimate* internet is vastly larger than any other internet and connects thousands of networks and hundreds of millions of computers throughout the world. The Internet is, therefore, an internet.

**TCP/IP** provides end-to-end connectivity **specifying how data should be formatted, addressed, transmitted, routed and received at the destination**. From lowest to highest, the layers are the **link layer**, containing communication technologies for a single network segment (link), the **internet layer,** connecting hosts across independent networks, thus establishing internetworking, the **transport layer** handling host-to-host communication, and the **application layer**, which provides process-to-process application data exchange e.g. HTTP, SMTP, FTP.

### Types of Networks based on management method:

## PEER-TO-PEER NETWORKS(P2P)

Peer-to-peer networks are also called **workgroups** and there exists no hierarchy among computers; all computers are equal. No administrator is usually responsible for the network. Peer-to-peer networks are appropriate for small, simple, and inexpensive networks. This type of network is appropriate where:

- there are 10 or less users
- No specialized services required
- Security is not an issue
- Only limited growth in the foreseeable future

### Advantages of peer-to-peer networks/workgroups

- Low cost of implementation
- Simple to configure
- User has full access to network resources
- P2P is more reliable as central dependency is eliminated. Failure of one peer doesn't affect the functioning of other peers.
- There is no need for full-time System Administrator. Every user is the administrator of his machine.

### Disadvantages of peer-to-peer networks

- May have duplication in resources
- Difficult to uphold security policies
- Data recovery or backup is very difficult.
- Difficult to handle uneven loading – unequal distribution of tasks among the workstations

## SERVER-BASED NETWORKS (CLIENT/SERVER MODEL)

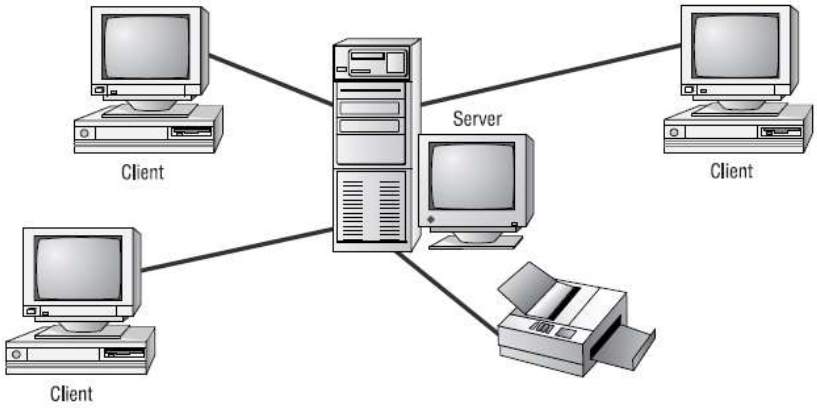
A computer network in which one centralized, powerful computer (called the server) is a hub to which many less powerful personal computers or **workstations** (called **clients**) are connected. The clients run programs and access data that are stored on the server. Network Clients (Workstations) computers request network resources or services while the network Servers provide network resources and services to clients.

A server usually has more processing power, memory and hard disk space than clients and **run Network Operating System that can manage not only data, but also users, groups, security, and applications on the network.** Servers often have a more stringent requirement on its performance and reliability.

Server-based networks use a **dedicated, centralized server**. All administrative functions and resource sharing are performed from this point. This makes it **easier to share resources, perform backups**, and **support an almost unlimited number of users**. It also offers better security. However, it does **need more hardware** than that used by the typical workstation/server computer in a peer-to-peer resource model.

A good example of a server based network is a **domain** which refers to a group of computers and devices on a network that are administered as a unit with **common rules and procedures**. Domain-based networks are composed of any number of computers and at least one **Domain Controller** (DC). The workstations could be used by employees and users in the organization, while the Domain Controller is capable of managing the user workstations in many different respects.

If you have a user account on the domain, you can log on to any computer on the domain without needing an account on that computer.




**Peer-to-Peer Networks vs Client/Server Networks**

| Peer-to-Peer Networks | Client/Server Networks |
|---|---|
| **1.** Easy to set up | More difficult to set up |
| **2.** Less expensive to install | More expensive to install |
| **3.** Can be implemented on a wide range of operating systems | A variety of OSs can be supported on the client machines, but the server needs to run an Operating System that supports networking i.e **NOS**. |
| **4.** More time consuming to maintain the software being used (as computers must be managed individually) | Less time consuming to maintain the software being used (as most of the maintenance is managed from the server) |
| **5.** Very low levels of security supported or none at all. | High levels of security are supported, all of which are controlled from the server including access to individual workstations. Such measures prevent the deletion of essential system files or changing of settings. |
| **6.** Ideal for networks with less than 10 computers | No limit to the number of computers that can be supported by the network |
| **7.** Does not require a server | Requires a server running a network operating system |
| **8.** Demands a moderate level of skill to administer the network | Demands that the network administrator has a high level of IT skills with a good working knowledge of a server operating system |



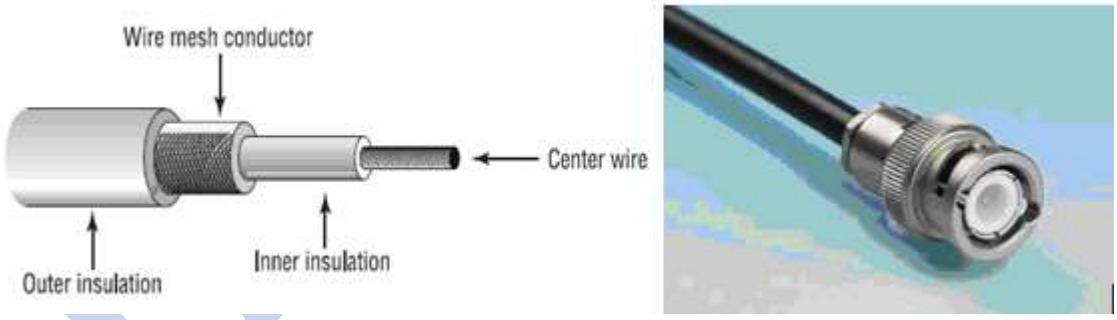
## NETWORK COMPONENTS

**(a) Networking/Communication Media**

The two most popular types of network cabling are the 10BaseT (also known as twisted pair or Cat5), 10Base5 (also known as Thicknet) and thin coax (also known as 10Base2 or Thinnet). The "10" in 10Base5 stands for the 10 Mbps transmission rates while the "5" stands for the maximum distance of 500 meters to carry transmissions. The pairs are twisted together for the purposes of cancelling out electromagnetic interference (EMI) from external sources

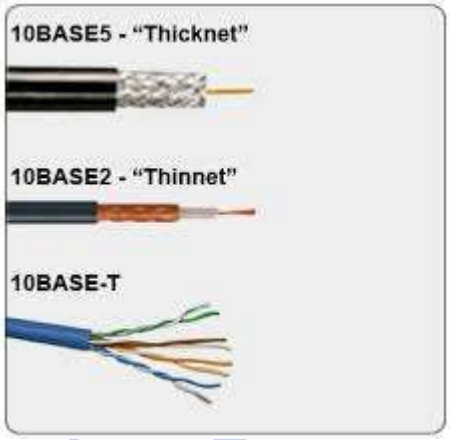
10BaseT cabling looks like ordinary telephone wire, except that it has 8 wires inside instead of 4, transmits at 10Mbps, with a maximum distance of 100 meters and physical star topology with a logical bus topology. There are basically two types of twisted-pair cabling: **unshielded twisted-pair** (**UTP**) and **shielded twisted-pair** (**STP**). UTP is simply twisted-pair cabling that is unshielded. In STP cables, each of the pair or collection of pairs of wires that are twisted together are coated with an insulating coating that functions as a ground for the wires which protects the transmission line from electromagnetic interference leaking into or out of the cable.

Thin coax looks like the copper coaxial cabling that's often used to connect an aerial antenna to a TV set. The 10baseT/Cat5 cables have connectors that resemble a phone cord connector, only larger. These are called RJ-45 connectors. Coaxial cables are connected using BNC connectors.




10Base5 Cable and BNC Connector

10BaseT cable, RJ45 Connectors and their ports



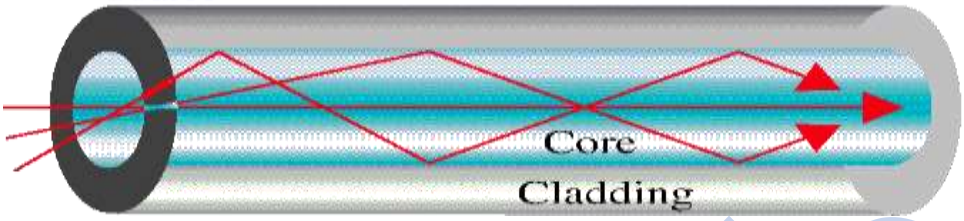

NB: The BASE is for baseband operation. Baseband is an adjective that describes signals and systems whose range of frequencies is measured from close to 0 hertz to a cut-off frequency (a maximum bandwidth or highest signal frequency); it is sometimes used as a noun for a band of frequencies starting close to zero.

RJ – Registered Jack

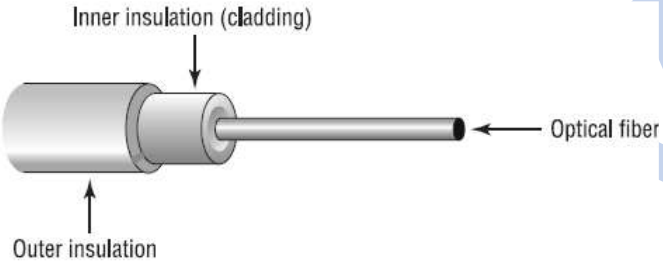
RJ45 connects Unshielded twisted pair cables

RJ48C connects shielded twisted pair cables

**Fiber Optic Cables**– signals are converted to light form and fired by laser or LEDs in bursts through insulated, thin glass or plastic fiber. Light bounces back and forth along the core. The pulses of light represent the 'on' state in electronic data representation. An optical fiber consists of a core (denser material) and a cladding (less dense material). In multi-mode fibres, as the name suggests, there are multiple modes of propagation for the rays of light. These range from low order modes which take the most direct route straight down the middle, to high order modes which take the longest route as they bounce from one side




It provides transmission speeds from 100Mbps up to 1Gbps and a maximum distance of several miles. A small fiber-optic cable can support large amounts of voice conversation at the same time.




Fiber Optic cable

## Advantages of Fiber Optic Cables

### i. Immunity to Electromagnetic Interference

Magnetic field lines generate an electrical current as they cut across conductors. The flow of electrons in a conductor generates a magnetic field that changes with the current flow. Electromagnetic Interference does occur in coaxial cables, since current does cut across the conductor. Fiber optics are immune to this EMI since signals are transmitted as light instead of current. Thus, they can carry signals through places where EMI would block transmission.

Although fiber optics can solve data communications problems, they are not needed everywhere. Most computer data goes over ordinary wires. Most data is sent over short distances at low speed. In ordinary environments, it is not practical to use fiber optics to transmit data between personal computers and printers as it's too costly.

ii. **Data Security**

Since fiber optics do not radiate electromagnetic energy, emissions cannot be intercepted and physically tapping the fiber takes great skill to do undetected. Thus, the fiber is the most secure medium available for carrying sensitive data.

iii. **Non Conductive Cables**

A serious concern with outdoor cables in certain computer networks is that they can be hit by lightning, causing destruction to wires and other components in the network.

Any conductive cables can carry power surges or ground loops. Fiber optic cables can be made non-conductive by avoiding metal in their design. These kinds of cables are economical and standard for many indoor applications. Outdoor versions are more expensive since they require special strength members, but they can still be valuable in eliminating ground loops and protecting electronic equipment from surge damage.

iv. **Eliminating Spark Hazards**

In some cases, transmitting signals electrically can be extremely dangerous. Most electric potentials create small sparks which can be bad in a chemical plant or oil refinery where the air is contaminated with potentially explosive vapours. Fiber optic cables do not produce sparks since they do not carry current.

v. **Ease Of Installation**

Increasing transmission capacity of wire cables generally makes them thicker and more rigid. Such thick cables can be difficult to install in existing buildings where they must go through walls and cable ducts. Fiber cables are easier to install since they are smaller and more flexible. They can also run along the same routes as electric cables without picking up excessive noise.

vi. **High Bandwidth Over Long Distances**

Fiber optic cables have a large capacity and can carry high speed signals over longer distances without repeaters in most cases several miles. Generally, coaxial cables have a bandwidth parameter of a few MHz/km, where else the fiber optic cable has a bandwidth of 400MHz/km.

**Disadvantages**

i. Cost - Optical fibers are expensive.

ii. Installation/maintenance is expensive - any crack in the core will degrade the signal, and all connections must be perfectly aligned.

# Wireless Technology

## i. Microwave Communications

Information is converted to a microwave signal, sent through the air to a receiver, and recovered. They use line-of-sight devices which must be placed in relatively high locations. Microwaves are electromagnetic waves which are "small" compared to waves used in typical radio broadcasting, in that they have shorter wavelengths.

## ii. Satellite Transmission

Communications satellites are relay stations that receive signals from one earth station and rebroadcast them to another. They use microwave signals

## iii. Infrared transmission

Involves sending signals through the air via light waves and requires line-of-sight and short distances (a few hundred yards). It is used to connect various computing devices. Infrared waves are electromagnetic radiation with longer wavelengths than those of visible light.

## iv. Bluetooth

Bluetooth is a specification (IEEE 802.15.1) for the use of low-power radio communications to link phones, computers and other network devices over short distances without wires.

Bluetooth technology was designed primarily to support simple wireless networking of personal consumer devices and peripherals, including cell phones, PDAs, and wireless headsets. Wireless signals transmitted with Bluetooth cover short distances, typically up to 30 feet (10 meters). Bluetooth devices generally communicate at less than 1 Mbps.

**FACTORS TO CONSIDER WHEN CHOOSING TYPE OF MEDIA TO USE**

1. The distance the media can successfully carry a signal
2. Environment in which the media is to be installed
3. Amount of data and the speed at which it must be transmitted
4. Cost of the media and installation

**(b) Hub**

The central connecting device is called a hub. A hub is a box that is used to gather groups of PCs together at a central location using cables. A hub simply passes all the information it receives so that all the devices connected to its ports receive the information. Hubs are mostly used in a small network (usually less than 30 hosts). Hubs connect LANs of similar technology or to extend the distance of one LAN. They can be called **repeaters** or **amplifiers**.

**Advantages of using Hubs**

i. They are inexpensive
ii. Easy to install
iii. Can connect different media
iv. Very little delay

**Disadvantages**

i. Limited distance between devices
ii. No protocol or rate conversion
iii. No error detection
iv. Does not filter packets
v. Can compromise data security
vi. Generates unnecessary network traffic
vii. A maximum of 30 devices

**(c) SWITCH**

The Switch is a more advanced unit over the basic hub. Unlike a hub, a switch will forward information/packets to the appropriate machine or port according to the address information on a particular packet. Switches are used on **large networks** in order to cut down the amount of unnecessary traffic being generated. They can use the same or different types of cable.

**Advantages**

i. Can convert protocols

ii. They enhance network performance

iii. Can be configured

iv. Enhances security- only destined device receives the packet.

i. It does filter packets

ii. Does error detection

**Disadvantages**

i. More expensive than hubs

ii. Higher maintenance demands

## (d) Router

Routers are highly intelligent devices that **connect multiple network types.** A LAN is connected to a WAN using a router. They:

a. They translate one network protocol and data format to another.
b. Determine the best path for sending data.
c. They **route packets across multiple networks**. They use routing tables to store network addresses to determine the best destination.
d. They are used to **segment large networks**.
e. They **filter out noise**.
f. They are normally used to **connect one LAN to another**. Typically, when a WAN is set up, there will be at least two routers used.

Their **disadvantages** include:

a. They are a **bit slow** because they are **intelligent** devices; as such, they **analyze every packet**, **causing packet-forwarding delays**.
b. Because of this intelligence, they are also **more expensive**.

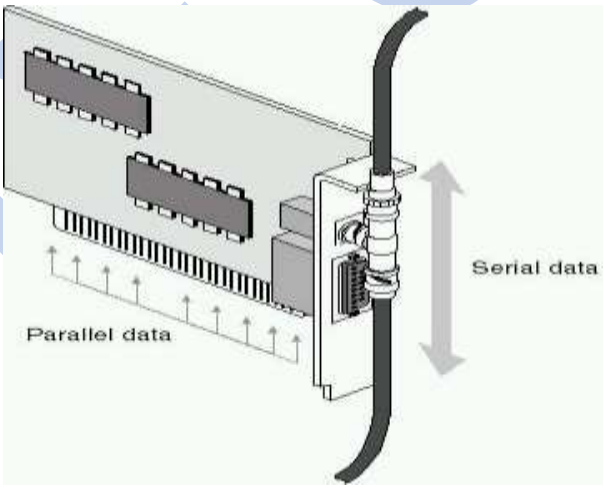
Routing moves data on a hop-by-hop basis, what is often called **'hot potato'** routing. If a set of routers ends up passing the data around in a circle, without reaching the destination, it's called a '**routing loop'**. Packets get tossed around the loop until they die of old age: their 'Time To Live' counter in the IP datagram is decremented as it passes through each router and eventually it reaches zero and is discarded.

**(e) Network Adapter Card**

A computer is connected to the network through a **network interface card**, (also called a "NIC", "nick", or network adapter).

The functions of the NIC include:

i. Prepare data from the computer for the network cable. Data moves through a computer along paths called *buses*. These are actually several data paths placed side by side. Because the paths are side by side (**parallel**), data can move along them in lateral groups instead of in a single (serial) data stream. When data travels on a network cable it is said to be traveling as a ***serial transmission*** because one bit follows another.




ii. Send the data to another computer.

iii. Controls data access to the cable by following specific rules.

iv. Receive incoming data from the cable and translate it into bytes that can be understood by the computer's central processing unit (CPU).

v. **Servers**

A sever is a computer system that provides **essential services** across a network, to private users inside a large organization or to public users in the internet. They typically are configured with additional processing, memory and storage capacity to handle the load of servicing clients.

**Servers offer networks the capability of centralizing the control of resources and can thus reduce administrative difficulties**. Servers perform several tasks. For example, servers that provide files to the users on the network are called **file servers**. Likewise, servers that host printing services for users are called **print servers**.

Servers can be **Dedicated Servers/single-purpose** are assigned to provide specific applications or services for the network, and nothing else. For instance, a file server or print server. **Non-dedicated Servers/multi-purpose servers** are assigned to provide one or more network services and local access. For example, a server can be both a file server and a print server at the same time.

**(g) Network Operating Systems (NOSs)**

PCs use a disk operating system that controls the file system and how the applications communicate with the hard disk. Networks use a network operating system (NOS) to control the communication with resources and the flow of data across the network. The NOS runs on the server. Some of the more popular network operating systems at this time include Unix, Novell's NetWare, and Microsoft's Windows NT Server (or Windows 2000).

**(h) Gateways:** A gateway is a device used to connect networks using **different protocols**. Broadly, a gateway is any connection point or node on a network that provides access to a larger one and therefore a router is a gateway. They translate one network protocol and data formats to another. They can translate from network-to-network, system-to-network and system-to-system. Another example of gateway is a bridge.

**(i) Workstations/Client Computers/Terminal**

Workstations are the computers that the users on a network do their work on, performing activities such as word processing, database design, graphic design, e-mail, and other office or personal tasks. Workstations are basically nothing more than an everyday computer, except for the fact that they are connected to a network that offers additional resources. Workstations can range from a diskless computer system to a desktop system. In network terms, workstations are also known as client computers.

**(k) Repeaters**

These are network devices used to regenerate or replicate a signal distorted by transmission loss. They allow a cabling system to extend beyond its maximum allowed length by amplifying the network voltages so they travel farther. Repeaters are like amplifiers and, as such, are inexpensive. Repeaters can only be used to regenerate signals between similar network segments.

**(l) Bridges**

A bridge is a hardware device for linking two networks that work with the **same protocol**. Unlike a repeater, which works at the physical level, a bridge works at both the physical and the logical levels, which means that it can filter frames so that it only lets past data whose destination address corresponds to a machine located on the other side of the bridge.

## How to configure a computer to work in a network.

1. First attach the RJ-45 connector to the Ethernet network port on your PC.
2. Go to **Start Button**, **Control Panel**, **Network and Internet** and then **Network and Sharing Center.**
3. Click on **Change Adapter Settings** on the left panel which will display several network connection icons e.g. Local Area Connection or Wireless Network Connection
4. Right click on the appropriate adapter, choose **Properties** to display **Connection Properties** window.
5. For most LANs, select the **Internet Protocol 4 (TCP/IPv4).** Highlight the protocol and choose **Properties**.
6. Select **Obtain IP address and Obtain DNS Server Address** both **Automatically** or enter the settings manually by clicking the radio button for **Use the Following IP Address** and enter the IP Address, Subnet Mask, and Default Gateway settings. You will also need to enter in your DNS server addresses as well.
7. Click on Ok button to apply the settings.

***NOTE:*** *Internet protocol 6 (TCP/IPv6) is also available in Windows Vista/7.*

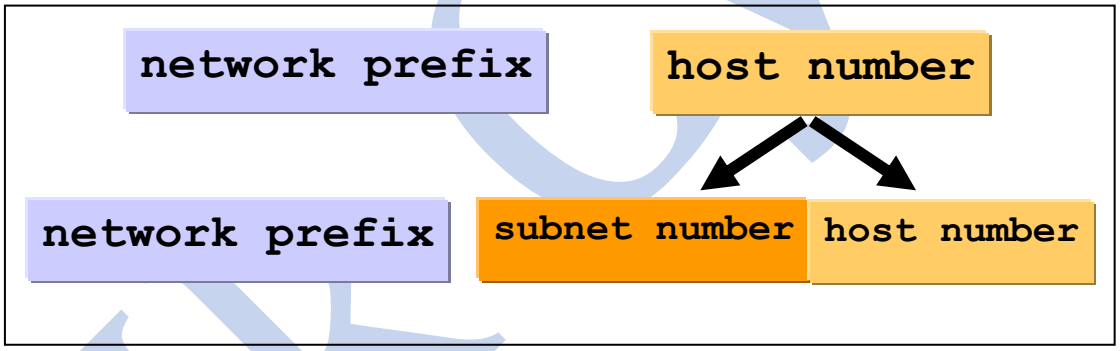
## Internet Protocol address (IP Addresses)

An **Internet Protocol address** (**IP address**) is a numerical label assigned to each device (e.g., computer, printer, router) participating in a computer network that uses the Internet Protocol for communication. IP addresses are binary numbers, but they are usually stored in text files and displayed in human-readable dotted decimal notations, such as 172.16.254.1

An IP address has two components, the **network address** and the **host address**. For example, consider the IP address 150.215.017.009. Assuming this is part of a Class B network, the first two numbers (150.215) represent the Class B network address, and the second two numbers (017.009) identify a particular host/device on this network.

**Subnetting**

Organizations have multiple networks which are independently managed and each is allocate a separate network address. Therefore, the host number portion of an IP address is split into a subnet number and a (smaller) host number. This result is a 3-layer hierarchy




## BASIC NETWORK COMMANDS

## 1. Ping:

Ping sends an *ECHO_REQUEST* packet to the specified host. If the host responds, you get an ICMP packet back which means the machine is up and connected to the network. You can "ping" an IP address to see if a machine is alive. If there is no response, you know something is wrong. E.g.

**C:\>ping xxx.xxx.xxx.xxx  e.g. ping 192.168.1.10**

Allows you to ping another computer (the x's represent the IP address of the computer you are attempting to ping). If this is not able to complete, this should relay back an unsuccessful message, which could be an indication of cable issues, network card issues, hub issue, etc

**C:\>ping localhost**

Pings the local host, this will allow you to see if the computer is able to send information out and receive the information back. Note that this does not send information over a network but may allow you to see if the card is being seen.

## 2. IPCONFIG

Ipconfig  displays the network settings currently assigned and given by a network such as IP address, subnet mask and default gateway for each adapter bound to TCP/IP. This command can be utilized to verify a network connection as well as to verify your network settings.

To get all local network information for your computer use the /all switch as shown below, followed by the results that would be seen when using this command.

**C:\>ipconfig /all**

## 3. Pathping/Tracert

Pathping is designed for environments in which one or more routers exist between hosts. It sends a series of packets to each router that's in the path to the destination host in an effort to determine whether the router is performing slowly or dropping packets.

E.g. **pathping 192.168.1.10**

Example Results might be:

| | | | | | |
|---|---|---|---|---|---|
| 1 | 3ms | 1ms | 1ms | 192.168.0.1 | (to the router) |
| 2 | 4ms | 1ms | 1ms | 192.168.1.10 | (to the proxy server) |

## NETWORK TOPOLOGIES

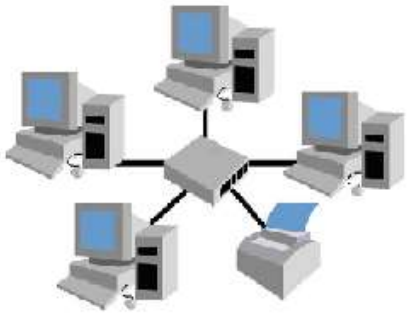
The devices on a network are referred to as *nodes*. Nodes can be connected using any of the various types of *media*, including twisted pair copper wire cable, optical fiber cable, coaxial cable and radio waves. The nodes in a network can be arranged according to several basic *topologies* (i.e., layouts).

A network topology can be physical or logical. Physical Topology is the actual layout of a network and its connections. Logical Topology is the way in which data accesses the medium and packets are transmitted/ travel.

## Physical Topologies

There are several physical network topologies:

### Star Topology



The most commonly used topology in LANs is the star topology. All the nodes in a star topology are connected to a central device like a hub, a switch or a router with a **point-to-point connection**. The hub acts as a **signal repeater.** The **hub or switch manages and controls** all functions of the network. Star topologies can be implemented at home, offices or even in a building.

**Advantages**

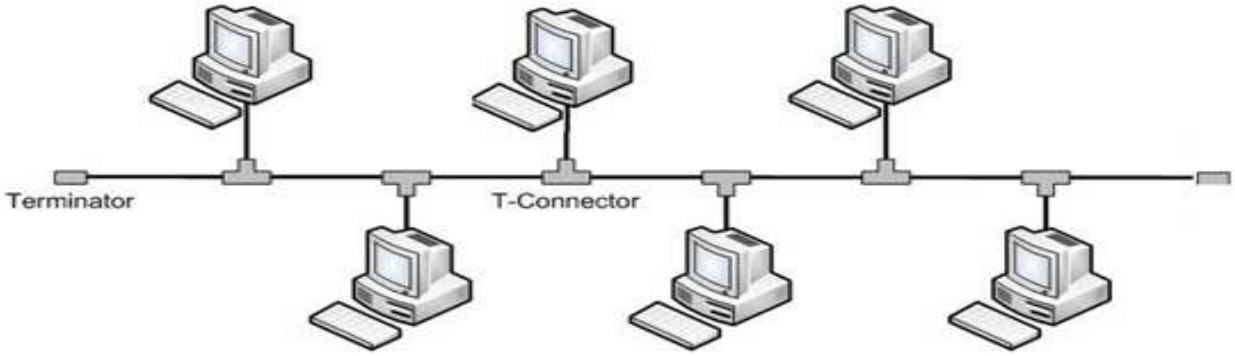
- The star topology is considered the easiest topology to design and implement.
- The failure of a node or cable in a star network will not take down the entire network as compared to the Bus topology.
- Signals do not get transmitted to all the workstations **if a switch** is used and therefore better performance.
- It is also easier to monitor due to the centralized management. Centralization allows inspection of the traffic through the network which makes detection of suspicious behaviour on the network easy.
- It is very easy to add additional nodes.

- It is easy to troubleshoot (detect faults) and to remove parts.
- Data is **safe** if a switch is used as the packets only move through three points; originator-central device-destination.

**Disadvantages**

- The network is highly dependent on the central connecting device. If the central connecting device such as a hub, a switch or a router fails due to any reason, then ultimately the whole network can come down or collapse.
- As compared to the bus topology, a star network requires more cables to complete a network.
- The performance as well as the number of nodes that can be added in such a topology depends on the capacity of the central device.

## Physical Bus Topology




Bus topology uses a **common backbone/trunk** to connect all the network devices in a network in a **linear layout**. A single cable functions as the shared communication medium for all the devices attached to this cable with an interface connector or **T-connector**. The device, which wants to communicate, sends the message/signal to all the devices attached to the shared cable but only the intended recipient actually accepts the message. A **terminator** is added at both ends of the central cable, to prevent bouncing of signals.

10Base-2 and 10BaseT are two popular types of the Ethernet cables used in the Bus topology.

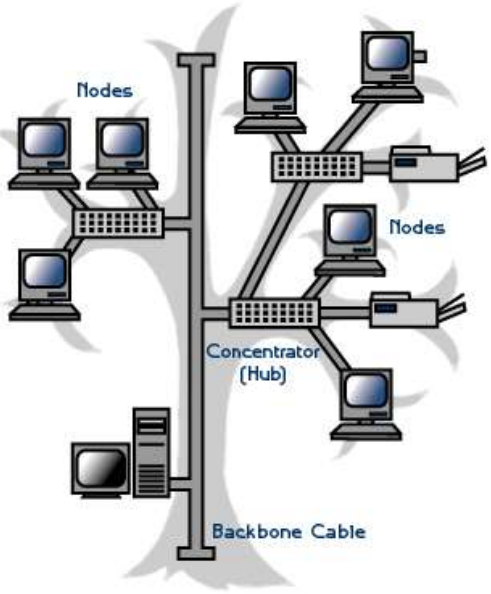
**Advantages**

- Bus topologies are **easy** to implement
- It is easy to extend the network
- **They are inexpensive to install** and do not require much cabling.

**Disadvantages**

- Bus networks work with **very limited devices**. **Performance issues** are likely to occur in the Bus topology **if more than 12-15 computers** are added in a Bus Network.
- Dependency on the central cable is risky. If the Backbone cable fails then the whole network becomes useless and communication fails among all the computers.
- It is difficult to detect faults at individual station and addition of new devices can be difficult
- Data can be transmitted only in one direction and is then destroyed when it reaches the end of the line else it will lead to repetition.
- Security is very low because all the computers receive the sent signal.
- Because the bus network is just a collection of cables, connectors, and terminators, there is no amplification of the signal as it travels on the wire. This means that the size of the network will be limited by the maximum distance the cable type can actually move the signal that holds the data.

## Physical Tree Topology




Tree topologies are comprised of **multiple star topologies on a bus** i.e. it is a bus/star hybrid topology. Only the hub devices can connect directly with the tree bus and each hub functions as **the root** of a tree for the network devices. The concentrator hub is a communications device that **multiplexes** (combines) several signals for transmission over a single medium.

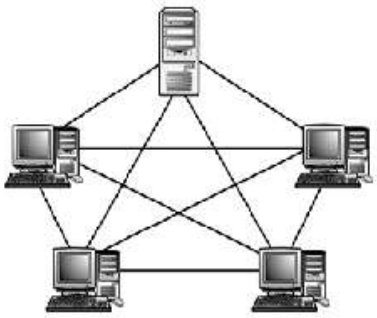
**Advantages**

- This bus/star hybrid combination **supports future expandability of the computer networks**, much better than a bus or star.
- The fact that the network is divided into segments makes the network **more manageable** hence **easier fault identification and isolation (maintenance)**.
- If one segment is damaged, other segments are not affected.
- The hybrid system overcomes the limitations of both the star and the bus topology. It doesn't have the limitation of hub connection points that a star has and also does not have the limitations of the broadcast traffic and overall dependency on a single bus of the bus topology.

**Disadvantages**

- Maintenance and management of the network may be an issue when the network spans a great area.
- Since it is a variation of the bus topology, if the backbone fails, the various star networks will not be able to communicate

## Mesh Topology



This is a type of network in which devices are connected with many **redundant interconnections** between network nodes such as computers, routers and switches. Every node not only sends its own signals but also relays data from other nodes i.e. must collaborate to propagate the data in the network. Mesh topologies work on the concept of routes. The message sent to the destination can take any possible, shortest, easiest route to reach its destination. Mesh networks are typically **wireless**.

Routers work in finding the routes for the messages and in reaching them to their destinations. The topology in which every device connects to every other device is called a **full Mesh topology** unlike in a **hybrid**/**partial mesh** in which some nodes are connected to all the others, but some of the nodes are connected only to those other nodes with which they exchange the most data.

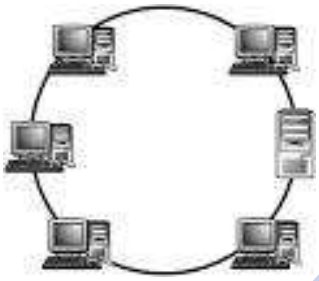
**Advantages**

- A mesh network is reliable and offers redundancy. If one node can no longer operate, all the rest can still communicate with each other, directly or through one or more intermediate nodes.
- The network can withstand high traffic and data can be transmitted from different devices **simultaneously**.
- Expansion and modification can be done without disrupting existing nodes.
- Point-to-point connections make identification and isolation of faults easy.
- Messages travel through a dedicated line, directly to the intended recipient and therefore privacy and security are thus enhanced.

**Disadvantages**

- It is expensive to implement due to the amount of cabling and the number of hardware ports it will require in order to ensure the redundancy. It is therefore mostly used in wireless networks.
- Setup and maintenance is very difficult.

## Physical Ring Topology



In a ring topology, all the nodes are connected to each other in such a way that they make a closed loop/ring. Each workstation is connected to two other components on either side and it communicates with these two adjacent neighbours. Data travels around the network in one direction and sending and receiving of data takes place by the help of a **Token**. A token contains a piece of information which is sent along with the data by the source computer. Once a node receives a packet, it sends a confirmation to the source machine. Each node gets to send data when it receives an empty token.

NB: Token Ring Networks

### Advantages

- The topology is very organized and eliminates chances of collision since only one token is usually in circulation.
- Additional nodes on the network do not affect the performance of the network.
- Each computer has equal access to network resources.
- It is easy to add devices to the network due to the point-to-point line configuration.
- It is easy to identify and isolate faults due to the point-to-point line configuration.

**Disadvantages**

- Each packet of data must pass through all the computers between source and destination. It is therefore slower than a star topology.
- If one workstation goes down, the entire network gets affected.

- Data security might be compromised.

## Logical Topologies

There are three logical topologies (bus, ring, and switching) which are usually implemented as a physical star.

### LOGICAL BUS TOPOLOGY

Modern Ethernet networks are Star Topologies (physically) but logically they are bus topologies. The Hub is at the centre, and defines a Star Topology.

In any network, computers communicate by sending information across the media as a series of signals. In a logical bus topology, the signals travel along the length of the cable in all directions until they weaken enough so as not to be detectable or until they encounter a device that absorbs them. This traveling across the medium is called **signal propagation**

When a computer has data to send, it addresses that data, breaks it into manageable chunks, and sends it across the network as electronic signals

- All computers on a logical bus receive them
- Only the destination computer accepts the data
- All users must share the available amount of transmission time, implying network performance is reduced
- Collisions are bound to occur since all nodes are sharing same bus.

### LOGICAL RING TOPOLOGY

Data in a logical ring topology travels from one computer to the next computer until the data reaches its destination. Token passing is one method for sending data around a ring. A token is a small packet which passes around the ring to each computer in turn.

Logical ring can be implemented on a physical star. Modern logical ring topologies use **smart hubs** that **recognize a computer‘s failure** and **remove the computer** from the ring automatically. One advantage of the ring topology lies in its capability to share network resources fairly. The topology eliminates the chances of collision.

### SWITCHING

**A switch** takes a signal coming from a device connected and builds a circuit on the fly to forward the signal to the intended destination computer.

Switching is superior to other logical topologies because unlike bus and ring, **multiple computers can communicate simultaneously without affecting each other**. Switching is the dominant logical topology in LAN design.

NB: Advantages and disadvantages of a certain topology depend on the following factors:

Ease of management, Performance, Troubleshooting (maintenance), ease of design and implementation, safety of data, cost, expandability and robustness.

## INTERNET AND WORLD WIDE WEB

Specific Objectives:

By the end of this topic, the trainee should be able to:

a) Define the Internet
b) Explain the applications of the Internet
c) Explain the challenges in the use of the Internet in the business environment
d) Explain the need for Internet security
e) Open the browser
f) Surf the net
g) Create e-mail accounts
h) Use e-mail
i) Use search engines
j) Print documents

**Task 1 Defining the Internet and applications**

**Definition of the Internet**

The **Internet** is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billions of users worldwide. It is a *network of networks* that consists of millions of private and public, academic, business, and government networks of local to global scope that are linked by a broad array of electronic and optical networking technologies. The Internet carries a vast array of information resources and services, most notably the inter-linked hypertext documents of the World Wide Web (WWW) and the infrastructure to support electronic mail.

**History of the Internet**

In the 1960s, one of MIT's projects Mac was funded by ARPA (Advanced Research Projects Agency) of the department of defense. During one of its conferences, ARPA rolled out the blueprints for networking the main computers of about a dozen ARPA-funded universities institutions. They were to be connected with communication lines at then-stunning 56 Kbps. Shortly after the conference, ARPA proceeded to implement the *ARPAnet*, the predecessor of today's *Internet*.

Things worked out differently from what was originally planned. Rather than the primary benefit of researchers sharing each other's computer, it rapidly became clear that enabling the researchers to communicate among themselves via electronic mail (e-mail) was the key benefit of ARPAnet. One of the primary goals for ARPAnet was to allow multiple users to send and receive information simultaneously over the same communication paths. The network operated with a technique called packet switching, in which digital data was sent in small packages called *packets*. The packets contained data addresses, error control and sequencing information. The address information allowed packets to be routed to destinations. The sequencing information helped reassemble the packets into their original order for presentation to the recipient since they could arrive out of order.

The protocols for communicating over the ARPAnet became known as TCP (Transmission Control Protocol). TCP ensured that messages were properly routed from sender to receiver and that those messages arrived intact. As the internet evolved, organizations worldwide were implementing their own networks for both intra-organization and inter-organization communications. A wide variety of networking hardware and software appeared. One challenge was to get these networks to communicate. ARPA accomplished this with the development of *IP* – the *Internetworking Protocol,* truly creating a network of networks, the current architecture of the Internet. The combined set of protocols is now referred to as *TCP/IP*.

The history of the TCP/IP protocol suite can be traced back to one of the first WANs consisting of computers from different manufacturers running different operating systems. Before ARPAnet, most computer networks were homogeneous, consisting of computers from the same hardware manufacturer running the same operating system.

The ARPAnet's popularity became apparent, and in 1975, it was converted from an experimental research network into a fully operational network. Research into network protocols continued and the Internet Protocol Suite resulted. The TCP/IP protocols were adopted as Military Standards in 1983, and all computers connected to the ARPAnet were required to adopt the new protocol. The ARPAnet was then split into two networks: the MILNET, used for military communications, and the new, much smaller ARPAnet, used for further research. MILnet and ARPAnet together became known as the *Internet*. Initially, Internet use was limited to the universities, research institutions and the military, but eventually with time Internet has incorporated commercial applications.

The term *internet* (notice the lower case *i)* is now used to refer to any collection of physically separate networks that share the same communication protocols (not necessarily TCP/IP) to appear as a single logical network. The term *Internet* (notice the upper case *I)* is used to refer to the worldwide collection of interconnected computer networks that run the TCP/IP protocols.

Internetworking evolved as a solution to three key problems which are as follows:

i) **Isolated LANs**
   It made electronic communication between different offices or departments impossible.
ii) **Duplication of Resources**
   The same hardware and software had to be supplied to each office or department, as did separate support staff.
iii) **Lack of Network Management**
   No centralized method of managing and troubleshooting networks existed.

## Web related terminologies:

## Web browsers

Web browsers are software applications that are used to retrieve web pages from the Internet onto a device. They let you surf (or browse) through information on the Web. Information on the Web is structured into pages. Each page has a specific address that is used to locate and access information on that page.
The three browsers that particularly dominate the Internet market are:
- Microsoft's Internet Explorer
- Mozilla Firefox
- Netscape's Navigator
- Torch

## Modem (Modulator / Demodulator)

On the Internet, computers exchange information via telephone lines. A modem is a device that enables you to connect to the Internet and access information through telephone wires. As a transmitting modem, it translates computer information into a form that can transmit over telephone lines (this is the process of modulation).
As a receiving modem, it translates the information in a form that your computer can understand (this is the process of demodulation) i.e. from analogue to digital.
A fast modem is essential. It will reduce the amount of time spent waiting for web pages, files, or messages from the Internet. Modem speeds are quoted in 'bps' (bits per second).
Typical speeds are 9600 bps, 4.4 Kbps (Kilobits per second), 28.8
Kbps, 56 Kbps, etc.

## Internet Service Provider (ISP)

This is a commercial organization that **provides Internet connections**, along with a set of support services for a fee.
Most people and organizations get a connection to the Internet over a telephone line through an ISP, though some larger businesses and institutions (such as universities) have their own internet connections.

An ISP will usually have a number of host computers. These hosts will typically **provide storage space for electronic mail messages for their users**, users' own web sites and a set of related facilities such as **advice**, **support software** and **appropriate security**.
Examples of local ISPs include Africa Online, Kenya Web, ISP Kenya, Swift Kenya and Inter-Connect.
When you open an account with an ISP you will be provided with a user name and a password:

Username - Every time you get connected, you require a name to identify yourself on the Internet.
Password - This is needed for security purposes. This ensures that your Internet account is secure.
*NB: ISPs charge for the services rendered.*

## The World Wide Web

The World Wide Web is also known as the Web, WWW or W3. The Web is a part of the Internet.

The WWW **is a collection of hyperlinked web pages published on the Internet**. This huge collection of documents is stored on computers, called *hosts*, around the world. The documents may contain text, pictures, sounds, small programs or forms to be completed by a user.

## Web Page

**Web pages are documents published on the Web** by organizations and individuals interested in making themselves available online. Web pages can include text, pictures, sound and video.
**Each web page has an address on the Internet.** This address is called a **Uniform Resource Locator** (**URL**). Web pages are created using Hypertext Markup Language.

## Web Site

A **collection of web pages belonging to an organization or individual** is called a website. These organizations or individuals maintain the website.

## Hyperlinks

These are links that connect one page to another which creates the World Wide Web. These links connect:
1: One web page to another part of the same web page. This is useful if it is a really large page.
2: One web page to another website somewhere on the Web.
3: A page to a file, such as a sound clip, video, a spreadsheet or a Word document etc.

These links to other pages can be links to objects stored anywhere on the Internet. Hypertext links are indicated by underlined text highlighted in blue (usually).
**Hyperlinks are also represented by buttons, graphics or pictures**.

## Web Hosting

A World Wide Web server is a computer with programs that answer requests for documents from clients (browsers) over the Internet. Files containing web sites are placed on these servers also known as host computers. A ***host computer*** is any computer connected to the Internet and has stored information that has been made available to the Web.

## Home Page

The Home page is the web page loaded when Internet Explorer is first started i.e. when you access the Web. You can set any web page as your home page.

The home page is also the first page of a company or an individual's website on the Web.

*Note: Do not confuse your home page with the home page of the websites you visit. Your home page is set through Internet Explorer.*

*The home page of a website is the introductory page for the site.*

*If you click a hyperlink such as Home on a web page, you will jump to the website's home page, not yours.*

*To access your home page, click the Home button on the Explorer toolbar.*

## Web Address (Uniform Resource Locator (URL))

Each web page has a unique address or location, called the Uniform Resource Locator (URL).

You can instantly display any Web page if you know its URL. For example, http://www.compaq.com

You can include *wildcards* in a URL in cases when you may not know the full path. For example:

*http://www.mars.superlink.net/~zorro/humor.com*

The wild card (~) is used to represent character(s). In the above example, sites that have Azorro, Thezorro etc instead of ~Zorro will be displayed.

A wrongly entered character can result in an invalid URL, e.g. a comma instead of a full stop or a dash instead of an underscore.

## Search Engines/Search Services.

A search engine is software that helps you locate information in the Web. There are several search engines such as Google search engine, Yahoo, Infoseek, Lycos, Web Crawler, and Excite that offer different kinds of searching capabilities.

## Spam

Unwanted internet mail and ads.

## Applications of the Internet

Once you're connected to the Internet, there are limitless possibilities. You can send messages to users in other countries, join a chat group, or try out new games. Some of the services offered on the Internet include the following:

1. ***Electronic Mail (e-mail)***

   Email is a system for transmitting messages between computers. Exchanging electronic mail is the most popular feature on the Internet. With Internet email you can send messages to people all over the world including friends, customers and even people you meet on the Internet. Electronic mail is faster than ordinary mail, easy to manage, inexpensive and saves paper.

2. ***Information***

   The Internet gives you information on virtually any subject. This is because of the World Wide Web. The World Wide Web (www) is a global system of linked web pages containing information - text, pictures, sound and video.

   You can review newspapers, magazines, academic papers and much more. Governments, colleges, universities, companies and individuals all offer free information on the Internet. For example, you can inquire about universities in Britain or America.

3. ***Programs***

   Thousands of programs are available on the Internet. These programs include word processors, spreadsheets, electronic cards and much more. You can look for the latest software over the Internet. For example, you can get the latest Anti-Virus software available and in addition, retrieve a free trial issue.

4. ***Entertainment***

   Hundreds of simple games are available on the Internet, including racing cars, chess, poker, football and much more. The Internet also lets you review current movies and hear television theme songs.

5. ***Discussion Groups (Chat groups/Rooms)***

You can join discussion groups on the Internet and meet people around the world with similar interests. IRC (Internet Relay Chat) is a chatting system on the Internet that lets you chat privately or in groups. You can ask questions, discuss problems and read interesting stories. There are many discussion groups on various topics.

6. ***Online Shopping/trading and advertising(e-commerce)***

   You can order goods and services on the Internet without leaving your desk. For example, you can view a catalogue of a certain clothes shop over the Internet and fill in an online order form.

7. ***Newsgroups***

   These are discussions on a range of topics from recreational activities to scientific research. Any Internet surfer can access some of these newsgroups, while others will need subscription. You can read any articles or write articles and post them.

8. ***Social Networking***

   By far the most popular and fastest growing communication method made possible by broadband Internet service, social networking started out as a way for people to find old friends, stay in touch with current ones, and meet new ones. It has now grown into a prolific communication tool for both personal and business use. You can organize groups, notify people of events, send mass email messages, chat, and so much more. Facebook, Twitter, and MySpace are currently the most popular social networking sites, and have attracted billions of users. Many businesses have used social networking for advertising and marketing purposes and seen great results.

9. ***As a research tool***

   To learn about new developments or products, competitors, market news and customer opinions.

**The challenges in the use of the Internet in a business environment**

**Explaining the need for Internet security**

With the number of businesses that are connecting to the Internet and using cable modems, DSL lines, and T1 circuits, the need to secure their connections is not only necessary but also simply due diligence on the part of the company. Businesses rely on their Internet connection to send credit card payments through, to run their VoIP phones, and even to host their webpage. If Internet connectivity is disrupted then business can not operate as usual.

In order to insure that the connection to the Internet is secure there are some basic methods that can be utilized that are fairly cheap and will more than pay for themselves with the increased security and uptime of the Internet connection. A business does not need to make sure their network is as tight as an Army base; they just need to make sure they are more secure than others so that attackers will target the easier sites and leave theirs alone.

The very first thing that needs to be put in place at each and every Internet connection is a firewall. All businesses should have a hardware firewall that protects and separates their business from the Internet. A cable modem with built-in firewall may be adequate for a household, but a business should look at a commercially available firewall such as a Juniper firewall 5 series, a SonicWall firewall, or even a Cisco SOHO. These are all inexpensive and are easy to manage and configure. A firewall is the first step of protection that keeps out those who do not need to have access to the internal business network. Essentially installing a firewall is similar to installing locks on a house. Only those with the proper keys can access the house just as only those who have been specifically granted access can access the network behind the firewall.

Once a firewall has been installed, configured, and is working properly a business is going to want to look at the computers themselves. There are two things that need to be done on all the machines that will insure that the machines stay up and operational longer than those that are left unprotected. The two things are necessary are: patching the machines for the latest updates for both the operating system (OS) and the applications, and then installing antivirus software.

The patching of the systems will insure that the vulnerabilities that virus/worm writers are using to exploit and take over machines will not be effective against a patched machine. By patching the machine the entry door is closed and the worm will not be able to gain access. Application patches update their tools and software being used on the machine. With the latest patches this too will make it more difficult for attackers to exploit machines and gain entry to them.

Antivirus software is an absolute necessity on machines. System administrators and users can become annoyed with it as it is a resource hog but that is because the software is tasked with protecting the system and they continually scan the system for infections. When used in “real-time” mode each file is scanned before downloading, uploading, or being saved to the disk. This is important when reading emails, sending emails, or even surfing on the Internet.

There are many other steps that can be taken to give a business a stricter security posture. However, by taking the above steps a business can rest assured that they have taken the due diligence and installed the most basic security measures in their business that will make it difficult for an attacker to gain unauthorized access to a business's network.

**Opening the browser and surfing the internet**

There are several ways to start Internet Explorer.

1. To start Internet Explorer from the Windows desktop, double-click the Internet Explorer icon.

**OR**

1. On the Windows taskbar, click **Start**.
2. Select the **Programs** menu item.
3. From the submenu displayed, select **Internet Explorer** from the Internet Explorer group.

   You may be required to make a connection through your ISP in order to log on to the Internet.
4. Click in the **User name:** box and enter your user name.
5. Type in your password in the **Password** box.

   The password appears in asterisk format (*) for added privacy and security.
6. Click **Connect** to access the Internet.

   *Note: The Dial-up Connection dialog box will not be displayed if you are connected to the ISP via a proxy server. A proxy server allows several users to access the Internet account using a single account.*

Upon successful logging on, the Internet Explorer displays the 'home page' and a Connection Indicator appears on the Taskbar to indicate that you are online.

***NB:*** *All the time you are connected, you incur a local telephone charge to the local phone company and access time to the ISP.*

Connection indicator

*You can find out at what speed you are receiving data, how much time you have spent online etc., by double-clicking the Connection Indicator.*

***Other browsers have a similar procedure for opening.***

**CUSTOMIZING THE WEB BROWSER.**

**Purpose.**

Moving from site to site can be slow if the ISP or Internet lines are busy, if the host server (the server storing the site you are trying to access) is busy or if you are using a slow modem.

The volume of traffic is also growing on the Internet and so web designers are constantly looking for ways in which they can make their pages load faster.

If a site contains graphics (or other multimedia content like video, audio etc) you can prevent the graphics from downloading so as to speed up browsing.

**Step-by-Step.**

1. From the **View** menu, select **Internet Options…**.
2. Click the **Advanced** tab.
3. Scroll down to the **Multimedia** section.
4. Deselect the options or content that you want turned off e.g Show Pictures, Play Animations or Play Videos.
5. Click **OK**.

*NB: If the **Show pictures** check box is cleared, you can still view an individual picture on a web page by right-clicking its icon and then clicking **Show Picture**.*



## ELECTRONIC MAIL (E-MAIL)

One of the common services provided by the Internet is electronic mail, also known as e-mail. This is a worldwide system for sending and receiving electronic messages from one computer to another.

E-mail is a much faster, economical and convenient way of sending messages to family, friends and colleagues than the old fashioned mail called “snail mail”. With “snail mail” a message or letter is sent to the recipient through the post office and takes days or weeks before reaching the destination. An e-mail message can travel around the world in minutes.

For one to be able to communicate using email, the following components are needed:

1) A computer where you will send or receive the e-mail messages.
2) Your e-mail address and that of the receiver.
3) An ISP company who will deliver your message to the receiver.

4) An e-mail program that lets you send, receive and manage your e-mail messages, e.g. Microsoft Outlook, Outlook Express, Lotus Notes, Eudora.

Once you send a letter, it travels from your computer, through a modem, which connects your computer to the Internet via the telephone network. The mail travels through various computers, until it reaches the final destination.

**Components of an e-mail address:**

An e-mail address consists of two parts separated by the @ symbol.

If your e-mail address is drg@tropicalheat.com:

i) The first part refers to the **person's identity** or **log-in name**, e.g.

"drg"

ii) The second part following the "@" symbol is usually made up of two to three sub-parts to further identify the individual, organization or ISP. In this case:

• 'Tropical heat' identifies the business.

• '. com' is the extension and this **identifies the type of the organization**.

The table below shows some extensions and what they represent: -

| **Extension** | **Represents** |
|---|---|
| **.org** | non-profit making organization |
| **.edu** | an educational institution/organization |
| .ac | an academic institution |
| **.com** | a commercial organization |
| **.net** | network service provider |
| **.mil** | military |
| **.gov** | government |

Sometimes the name of the country is included in the e-mail address

e.g. skynews@sky.co.uk or nation@africaonline.co.ke. Here '.co.uk' refers to a company in the United Kingdom whilst '.co.ke' refers to one in Kenya.

Examples of E-mail Addresses:

Smith@compuserve.com

Iat@africaonline.co.ke

Were@ku.ac.ke

Hr-manager@kplc.org

Bridge@arcc.or.ke

Tim@yahoo.com (free e-mail address)

Douglas@hotmail.com (free e-mail address)

## Advantages of emails over Traditional Paper-Based Mail

- Emails are fast. They are **delivered** at once around the world. No other form of written communication is as fast as an email.
- When you **reply** to an email you can **attach** the original message so that when you answer the **recipient** knows what you are talking about. This is important if you get hundreds of emails a day.
- It is possible to send **automated** emails with a certain text. In such a way it is possible to tell the sender that you are on vacation. These emails are called **auto responders**.
- Emails are easy to use. You can organize your daily **correspondence**, send and receive electronic messages and save them on computers.
- Emails do not use paper. They are **environment** friendly and save a lot of trees from being cut down.
- Emails can also have pictures in them. You can send birthday cards or newsletters as emails.
- Products can be advertised with emails. Companies can **reach** a lot of people and inform them in a short time.
- It is possible to tell whether an email has been delivered or not.

## Disadvantages of emails

- Emails may carry viruses. These are malicious programs that harm your computer system. They can read out your email address book and send themselves to a number of people around the world.
- Many people send unwanted emails to others. These are called spam mails. It takes a lot of time to **filter out** the unwanted emails from those that are really important.
- Emails cannot really be used for official business documents. They may be lost and you cannot **sign** them.

## Reading e-mail messages.

Once an e-mail message that has been sent to you arrives at your computer, to read the contents you must open it using the program you have installed for sending e-mail, e.g. Microsoft Outlook.

**Step-by-Step.**

1. Launch the e-mail program Microsoft Outlook from the **Start** menu or a shortcut on the desktop.
2. Enter the password if prompted and click OK.
   Alternatively, you may need to select your profile from the **Choose Profile** dialog box that appears.
3. In this case, select your profile by clicking the down arrow key of the **Profile Name** dialog box and click **OK.**
   ***NB:*** *A User Profile is a group of settings that define how Outlook is set up for a particular user. It also defines through the information services how a user can send, store, and receive messages.*
4. The **Inbox** is where all incoming messages are stored when you connect to Outlook. Displayed are the e-mail messages that you have received.
   Unopened mail
   Opened mail
   A list of e-mail messages
5. To open and read e-mail messages in the Inbox, choose the message that you want to read. Then, double click on it to open it.

   Message
   The lower grid of your screen will have the full message. As you read the items in your Inbox, you can reply to, forward, or file them in other folders that you create.
   When you have finished reading a message, you can close the window by selecting the **File** menu, then choosing **Close**. This will take you back to the Outlook window.
   When you do not need to use any other e-mail services, you can exit the Outlook program by selecting the **File** menu, then choosing **Close.**
   If there are any e-mail messages in the Outbox that have not been sent, a message will appear prompting you to send the e-mail(s) at that particular time or you can choose to send it later.

**Reply to e-mail messages.**

If you have read a message, you may want to send a reply to the original sender.

If the original message that you are replying to was also copied to a number of other people, you may want to send a reply to all of them.

**Step-by-Step.**

When replying to a mail message, you can choose to reply with or without the original message insertion. The original message, sometimes referred to as the history, appears in the body of the message. This is just for reference purposes and can be removed by selecting the text and pressing the Delete key or setting options in the

Options dialog box.

**Reply and include the original message**

1. If the message you want to reply is not open, select it and open it.
2. Click the **Reply** button in the **Mail** window. The **Reply** message window appears. This window contains the message you are replying to at the bottom.

The Reply button

History/Original

Message part

3. Type the reply where the insertion point is.
4. When you have finished typing and editing the reply, click the **Send** button if you are on-line to send the message. Send button

NB: If you click the Send button while you are offline, the mail will be placed in the **Outbox** folder and will automatically be sent the moment you go online.

Reply without including the original message

1. From the Tools menu, click Options.
2. Click the Preferences tab, and then click Email Options.3. In the On replies and forwards section, click the down arrow key under When replying to a message box.
4. Select Do not include original message.
5. Click **OK**.
6. Open the mail message you want to reply to.

Information and Communication Page 45

7. Click the **Reply** button in the **Mail** window. The **Reply** message window appears. This window does not contain the message you are replying to at the bottom.
8. Type the reply where the insertion point is.

9. When you have finished typing and editing the reply, click the **Send** button.

**Notes:**

*Working Off-line* Connection to the Internet usually means that you are using telephone lines, and therefore incurring telephone charges and usage on your ISP account. Once you have launched the Mail program, it is not necessary for you to be connected directly so that you can read and write your e-mail messages. You may choose to work offline to save on costs and when you are ready to send your messages you can connect and send them all at once.

1. On the **Task** bar, click on the **Status** button.
2. Choose **Disconnect**.

Connection Indicator

3. The Connection Indicator disappears from the Taskbar showing that you are now working off-line. Some services like Internet, Usenet, newsroom, or shopping will not be available when you are off-line.

To use these services, you need to re-establish the connection.

***Sending an e-mail message.***

1. To communicate with another user who has an e-mail address. This is cheaper than sending fax or using the telephone especially for long distance calls.
2. It is also faster to send e-mail than to post a letter.

For example, to send a letter around the world using e-mail is just a matter of minutes as compared to the weeks ordinary mail takes.

For this reason, most Internet users refer to ordinary mail as 'snail mail'.

**Step-by-Step.**

1. From the Outlook window, click the **New Mail Message** button.

   The New Mail Message button

   The message composition window is displayed:

   Subject box

   Message area

2. In the **To…** box, type the e-mail address (or select one from the address book by clicking on the **To…** button) of the recipient of your e-mail.
3. If you want copies of the message to be sent to other people, type in their e-mail addresses in the **Cc…** box. Be sure to separate each address with a semi-colon.

You can also send a Blind Carbon Copy (Bcc). Here, the recipients entered receive the message but their names are hidden from other recipients of the message. To add a Bcc field, click the **View** menu and select **Bcc field**.

**Cc**: stands for "carbon copy". Anyone listed in the Cc: field of a message will receive a copy of that message when you send it. All other recipients of that message will be able to see that the person you designated as a Cc: recipient has received a copy of the message. The Cc: field is useful in instances when you wish to share a message with someone but are not requesting that they reply or take any direct action in response.

**Bcc:** stands for "blind carbon copy". This is similar to the Cc: feature, except that Bcc: recipients are invisible to all of the other recipients of the message (including other Bcc: recipients). For example, if you send a message To: johndoe@yahoo.com and Bcc: janedoe@yahoo.com, then johndoe will see himself as the message's only recipient, while janedoe will see that you have also sent the message to johndoe. The Bcc: field is useful in instances when you don't wish to share your recipients' email addresses with everyone who receives your message.

To send a message, you must always specify at least one recipient in the To: field. If you don't, an error message will appear when you attempt to send the message.

4. Type the subject or topic in the **Subject** box.

5. In the lower grid of the message composition window, type in the message that you want to send as seen in the illustration above.

You can format the email message using the formatting tools like

Bold, Font size, Underline etc.

When you have finished typing the message, editing, and spellchecked it, click the **Send** button.

*NB: A message that returns to the sender because it cannot reach its destination is referred to as a bounced message.*

**To display the Formatting toolbar**

If the formatting toolbar is not visible, you will need to display it.

1. Click the **View** menu from the menu bar, highlight **Toolbars** then click the **Formatting** option.

Formatting toolbar

• You can add Smiley/Smilies to your messages. These are special symbols used to express emotions in messages. These characters resemble human faces if you turn them sideways as shown in the table below:

**Smiley Represents**

**: `-(**Cry

**:-(** Frown

**:-**I Indifferent

**:-o** Surprise

**:-)** Smile

**Spell-Checking Mail Messages.**

Before sending a mail message you can spell check it to correct any spelling mistakes in the mail.

1. From the **Tools** menu click **Spelling**.

2. The **Spelling** dialog box appears as shown below. The misspell words are highlighted and shown in this dialog box. Choose the correct word

by selecting it and clicking the **Change** button.

3. If the word or phrase is correct but is not in the dictionary, click

**Ignore**.

4. Once the spell check is complete, click **OK.**

**Set up view options.**

To make the Microsoft Outlook screen comfortable and convenient to your individual preferences. For example, if you usually receive a lot of mail you may prefer to see the mail grouped by sender's name, or you can preview the contents of an e-mail message before opening it.

**Step-by-Step.**

1. Load Microsoft Outlook.

2. From the **View** menu highlight **Current View**.

The submenu displays the various view options that can be selected:

3. As an example, highlight the **By Sender** option and click.

**Grouped messages**

4. The mail messages are then grouped by the sender. To display the contents of a group click the plus button of the group.

**To remove folder listing.**

The folder list is displayed by default. However if you do not want to view the folder list you can remove it, by selecting **Folder List** from the **View** menu.

To redisplay the folder list, repeat the same step outlined above.

**Using the Address Book.**

The Address Book is a directory of personal details, including email addresses, for the people to whom you send messages (called contacts).

You can store such addresses in the Address Book so as to address mail more easily i.e. each time you want to send email messages you simply select the names from the list of addresses.

This will save the time used to enter lists of email addresses as well as help maintain their accuracy.

For example, the email address 'njiiri.mworia@mit.edu.uk' can be difficult to remember. Besides, one can easily make a typing error when typing it in. If you store this address accurately in the Address Book then you will not worry about remembering it or typing it wrongly.

**Step-by-Step.**

***To Add a Contact to the Address Book***

1. To open the Address Book, click on the **Address Book** button.

   Address Book button

   There may be several types of address books in the Address Book dialog box including the Personal Address Book and other Address Books created by the administrator.

2. Select the type of address book that you want to use in the **Show names from the: box**.

   The **Personal Address Book** is the address book used to store personal distribution lists you frequently address messages to, such as a list of your friends.

The **Global Address List** (or other listed address books) is the address book that contains all e-mail addresses for users, groups, and distribution lists in your organization that you can address messages to. It is the network administrator who creates and maintains this address book.

3. Click on the **New Entry** button.

New Entry button

4. Specify the entry type of the contact i.e. whether it is a Private

Address Book Mail Recipient or an entry for a Distribution List.

5. Type in the names for the contact as well as the full email address.

6. Complete the dialog box with the rest of the contact details using

the other tabs e.g. Work or Home information.

7. Click on **OK**.

The contact or address is added to the Address Book.

**To Edit a Contact in the Address Book**

You may want to edit a contact's details. You can do this from the Address Book.

1. Open the Address Book.
2. Select the contact that you want to edit.
3. From the **File** menu, select **Properties**.
4. Make the necessary changes to the information and click **OK**.

**To Create a Contact from a Mail Message**

When you receive a mail message, you can add the sender's details (name and email address) to your Address Book in these steps.

1. Open the e-mail message that contains the name you want to add to your contact list.
2. In the **From** field, right-click the name you want to make into a contact, and then click **Add to Contacts** on the shortcut menu.

Or from the shortcut menu, select **Add sender to Address Book**.

**To Delete a Contact from the Address Book**

1. Open the Address Book and select the address that you want to remove.
2. Click on the **Delete** button.

Delete button

3. Click **Yes** to confirm that you want to delete the name or entry.

**To Create a Distribution List**

If you send mail to the same group of people frequently, you can create a group address list. When you address a message to that group, each individual in the group receives it. Group address lists are known as distribution lists.

You must have a Personal Address Book set up in order to be able to create a personal distribution list.

1. On the **File** menu, point to **New**, and then click **Distribution List**.
2. In the **Name** box, type a name.

   The distribution list is saved in your **Contacts** folder by the name you give it.
3. Click **Select Members**.

   In the Show names from the list, click the address book that contains the e-mail addresses you want in your distribution list.
4. In the **Type name or select from list** box, type a name you want to include. In the list below, select the name, and then click **Add**.

   To add members who are not on the address books, click on **Add New** and type in the details and click **OK**.

   The list of members in the distribution list is displayed.
5. Click on **Save and Close** to exit.

   There is another method of creating a distribution list. In this method, you use the **New Entry** button.
6. Then select the entry type box, click **Private Address Book Distribution List** and then click **OK**.
7. In the Distribution List Name box, type a name for the group and click **OK**.

   The limitation with this method is that you have to involve the administrator when adding names to the group.
8. Once this is done, the contact is copied to the Private Address Book Distribution List box.

   Repeat this process until you have all the names you want in your group in the Personal Distribution List.
9. Click **OK**.

   The group or distribution list is now listed in the Address Book.

A group icon showing a distribution list

**To Send a Message using the Address Book or Distribution List**

1. In Outlook, select the **New Mail Message** option from the **File** menu.
2. Click on the **To…** button to open the Address Book.
3. Select the contact names from the list or select the distribution list and click on **To ->**.

   *NB: To see the full email addresses select the name of the person from the list and click on **Properties** button.*
4. Click **OK** to return back to the Message Composition dialog box.
5. Type out the rest of the message and click on **Send**.

**Attaching files to email messages.**

You can attach any type of file such as a document, spreadsheet, graphic image or presentation to your email messages.

When you attach a file, you're actually attaching a copy of the file, so the original is not affected.

**Step-by-Step.**

1. Click the **New Message** button.
2. In the Message Composition dialog box enter the email address and type in the message to be sent. Then click where you want the file attachment to appear.
3. Click on the **Insert File** button.

   Insert File button
4. The Insert File dialog box is displayed. Locate the file's folder and then select the file.

   You can select multiple files by pressing the CTRL key while clicking once on the file names.

   However, when attaching several files take care not to attach too many large files or they will take a long time to send and receive.
5. Click **OK**.

   The attached file is displayed as an icon in the body of the message.

   The icon indicates the file type and name. For example, shown below is an icon for an Excel workbook file attachment:
6. Click on **Send**.

**To Open or View an Attachment**

Documents that contain file attachments display a paper clip image in the
view or folder next to the document title.

Once the document is open, Outlook displays an icon representing the attachment.

1. In the Inbox, select the message that contains the attachment and open it.
2. Double-click the icon that represents the attachment.

You must have the application in which the attachment was composed in order to open it. The MIME (Multipurpose Internet Mail Extension) type of file enables Internet browsers to access an Internet mail file without prompting the user to specify the program used to create the attached file.

As a precaution, do not open file attachments unless you are sure you know where they came from. There have been several cases of entire hard disks getting damaged due to viruses sent via e-mails. Examples of email viruses are 'Melissa', 'Bugbear', 'Sasser' etc.

**Deleting an Attachment**

1. Open the message that has the attachment you want to delete.
2. Select the file (attachment) icon and press the **Delete** key.

**Organizing e-mail messages.**

You can use Outlook to organize your incoming messages and make it easy to send mail.

There are some messages that you would like to keep for future reference. Instead of letting them clutter the Inbox, you can make them easier to find by storing them in folders you create.

**Step-by-Step.**

***Organizing the Inbox***

You can organize the messages in your Inbox quickly by sorting them.

To quickly sort messages by subject, sender or the date received, click on the respective column header.

For example, to sort your messages in alphabetical order by sender, you can click on **From** in the column header.

***To Create a Mail Folder***

1. From the **File** menu, choose **New** then **Folder**.
2. Enter the name of the folder in the **Name** box, e.g. Personal Stuff.
3. Select the **Inbox** folder so that the mail folder created will become a subfolder of the Inbox.
4. Click **OK**.

**To Move Messages**

1. Select the message(s) you want to move.
2. Using the drag and drop method move the mail into the new folder created.
3. In the pop-up menu, select **Move**.

**OR**

From the **Edit** menu, select the **Move to Folder** option then select the folder you want to move the message to.

4. Click **OK**.

**Task 6 Using search engines**

**SEARCHING THE WEB.**

1. If you want to get some information concerning an area or subject of interest over the Web but you do not know where to find it, you can use a search engine or service to locate sites that contain that information.
2. Locate particular information in a web site, e.g. you can load a web site like http://www.cnn.com/ and wish to read the sports news.

You can use a search engine within that site to locate information on sports.

***How Search Engines find Web Pages.***

Hundreds of thousands of new web pages are created each day, it is almost impossible for a search engine to catalog every new page on the

Web. There are two ways that search engines use to locate web pages:

a) Spiders / Robots

Automated robots called *spiders* travel around the Web looking for new pages, creating links to them.

b) Submissions

These are derived from people who have created new web pages and then submit information about pages they have created.

**Step-by-Step.**

1. Select a search engine, e.g. Yahoo, and type its address in the **Address** box, i.e. http://www.yahoo.com. Once the search engine home page appears, type a keyword or phrase in the **Search** box, e.g. Kenya, then click the **Search** button. The steps may vary depending on the search engine you are using.
2. As soon as the search is completed, you will be presented with a list of sites that contain the keyword or phrase you are looking for. Select a site whose description comes closest to the information you desire and click on its link.
3. If there are many sites, not all links will be displayed. However there will be an option that allows you to view the next 10 or so matches. Click on this if necessary to view the next set of links. Information and Communication Page 24

   ***NB:*** *If there are too many matches you may want to use an additional keyword to narrow down the search. Type the additional key word in the search box e.g. "Kenya AND Economy" to narrow down to sites that contain information about the economy in Kenya.*
4. Click **Search**.
5. From the search results, select the links that may help you get the information you require. You may need to click on a number of links to get your exact requirement. Information and Communication Page 25

**Locate information within a website.**

Once you access a website, you can search for specific text or information on that site or page. Unlike search engines like Yahoo, Infoseek, Lycos, Web Crawler, and Excite that present you with the URLs or links of sites that hold information you are looking for, search engines within a web page locate information within that web page.

**Step-by-Step.**

**1**. Load the web page to browse. In the example below, the following website is used: http://www.carleton.ca.

*NB: The steps involved in searching are not standard, they differ from one web page to another.*

**2.** Position the cursor within the **Search** box and type a keyword(s), e.g. International AND Student.

*NB: When typing in a keyword you can use logical words or operators like **AND** (when you want to display results that meet both criteria) and **OR** (when you want to display results that meet one of the two criteria).*

**3**. Click the **go** button to begin the search.

**4**. From the Search Results screen, click on a link that is closest to your requirements.

## Task 7 Printing documents

***PRINTING WEB PAGES.***

To obtain a hard copy of the information that you have researched on and collected, for the purposes of reviewing later or filing.

**Step-by-Step.**

*Setting Page Setup options.*

Before printing a web page it is advisable to check the settings in the Page Setup dialog box. This will ensure that the right paper size, margins and orientation of the page are set correctly. You can also add headers and footers to a web page.

**1.** From the **File** menu click **Page Setup…**.

**2.** In the Margins boxes, type the margin measurements.

**3**. In the Orientation area, select either Portrait or Landscape.

**4.** In the Headers & Footers section, specify the information to be printed.

**5**. Click **OK**.

**Printing the web page.**

1. From the **File** menu select **Print**.
2. The **Print** dialog box appears.
3. Set the print options if necessary and click **Print**.

# DATA SECURITY

## THREATS AND HAZARDS TO DATA

The following are among the threats to data security:

1. Data may get lost or damaged during a system crash - especially one affecting the hard disk
2. It can be corrupted as a result of faulty disk drives, or power failures
3. It can be lost by accidental deletion or overwriting of files
4. It can be lost or become corrupted by computer viruses
5. It can be hacked into by unauthorized users and stolen, deleted or altered
6. It can be destroyed by natural disasters, acts of terrorism, or war
7. It can be deleted or altered by employees wishing to make money or take revenge on their employer

## METHODS OF SECURING DATA

**Data security** refers to protecting data from destructive forces and unwanted actions of unauthorized users. Data needs to be protected from loss through accidental or malicious deletion, virus attacks hard disk or system failures, unauthorized access etc. Methods of protecting data include:

i) **Use of passwords (Access Authentication):** A password is a secret word or string of characters that is used for user authentication/verification before the user can gain access to data. The password should be kept secret from those not allowed access. **Passwords** are used together with **usernames** by users in a log-in process that controls access to protected system data.

ii) **Right of Access** refers to the authorization you have to access different data files. Right of access helps determines who has the right to do what in relation to certain data or information. For example, database administrators may be able to remove, edit and add data while a general user may not have the right to do the same. Right of access in an organization is usually given/ specified by the system or database administrators.

iii) **Logs and Audit trails**: An audit trail is a record showing who has accessed a computer system, when and what operations he or she has performed during a given period of time. An audit trail can also maintain a record of activity by the system itself. Audit trails are useful both for maintaining data security and for recovering lost transactions.

iv) **Anti-virus programs** are software used to prevent, detect and remove malicious software such as viruses which can interfere with or lead to the loss of data stored on a computer. A virus or a malware in general is software used or programmed by attackers to disrupt computer operations or gain access to private computer systems in order to steal or destroy sensitive information of personal, financial or business importance. Examples of anti-virus software include Norton, AVG, Kaspersky etc.

v) **Encryption:** This is the process of encoding (convert into a coded form) information stored on a device especially where the data is stored on a portable device or transmitted over a public network. The key to decrypt the data should be kept securely.

vi) **Firewalls:** A firewall is a software or hardware-based network security system that prevents unauthorized access to or from a private network. Such a system is very important where there is any external connectivity, either to other networks or to the internet.

vii) **Physical Security:** This includes locking of offices and use of alarms, keeping computers or database servers in strong-rooms, use of security cameras and employing security guards where necessary.

viii) **Data Protection Act**

This refers to an Act of Parliament enacted to regulate the collection, processing, storage/keeping, use and misuse and disclosure of information relating to individuals that is processed automatically. The Act created a Commission-Freedom of Information Commission of Kenya-with the mandate of ensuring the implementation of the Act, to receive complaints regarding violations of the Act, institute legal proceedings and settlement concerning such violations. The Act, however, only applies to personal information held by public authorities and excludes private bodies.

ix) **Data Back-up** refers to the copying and archiving of computer data in a secure location so that it may be used to **restore** the original data after a data loss event occasioned by either accidental or malicious deletion, system failure, virus attack, data corruption or natural disasters.

## HARDWARE SAFETY

Hardware safety protects the machine and peripheral hardware from theft and from electronic intrusion and damage. Hardware safety can be ensured through:

### a) Safety Against Theft

Computers are very valuable and relatively portable they and can easily be stolen which would be made worse by the loss of the valuable data stored on them. Physical safety should be put in place such as locking the rooms, installing alarm systems and Closed Circuit Television Cameras (CCTV) where they are kept to prevent theft. The computers can also be bolted to benches or cabinets in order to make theft difficult.

### b) Protection from Power Interruptions

The power delivered to computers should be stable and constant but sometimes fluctuations in power supply occur. For example, voltage surges and spikes, a blackout or brownout can cause a computer to shut down abruptly. Information that is stored only in short-term memory will be lost. As well, the fluctuation can physically damage computer components such as the power supply unit. Computer systems can be protected from such interruptions through:

#### i) Use of uninterruptible Power Supply (UPS)

A UPS is a device that allows a computer to keep running for at least a short time after the primary power source is lost. The device also provides protection against power surges and drops.

#### ii) Use of power surge protectors/suppressors

A surge protector or suppressor is an appliance designed to protect electrical devices from voltage spikes caused by events like lightning strikes and short circuits. Voltage spikes might damage a computer's electronic parts, melting plastic and metal parts or even corrupting the data stored on the computer. Surge protectors limit the voltage supplied to a device by either blocking the unwanted voltages or by shorting the voltages to ground.

### c) Environmental Safety

Computers also require the right balance of physical and environmental conditions to operate properly. Measures should be put in place to protect computers from fire, smoke, dust, excessive temperatures, high levels of humidity and electrical noise such as from motors. Such measures include installation of climate control systems and dehumidifiers, fire fighting systems etc.

**d)** Other physical measures include the disabling of USB ports or CD ROM Drives, installation of drive locks and case intrusion detection. This will help in protecting against unauthorized copying and transfer of data as well as preventing infection of the computer with viruses through portable storage devices such as pen drives.

## SOFTWARE SAFETY

Logical/Software Safety consists of **software safeguards** for a system, including user identification mechanisms and safety software. These measures ensure that only authorized users are able to perform actions or access information in a network or a workstation.

Elements of logical safety include:

**a) Biometric authentication**

Biometric authentication is the use of a user's physiological features to confirm their identity before they are allowed access to a computer system. These features include software that verify user identification through fingerprints, eye retinas and irises, voice patterns, facial bone structure etc.

**b) Token authentication**

Token authentication comprises safety tokens which are small devices that authorized users of computer systems or networks carry to assist in identifying them as they log into the system. They include smart cards or small USB drives with built-in code generators and are inserted to the computer through USB ports.

**c) Password authentication**

This method uses secret data e.g. strings of character to control access to a system and is normally used together with usernames. The passwords are either created by the user or assigned by system administrators. Usually, limitations to password creation include length restrictions, a requirement of number characters, uppercase letters or special characters. The system may also force a user to change their passwords after a given amount of time.

d) Access Rights
e) Audit Trails

**f) Use of Safety Software**

Safety software refers to any computer program whose purpose is to help secure a computer system or a computer network. Types of safety software include Antivirus software, Anti-key loggers, Anti-Spam software, Firewall systems etc

These software systems protect computers and the data they hold from various threats. The threats include, among others, industrial espionage, loss of data to hackers (people who exploit weaknesses in a computer system to gain access and motivated by reasons like profit/theft of data, protest or challenge) and attacks from malicious code such as:

- **viruses**

  A virus is a malicious program that replicates itself and spreads from one computer to another. They attach themselves to existing programs in order to spread. Viruses almost always corrupt or modify files on a targeted computer.

- **Trojan horses**

This is a type of malware (malicious software) that gains privileged access to a computer system while appearing to perform a desirable function but instead installs a malicious code that allows unauthorized access to the target computer. They usually come as free software offers in some websites which users download and install on their machines.

Trojans do not self-replicate. Distribution channels include e-mail, malicious or hacked Web pages, Internet Relay Chat (IRC), peer-to-peer networks etc.

- **Worms**

  Worms are malware that spread themselves to other computers using computer networks and do not need to attach themselves to existing software. They harm networks by consuming bandwidth (by increasing network traffic etc) but do not attempt to change the systems they pass through.

- **Rootkits**

  A rootkit is a type of malicious software that is activated each time your system boots up. Rootkits are difficult to detect because they are activated before the Operating System has completely booted up. A rootkit often allows the installation of hidden files, processes, hidden user accounts, and more in the systems OS. They are also able to intercept data from terminals, network connections, and the keyboard.

- **Keyloggers**

  This is a type of malware that records (or logs) the keys struck on a keyboard, usually in a covert manner so that the person using the keyboard is unaware that their actions are being monitored and then the information is transmitted to the originators.

Anti-virus software include Norton, AVG, Kaspersky, MacAfee, Avast etc. These software programs are meant to prevent, detect and remove malicious software from computer systems.

The software come with a database of all known or identified malware against which they protect the systems they are installed on. The databases and the software themselves need to be updated regularly to ensure continued protection for the system. Once installed on a machine, the anti-virus software always runs in the background watching out for suspicious activity that could be initiated by a virus and if it makes detection, it warns the computer user and provides a solution to the threat.

**A virus scan** involves the examining of the content of the computer's memory (RAM and boot sectors) and the files stored on fixed and removable drives and comparing those files against the database of known viruses.

Anti-virus software should be registered in order to be used even if they are offered free of charge. **Software registration** is a means of providing the End-User with a license from the developer which makes the use of the software legal. It also makes it possible for the End-User to update the software for continued protection.

### Firewalls

A firewall is software or hardware-based network safety system that controls the incoming and outgoing network traffic by analyzing the data packets and determining whether they should be allowed through or not, based on set rules.

## COMPUTER CRIMES/Cyber crime

This refers to any crime that involves a computer and a network. **Netcrime** refers, more precisely, to criminal exploitation of the Internett

### A. Breaches of Physical Security

#### i. Dumpster Diving

Dumpster diving, or trashing, is a name given to a type of security attack by scavenging through materials that have been thrown away for any information that can help crack a system.

Around the offices and in the trash, crackers can find used disks and tapes, discarded printouts, and handwritten notes of all kinds. They may also retrieve printouts, computer manuals, and other documents from which they extract information needed to crack the system. In the system itself are files that have been deleted, but that haven't actually been erased from the system.

### ii. Wiretapping

A form of electronic eavesdropping accomplished by seizing or overhearing communications by means of a concealed recording or listening device connected to the transmission line. Packet sniffers -- programs used to capture data being transmitted on a network – are a commonly-used modern-day wiretapping tool. A variety of other tools, such as wiretap Trojans, are used for different applications.

### iii. Eavesdropping on Emanations

This refers to monitoring, intercepting, and decoding electromagnetic emissions from data processing and related equipment. Computer equipment, like every other type of electrical equipment emit electromagnetic impulses. Whenever you strike a computer key, an electronic impulse is sent into the immediate area.

Because of the emanation threat, government computers that are used to store and process classified information require special physical shielding.

### iv. Denial or Degradation of Service

A **denial-of-service** (DoS) or **distributed denial-of-service** (DDoS) attack is an attempt to make a machine or network resource unavailable to its intended users. A DoS attack generally consists of efforts to temporarily or indefinitely interrupt or suspend services of a host connected to the Internet.There are many ways to disrupt service, including such physical means as arson or explosions; shutting off power, air conditioning, or water (needed by air conditioning systems); or performing various kinds of electromagnetic disturbances.

Turning off power or sending messages to system software telling it to stop processing are examples of the first type of attack--a classic denial of service.

The other type of attack, known as flooding (or sometimes **wedging or spamming**) is the type employed by the Internet worm. As the worm spread across systems and networks, it keeps creating new processes that clogged the affected systems that other work cannot get done.

### v. Zero-day attacks, also called zero-hour attacks

A zero-day exploit is one that takes advantage of a security vulnerability on the same day that the vulnerability becomes generally known. There are zero days between the time the vulnerability is discovered and the first attack.

## B. Data Attacks

There are many types of attacks on the confidentiality, integrity, and availability of data. Confidentiality keeps data secret from those not authorized to see it. Integrity keeps data safe from modification by those not authorized to change it. Availability keeps data available for use.

i. The theft, or unauthorized copying, of confidential data is an obvious attack that falls into this category. **Espionage** agents steal national defense information. Industrial spies steal their competitors' product information. Crackers steal passwords or other kinds of information on breaking into systems.

Two terms you'll hear in the context of data attacks are **inference** and **leakage**. With inference, a user legitimately views a number of small pieces of data, but by putting those small pieces together is able to deduce some piece of non-obvious and secret data. With leakage, a user gains access to a flow of data via an unauthorized access route (e.g., through eavesdropping).

ii. **Unauthorized Copying of Data**

Preventing and detecting this type of attack requires coordinated policies among the different categories of computer security. In terms of personnel security, user education is vital. In terms of operations security, automated logging and auditing software can play a part as well.

iii. **Traffic Analysis**

This is the process of intercepting and examining messages in order to deduce information from patterns in communication. For example, accounts payable files tell can outsiders what an organization has been purchasing and suggest what its future plans for expansion may be.

Even the fact that two people are communicating--never mind what they are saying to each other--may give away a secret. Traffic analysis is the name given to this type of

## C. Software Attacks

i. **Trap Doors**

A trap door is a quick way into a program that allows program developers to bypass all of the security built into the program now or in the future but can be exploited by criminals to gain unauthorized access to a system.

To a programmer, trap doors make sense. If a programmer needs to modify the program sometime in the future, he can use the trap door instead of having to go through all of the normal, customer-directed protocols just to make the change. Trap doors of course should be closed or eliminated in the final version of the program after all testing is complete, but, intentionally or unintentionally, some are left in place. Other trap doors may be introduced by error and only later discovered by crackers who are roaming around, looking for a way into system programs and files. Typical trap doors use such system features as debugging tools, program exits that transfer control to privileged areas of memory, undocumented application calls and parameters, and many others.

ii. **Trojan Horses**

A Trojan horse is a method for inserting instructions in a program so that program performs an unauthorized function while apparently performing a useful one. Trojan horses are a common technique for planting other problems in computers, including viruses, worms, logic bombs, and salami attacks (more about these later). Trojan horses are a commonly used method for committing computer-based fraud and are very hard to
detect.

iii. **Botnets**

A botnet (also known as a **zombie army**) is a number of Internet computers that, although their owners are unaware of it, have been set up to forward transmissions (including spam or viruses) to other computers on the Internet. Any such computer is referred to as a zombie - in effect, a computer "robot" or "bot" that serves the wishes of some master spam or virus originator. Most computers compromised in this way are home-based.

iv. **Ransomware**

This is a type of malware which restricts access to the computer system that it infects, and demands a ransom paid to the creator(s) of the malware in order for the restriction to be removed.

v. **Viruses and Worms**

In a computer, a virus is a program which modifies other programs so they replicate the virus. In other words, a virus affects the way a program operates. It inserts a copy of itself in the code. Thus, when the program runs, it makes a copy of the virus. This happens only on a single system. However, if a virus infects a program which is copied to a disk and transferred to another computer, it could also infect programs on that computer. This is how a computer virus spreads.

**Unlike a virus, a worm is a standalone program in its own right. It exists independently of** any other program. To run, it does not need other programs. A worm simply replicates itself on one computer and tries to infect other computers that may be attached to the same network.

A worm operates over a network, but in order to infect a machine, a virus must be physically copied.

### vi. Salamis

This technique causes small amounts of assets especially money to be removed from a larger pool over a period of time. Usually, the amount stolen each time is so small that the victim of the salami fraud never even notices.

A clever thief can use a Trojan horse to hide a salami program that puts all of the rounded off values into his account. A tiny percentage of pennies may not sound like much until you add up thousands of accounts, month after month.

### vii. Logic Bombs

A typical logic bomb tells the computer to execute a set of instructions at a certain date and time or under certain specified conditions. The instructions may tell the computer to display a message on the screen, or it may tell the entire system to start erasing itself. Logic bombs may also find their way into computer systems by way of Trojan horses. Logic bombs often work in tandem with viruses. Whereas a simple virus infects a program and then replicates when the program starts to run, the logic bomb does not replicate - it merely waits for some pre-specified event or time to do its damage.

Some bombs do their damage after a particular program is run a certain number of times. Trojan horses present a major threat to computer systems, not just because of the damage they themselves can do, but because they provide a technique to facilitate more devastating crimes.

### viii. Data Diddling

Data diddling, sometimes called false data entry, involves modifying data before or after it is entered into the computer. Consider situations in which employees are able to falsify time cards before the data contained on the cards is entered into the computer for payroll computation.

### ix. IP Spoofing

A method of masquerading in which an attacker forges the IP addresses on the data packets he sends so they look as if they came from inside a network on which systems trust each other. Because the attacker's system looks like an inside system, he is never asked for a password or any other type of authentication.

### x. Password Sniffing

Password sniffers are programs that simply collect the first 128 or more bytes of each network connection on the network that they want to attack. When a user types in a user name and a password--as required when using certain common Internet services like FTP (which is used to transfer files from one machine to another) or Telnet (which lets the user log in remotely to another machine)--the sniffer collects that information. Additional programs sift through the collected information, pull out the important pieces (e.g., the user names and passwords), and cover up the existence of the sniffers in an automated way. Best estimates are that in 1994 as many as 100,000 sites were affected by sniffer attacks.

### xi. Rootkits

A rootkit is a type of malicious software that is activated each time your system boots up. Rootkits are difficult to detect because they are activated before the Operating System has completely booted up. A rootkit often allows the installation of hidden files, processes, hidden user accounts, and more in the systems OS. They are also able to intercept data from terminals, network connections, and the keyboard.

### xii. Keyloggers

This is a type of malware that records (or logs) the keys struck on a keyboard, usually in a covert manner so that the person using the keyboard is unaware that their actions are being monitored and then the information is transmitted to the originators.

### xiii. Excess Privileges

xiv.

This is a situation where users in a system have excess privileges--more privileges than they ought to have. If a cracker breaks into one user's account, he can compromise and damage that user's files, but he can't ordinarily get beyond the boundaries of the user's account to damage the rest of the system.

An ordinary user on an ordinary system doesn't need to be able to modify all of the files on that system. And yet, in many systems, a user has the system privileges that entitle him to do just that. The user may never actually want to change anyone else's files--he may not even know that he is allowed to--but nevertheless the privileges are there. If an intruder gets access to the system through the user's account, he can exploit this weakness.

#### xv. Zero Day Attack

A **zero day** vulnerability refers to a hole in software that is unknown to the vendor. This security hole is then exploited by hackers before the vendor becomes aware and hurries to fix it.

### D. NETWORK ABUSE

Network abuses are generally considered fraudulent network activity that is committed with the aid of a computer.

#### i. ELECTRONIC SPAMMING

**Electronic spamming** is the use of electronic messaging systems to send unsolicited messages (**spam**), especially advertising, as well as sending messages repeatedly on the same site. A person who creates electronic spam is called a *spammer*.

#### ii. PHISHING

This is the attempt to acquire sensitive information such as usernames, passwords, and credit card details (and sometimes, indirectly, money) by masquerading as a trustworthy entity in an electronic communication. Communications purporting to be from popular social web sites, auction sites, banks, online payment processors or IT administrators are commonly used to lure unsuspecting public. Phishing emails may contain links to websites that are infected with malware

#### iii. PHARMING

This is a cyber attack intended to redirect a website's traffic to another, fake site. **Pharming** can be conducted either by changing the hosts file on a victim's computer or by exploitation of a vulnerability in DNS server software.

## E. SOCIAL ENGINEERING

Social engineering is the act of manipulating people into performing actions or divulging confidential information, rather than by breaking in or using technical cracking techniques.[11] This method of deception is commonly used by individuals attempting to break into computer systems, by posing as an authoritative or trusted party and capturing access information from the naive target.[12] Email Phishing is a common example of social engineering's application, but it is not limited to this single type of attack.