The Computer Defined

- Computer is electronic device that convert data into information.
- It takes input, process it according to the stored instructions & produce result as output
  - Input: Data
  - Instructions: Software, Programs
  - Output: Information (numbers, words, sounds, images)

Computer data

- Fact with no meaning on its own
- Stored using the binary number system
- Data can be organized into files
- Processed data called ***information***

2. Computer generation

•The Five Generations of Computers

Each generation of computer is characterized by a major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, and more powerful and more efficient and reliable devices.

2.1 First Generation (1940-1956) Vacuum Tubes

- first computers used vacuum tubes for circuitry and magnetic drums for memory
- taking up entire rooms
- very expensive to operate
- used a great deal of electricity
- generated a lot of heat
- relied on machine language
- they could only solve one problem at a time
- Input was based on punched cards and paper tape, and output was displayed on printouts.
- UNIVAC and ENIAC computers are examples

2.2 Second Generation (1956-1963) Transistors

- Transistors replaced vacuum tubes and lead in the second generation of computers
- The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors.
- relied on punched cards for input and printouts for output
  - Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words.
- These were also the first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology.

Third Generation (1964-1971) Integrated Circuits

- integrated circuit was the hallmark of the third generation of computers
- increased the speed and efficiency of computers.

- users interacted with third generation computers through keyboards and monitors and interfaced with an operating system.
- allowed the device to run many different applications at one time with a central program that monitored the memory.
- smaller and cheaper.

Fourth Generation (1971-Present) Microprocessors

- The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip.
- As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet

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Fifth Generation (Present and Beyond) Artificial Intelligence

- Fifth generation computing devices, based on artificial intelligence, are still in development
- The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization.

Types of Computers 3.5

- ***Notebook computers***

◦Small portable computers
◦Weighs between 3 and 8 pounds
◦About 8 ½ by 11 inches
◦Typically as powerful as a desktop

- ***Mainframe computers***

◦Very big, powerful , expensive computers used in the background by most large organization

- ***Minicomputers***

◦Very powerful and also very expensive

◦Called midrange computers

◦Power between mainframe and desktop
◦Handle hundreds of users
◦Used in smaller organizations
◦Users access through a terminal

- ***Super Computers***

◦The most powerful computers made
◦High capacity of processing data
◦Handle large and complex calculations
◦Process trillions of operations per second
◦Found in research organizations
◦Used in military purposes

- ***Personal computers /Desktop computers***

◦The most common type of computer
◦Sits on the desk or floor
◦Performs a variety of tasks

Parts of the Computer System

Hardware

◦The physical devices that make up the computer
◦Anything that can be touched

Software

◦Is a set of instructions that makes the computer perform tasks
◦Tell the computer what to do
◦Also called a program
◦Thousands of programs exist

Live ware

◦People operating the computer
◦Most important part
◦Tell the computer what to do

Computer Hardware

Processing devices

◦Brains of the computer
◦Carries out instructions from the program
◦Manipulate the data
◦Most computers have several processors
◦Central Processing Unit (CPU)

◦Processors made of silicon and copper

Memory devices

◦Stores data or programs
◦Random Access Memory (RAM)
•Volatile
•Stores current data and programs
•More RAM results in a faster system
◦Read Only Memory (ROM)
•Permanent storage of programs
•Holds the computer boot directions

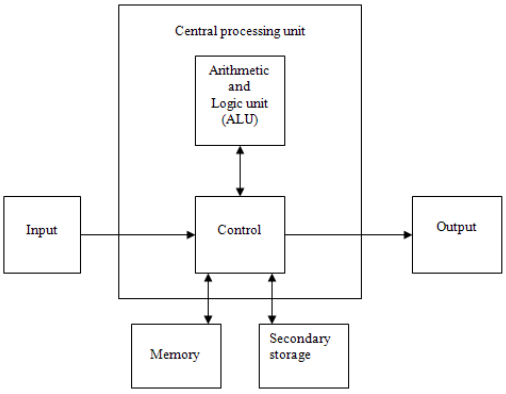
Input and output devices

◦Allows the user to interact
◦Input devices accept data
•Keyboard, mouse
◦Output devices deliver data
•Monitor, printer, speaker
◦Some devices are input and output
•Touch screens

Storage devices

◦Hold data and programs permanently
◦Different from RAM
◦Magnetic storage
•Floppy and hard drive
•Uses a magnet to access data
◦Optical storage
•CD and DVD drives
•Uses a laser to access data

Major Components of a Computer



Processor (CPU) - Runs program instructions

6.2 Memory - Storage for running programs and current data

6.3 Secondary Storage - Long-term program & data storage (hard disk, CD, etc)

6.4 Input Devices - Communication from the user to the computer(e.g. keyboard, mouse)

6.5 Output Devices - Communication from the computer to the user (e.g. monitor, printer, speakers)

Central processing Unit (CPU)

- The CPU is a silicon chip that contains millions of tiny electrical components.
- CPU is the brain within the computer.
- It performs most of calculation and is responsible for smooth running of OS as well application program.
- Governs the overall speed of the computer.
- The CPU controls all of the other resources within the system, in order to accomplish a task.

The CPU's three main parts are:

- Control Unit - **Coordinates processing steps**
- Arithmetic Logic Unit (ALU) - **Performs calculations and decisions**
- Registers - **Small, fast storage areas for instructions and data**

Control Unit

- Reads & Interprets Program Instructions
- Directs the Operation of the Processor
- Moves data and instructions between main memory and registers
- Controls the flow of programs and data into and out of memory

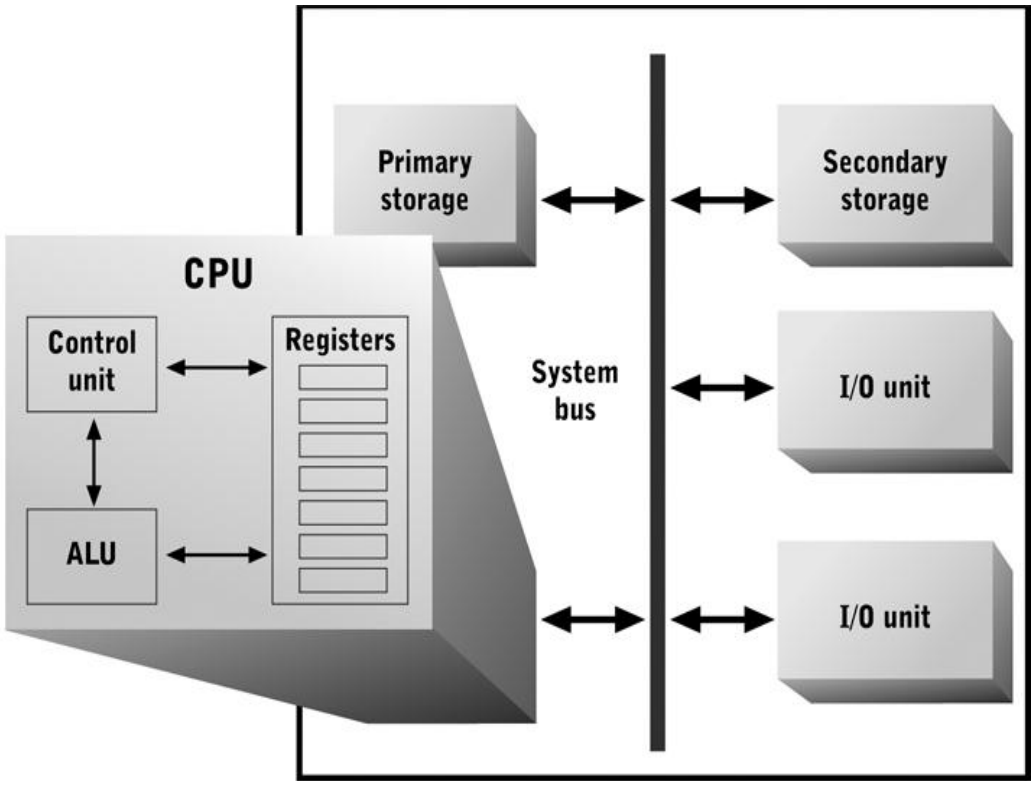
Arithmetic Logical Unit (ALU)

- is a digital circuit that performs arithmetic and logical operations.
  - Addition, Subtraction, Multiplication, Division
  - Comparisons (A>B)

Registers

- Storage locations that hold inputs and outputs for the ALU
- When the control unit and arithmetic & control unit operate, they store information & instruction temporally in registers

Figure 2-8 ►
Components of the central processing unit (CPU)



Memory

Two main types of physical memory are used in modern PCs:
ROM- Read-only memory
RAM – Random access memory

ROM

◦Read Only Memory is a special type of memory chip from which existing software can be read but not written to.
◦It is designed to perform a specific function and cannot be changed.
◦ROM-BIOS chip ,ROM chips in network and video card
◦Computer Manufacture create this memory

Types of ROM

•Programmable ROM (PROM)
•Erasable Programmable ROM (EPROM)
•Electrically Erasable Programmable ROM (EEPROM)

Programmable ROM (PROM)

•This is a type of ROM that can be programmed using special equipment.
•it can be written to, but only once

Erasable Programmable ROM (EPROM):

•An EPROM is a ROM that can be erased and reprogrammed.
•A little glass window is installed in the 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

Electrically Erasable Programmable ROM (EEPROM)

- 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.

RAM / Main memory

standing for Random Access Memory.
- also known as Main Memory or internal Memory
- temporary storage area
- It is constructed from integrated circuits and needs to have electrical power in order to maintain its information.
- When power is lost, the information is lost too!
- It can be directly accessed by the CPU.

RAM is the main 'working' memory used by the computer. When you first switch on the computer, OS loads from the hard disk to RAM
- Volatile(i.e the information lost when you switch off the computer)
- Expensive
- 256MB, 512MB, 1GB, 2GB
-

RAM is divided in to two categories
DRAM-Dynamic random access memory
SRAM-Static RAM

Dynamic RAM / DRAM

- Dynamic RAM (DRAM) is the type of memory chip used for most of the main memory in a modern PC.
- Loses it data rapidly, memory controller must refresh it several thousand times a second
- The main advantages of DRAM are that it is very dense, meaning you can pack a lot of bits into a very small chip,
- it is inexpensive, which makes purchasing large amounts of memory affordable.

Static RAM(SRAM)

- SRAM stands for Static RAM, which is so named because it does not need the periodic refresh rates like DRAM.
- "SRAM" is significantly faster than dynamic RAM.
- Used in processor Memory Cache

Type	**Speed**	**Density**	**Cost**
DRAM	Slow	High	Low
SRAM	Fast	Low	High expensive

Memory modules (Memory Technologies)

- SIMM – Single Inline Memory Module
- DIMM – Dual Inline Memory Module
  - SDRAM
  - DDR
  - DDR2
  - DDR3
- RIMM - Rambus Inline Memory Module

SIMM Single Inline Memory Module

- Outdated


DIMM

•SDRAM
◦First DIMM Synchronized with the system clock was synchronous DRAM(SDRAM)
•Two notches **(**The positions of these notches depend on the memory features the DIMM uses.)
◦Uses 168 pins

DDR (Double Data Rate)

•Also called Double rate SDRAM, SDRAM II)
•Improved verson of SDRAM
•DDR runs twice as faster as regular SDRAM
•Has one notch
•Uses 184 pins

DDR2 *(Double Data Rate 2)*

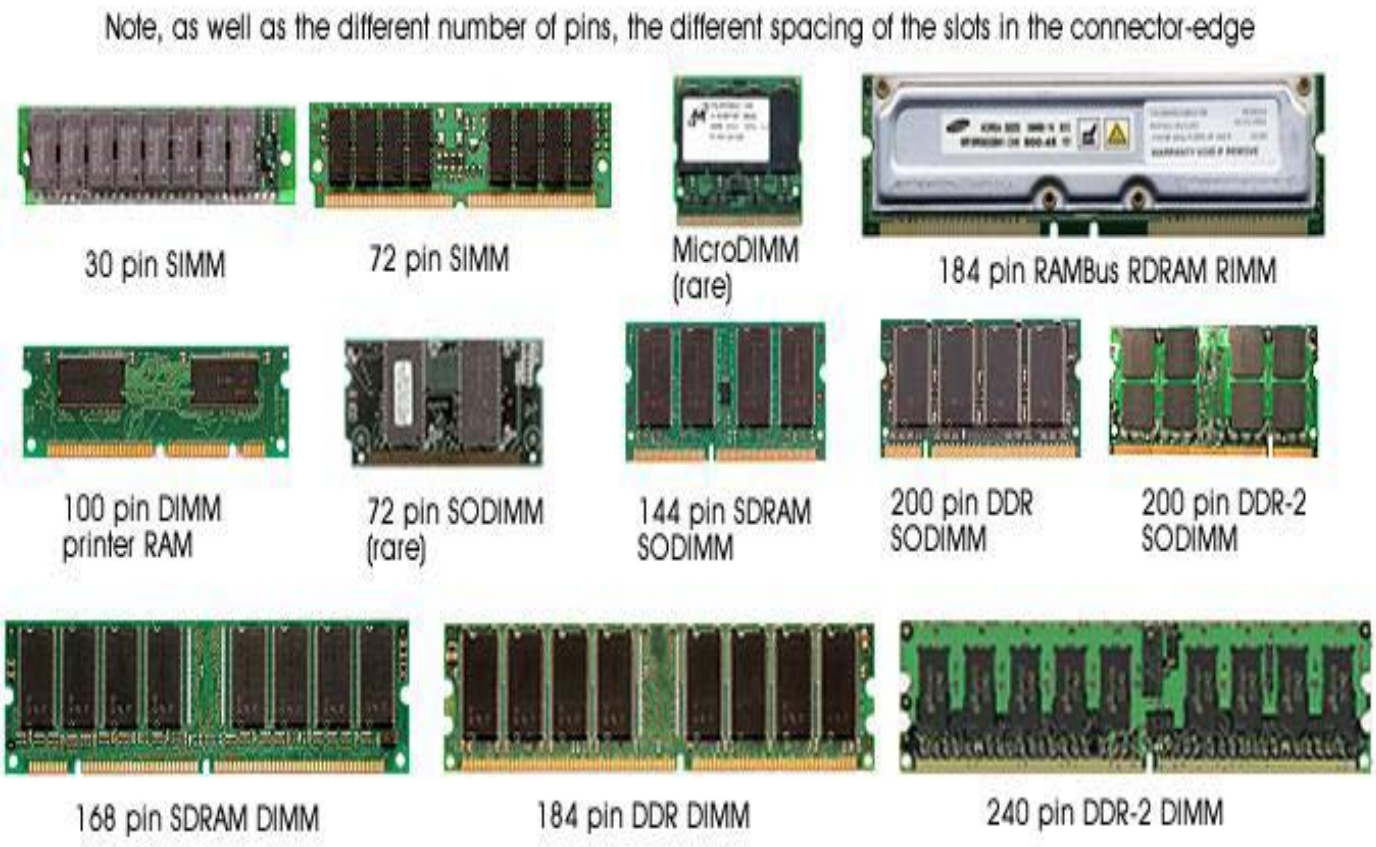
•Improvements of DDR
•Faster
•Uses less power than DDR
•240 pins
•Has one notch near the center of the edge connector.

DDR3 *(Double Data Rate 3)*

•Faster
•uses less power than DDR2
•240 pins
•has an offset notch farther from the center than a DDR2 DIMM.

RIMM Rambus Inline Memory Module

•RIMM has 184 pins
•two notches near the center of the edge connector.
•Out dated



Virtual memory

- Operating systems can use a technique known as virtual memory to run processes that require more main memory than is actually available.
- To implement this technique, space on the hard drive is used to mimic the extra memory needed.
- Accessing the hard drive is more time-consuming than accessing main memory, however, so performance of the computer slows.

Cache memory

- a special high-speed storage mechanism.
- It can be either a reserved section of main memory or an independent high-speed storage device.
- Two types of caching are commonly used in personal computers
  - *memory caching*
  - *disk caching*.

Memory caching

- sometimes called a *cache store* or *RAM cache*
- is a portion of memory made of high-speed static RAM (SRAM) instead of the slower and cheaper dynamic RAM(DRAM) used for main memory.
- Memory caching is effective because most programs access the same data or instructions over and over. By keeping as much of this information as possible in SRAM, the computer avoids accessing the slower DRAM

Disk caching

- Disk caching works under the same principle as memory caching
- instead of using high-speed SRAM, a disk cache uses conventional main memory.
- most recently accessed data from the disk (as well as adjacent sectors) is stored in a memory buffer.
- When a program needs to access data from the disk, it first checks the disk cache to see if the data is there.

Measuring Memory

Computer Memory - millions/billions of on/off charges
Divided into:
- **Bits** 0 or 1
- **Bytes** Groups of 8 bits A byte is the smallest unit of storage. (Can hold one text character)
- **Words** Groups of bits/bytes (8, 16, 32, 64-bits

Storage is usually too large to be expressed in **bytes** or **words**. Instead we use:
- **Kilobyte (KB)** = 1024 bytes (210 bytes)
- **Megabyte (MB)** = 1024 x 1024 bytes or one million bytes (220 bytes)
- **Gigabyte (GB)** = 1024 x 1024 x 1024 bytes or one trillion bytes (230 bytes)
- **Terabyte (TB)** = 1024 x 1024 x 1024 x 1024 bytes one quadrillion bytes (240 bytes)

Secondary Storage

- storage devices and storage media that are not always directly accessible by a computer
- commonly used for backup purposes
- popular way to save and transfer data.

Floppy disk
- Hard disk
- Optical disk
  - CD-ROM
  - CD-R
  - CD-RW
  - DVD(digital versatile disk)
- Magnetic tapes
- Pen drives/ Flash Drives

Floppy Disk

- is a data storage medium that is composed of a disk of thin, flexible ("floppy") magnetic storage medium sealed in a square or rectangular plastic carrier lined with fabric that removes dust particles.
- **3½-inch**
- **1.44 MB**

Hard Disk Drive

- Hard Disk is a secondary storage device consists of spinning disks with heads that moves over the disks.
- Capacity ranges from some MB to hundreds of GB

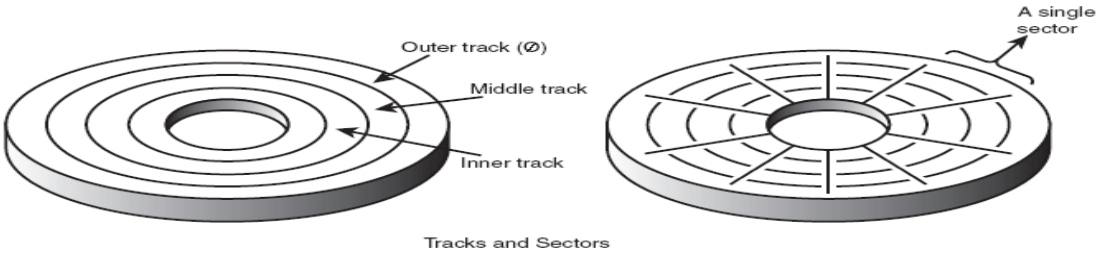
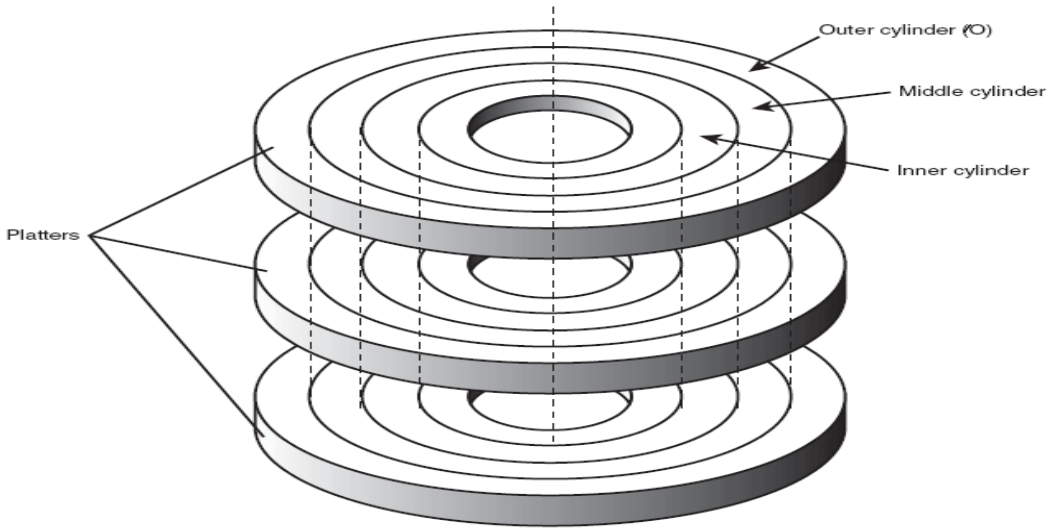


Figure 10.2 The tracks and sectors on a disk.



Optical Storage

- CD ROM-Compact Disk Read only Memory
  - CD-R
    - Compact disk recordable
    - 700MB
  - CD-RW
    - Compact disk Rewritable
  - DVD
    - Digital versatile Disk
    - 4.7GB

Magnetic tape

- uses digital recording on to magnetic tape to store digital information
- When storing large amounts of data, tape can be substantially less expensive than disk or other data storage options
- Tape storage has always been used with large computer systems


Flash Drive

- consists of a flash memory integrated with a USB (Universal Serial Bus) interface.
- USB flash drives are typically removable and rewritable,
- physically much small

Input Devices

What is input?

- **Input device is any hardware component used to enter data or instructions into a computer**
- **Data or instructions entered into the memory of computer**

Keyboard

- The keyboard is the most commonly used input device and has been used since computers were first introduced.
- Each key is a switch, which closes when that particular key is pressed.
- The microprocessor scans the keyboard hundreds of times a second to see if a key has been pressed; if it has, a code that corresponds to that key is sent to the Processing Unit.
- The CPU then translates this code into the ASCII code, which is then used by the computer program.
- Can be cordless or built-in

Mouse

- A mouse is another popular input device that forms an essential part of a computer system.
- Its movements on the desktop are translated into digital information, which in turn is fed to the computer, causing the cursor to move on the screen.
- A mouse usually has two or three buttons, and these are used to make selections on the screen.
- The Mouse is classified as a pointing device

What is output?

- **Data that has been processed into a useful form, called information**
  - **Output device** is any hardware component that can convey information to one or more people

What is a CRT monitor?

- **cathode-ray tube** A cathode-ray tube and associated electronics connected to the video output of a computer. These have higher resolution than TVs. Larger monitors with high resolution are used for specialized application such as desktop publishing and CAD.

Quality of a CRT monitor determined by

- **Screen resolution**
- **Refresh rate is speed at which monitor redraws images on screen**

LCD Monitor

- **liquid crystal display**
  - LCDs are screens made from two glass/plastic plates with liquid in between.
  - LCDs are commonly used for calculators and laptop computers, as they are far flatter than is possible with cathode ray screens used in TVs and standard computer monitors.
  - Have a small footprint
  - Used in mobile device

Main differences of LCDs as compared with CRT monitors

- Take s very little space
- Small energy consumption
- Sharp pictures
- No flicker or geometric distortion
- Fairly expensive

- Limited viewing angle
- Slower response time

LED Monitor

- LCD monitors are backlit by a single light source and use a liquid crystal display to produce the image.
- LEDs also use a liquid crystal display, but use a large number of LED to backlight the display.
- Because of this advantage, LED displays can produce images which are of a higher quality than LCD displays

Resolution

- Resolution is the amount of detail a monitor can render.
- This quantity is expressed in the number of horizontal and vertical picture elements, or pixels, contained in the screen.
- The greater the number of pixels, the more detailed the images.

Refresh rate

- The refresh rate (also called the vertical scan frequency) is the rate at which the screen display is rewritten.
- This is measured in hertz (Hz).
- A refresh rate of 72Hz means that the screen is refreshed 72 times per second.
- A refresh rate that is too low causes the screen to flicker, contributing to eyestrain.
- The higher the refresh rate, the better for your eyes and your comfort during long sessions at the computer.

Video Display Adapters

- A video adapter provides the interface between your computer and your
- monitor and transmits the signals that appear as images on the display.
- MDA (Monochrome Display Adapter)
- HGC (Hercules Graphics Card)
- CGA (Color Graphics Adapter)
- EGA (Enhanced Graphics Adapter)
- VGA (Video Graphics Array)- 640X480
- SVGA (Super VGA)- 800X600
- XGA (Extended Graphics Array)- 1,024X768
- UVGA (Ultra VGA)- 1,280X1,024

Printer

•Many different types of printer are in use today.
• Two primary technologies used for printing are:

➢**Impact printing**

◦Impact Printers use a print head containing a number of metal pins which strike an inked ribbon placed between the print head and the paper

➢**Non-impact printing.**

◦The non-impact printers are much quieter than impact printers as their printing heads do not strike the paper.

Three most common printer types are:

- ▪Dot matrix printers
- ▪Inkjet printers
- ▪Laser printers.

Dot-matrix printer

•These printers work by firing a matrix of tiny pins (which are located in the print head), through a ribbon similar to that found on a typewriter.
•Such printers are cheap and have the lowest running cost compared to any other type of printer.
•As the head moves across the paper the correct pins are fired out to hit an inked ribbon and form the shape of the character required.
• The greater the number of pins, the higher the quality of the print.
• Dot matrix printers are impact printers

Ink – jet printer

•Inkjet printers can produce high quality text and graphics.
•They are quieter than dot matrix printers
•.The technology involves ink flowing through the appropriate nozzles (usually in an array of 64) where it is then heated and a bubble is formed.
•This expands to release a tiny droplet of ink onto the paper.
•Non impact printer

Laser Printer

➢**High-speed, high-quality nonimpact printer**
➢**Prints text and graphics in very high-quality resolution, ranging from 1,200 to 2,400 dpi**
➢**Typically costs more than ink-jet printer, but is much faster.**

- A laser beam is used to form an image on a rotating, charged metal drum.

➢This then picks up toner from the toner cartridge and transfers it onto paper.
➢Very soon afterwards heat and pressure are applied so the toner sticks to the paper.
➢Color laser printers are now available and are mainly used for desktop publishing.
➢Although they are expensive, they are likely eventually to come into widespread use

Software

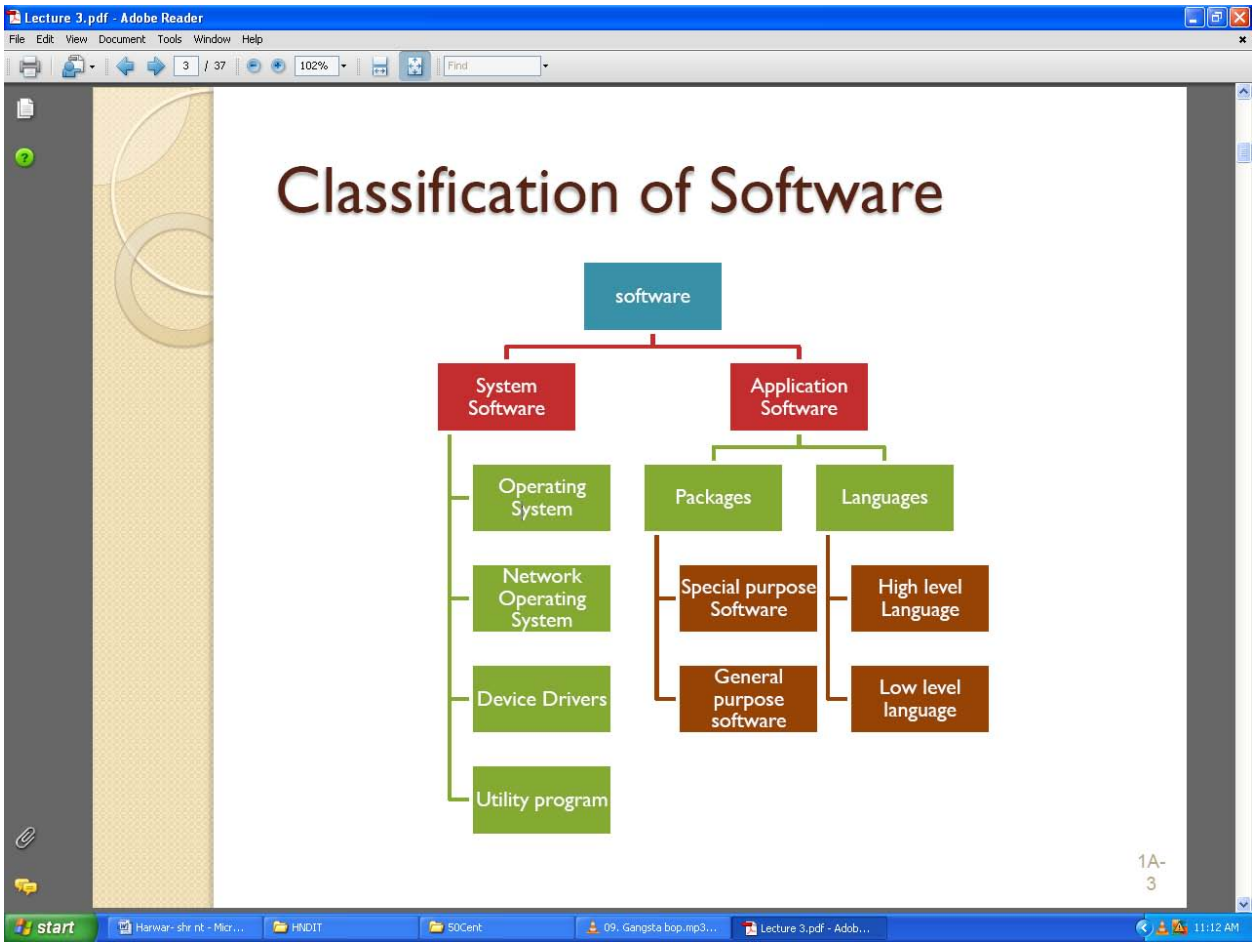
•Set of instructions that tells the computer what to do
•Runs the machine
•Two types

◦***System software***

•is the control software that operates the hardware and allows the applications to run.

◦***Application software***

•the programs we use for a specific purpose



Operating System

•An operating system is software program that controls the system hardware and which interact within the user and application software.

•OS is computer's master control program and provides the tools (commands) that enable you to interact within the PC.

- When you issue a command the OS translate it into machine language.

•The OS performs the following functions.

◦Provides user interface to interact with computer.

◦Loads programs into computer memory.

◦Coordinate how to work with the CPU, RAM and other hardware as well as with other software.

◦Memory management.

◦Protection

Network Operating System

•A network operating system (NOS) is a software program that controls other software and hardware that runs on a network.

- It also allows multiple computers, also known as network computers, to communicate with one main computer and each other, so as to share resources, run applications, and send messages,

The Network Operating System can also do the following:

1.Centrally manage network resources, such as programs, data and devices.

2.Secure access to a network.
3.Allow remote users to connect to a network.
4.Allow users to connect to other networks like the Internet.
5. Back up data and ensure its availability.
6. Allow for simple additions of clients and resources.
7. Monitor the status and functionality of network elements.
8. Distribute programs and software updates to clients.
9. Ensure efficient use of a server's capabilities.

Popular Network OS

◦Microsoft Windows Server 2003
◦Microsoft Windows Server 2008
◦UNIX
◦Linux
◦Mac OS X,
◦ Novell NetWare

Device drivers

•a computer program allowing higher-level computer programs to interact with a hardware device.
•Drivers are hardware-dependent and operating-system-specific

Utility programs

•Utility software carries out all the day-to-day tasks in maintaining a computer system and its data files.
• Utility is that enhances or extends the OS capabilities or which simply offer new features not provided by the OS itself

- There are thousands of different utility programs and you can find many of them free on internet.
  - ◦Disk Defragment
  - ◦Data compression software
  - ◦Backup utilities
  - ◦Disk management utilities
  - ◦Screen server
  - ◦Antivirus software

Disk Defragment

•If a file is too large to be served in a single sector on a disk, it must be broken into pieces.
• Each piece will be stored in a separate sector. If there are not enough contiguous sectors to store, the pieces are stored in non-contiguous sectors.
•When this happens to a large number of files that disk is said to be fragmented.
•Fragmented simply means the file is not stored in one place in its entirety, or what computer folks like to call a contiguous location.
- Different parts of the file are scattered across the hard disk in noncontiguous pieces.

• The more fragmented files there are on a drive, the more performance and reliability suffer as the drive heads have to search for all the pieces in different locations.
•The Disk Defragmenter Utility is designed to reorganize noncontiguous files into contiguous files and optimize their placement on the hard drive for increased reliability and performance

Data compression utility

•Data compression utility is used to reduce the size of files so that they consume less disk space.
• This utility programs use special algorithm to search files for unnecessary bits which are stripped out.
•E.g. WinZip, winRAR etc.

Antivirus utility

- These utility is used to detect and indicate the different types of viruses.
- Virus is unorganized software that is used to do some harmful things.
- Computer viruses spread from one computer to another generally through flash drives, internet etc.
- There are many problems caused by viruses such as damaging data, lost of user interface, unexpected screen massages, system crashes etc.
- There are many antivirus utilities such as MacAfee, Kaspersky, Symantec, and Norton antivirus etc

Diagnostic utility

- These utilities can detect bugs (errors in hardware and software) in computer.
  - For e.g. the problem of floppy and hard disk can easily detect by popular program called Norton Disk Doctor.

Application Software

- Application software describes the program that is written to apply the computer to a specific task

Packages

Special purpose application

- Software designed for specific tasks.

E.g. Payroll systems, Inventory systems, Library systems

General purpose application

- Software designed for variety of tasks and users.
  - *Word Processing Software*

Allows the users to make change in the document electronically in the memory.

- E.g. MS Word
  - *Spread Sheet*

Display data in a set of column and rows with the capability of easily recalculating numerical data.

- E.g. MS Excel, LOTUS 123

Languages

Low Level Languages

- Language that is machine dependent or that offers few control instruction and data type. Each statement in a program written in a low level language usually corresponds to one machine instruction.
- E.g. Machine Language, Assembly Language

Machine Language

- First generation language
- all instructions are given to computer in binary digits and can directly understand by computer.
- E.g. 1001110101110101 0001110101100110

Assembly Language

- 2nd generation language
- easier than machine language.
- Low level languages are used to develop system software and they are not used for application software.
- E.g. ADD A , B

High Level Languages

- High level languages usually contain English words and phrases.
- High-level programming languages create computer programs using instructions that much easier to understand than machine or assembly language instructions.
- Programs written in a high-level language must be translated into a low level language using a program called a *compiler or interpreter*.
- FORTRAN, COBOL, PASCAL, C, C++ and JAVA,VB

interpreter

- When each statement in a high-level source program is translated individually and executed immediately upon translation, the programming language used is called an *interpreted language*,
- program doing the translation is called an *interpreter*.

compiler

- When all of the statements in a high-level source program are translated as a complete unit before any one statement is executed, the programming language used is called a *compiled language*.
- The program doing the translation is called a *compiler*.

- **Advantages of High level languages over Low level languages :**
  - Easy to learn and use
  - The resultant programs are easier to read and modify
  - Does not refer very much from computer to computer.
  - High level languages usually less powerful and produce less efficient programs than low level languages

Spooling utility

- In multiuser or networking environment the input and output devices are generally overflow and the processing of computer is also slow down.
- To control the computer being slowed down, the spooling programs are used.
- Spooling stands for "Simultaneous peripheral operation on line" and used to buffer data for the printer.
- This program sends the output to the disk and printer does not interact with the CPU during printing.
- A spooling utility is mainly in computer system in multiuser network environment.

Bootstrap loaders

- A program that is automatically run when a computer is switched on (Booted). After performing a few basic hardware test, the bootstrap loader loads and passes control to a larger program which typically then loads the operating system. The bootstrap loader typically resides in the ROM.

BIOS (1)

- The BIOS software is built into the PC, and is the first code run by a PC when powered on ('boot firmware').
- The primary function of the BIOS is to load and start an operating system.
- When the PC starts up, the first job for the BIOS is to initialize and identify system devices such as the video display card, keyboard and mouse, hard disk, CD/DVD drive and other hardware.
  - The BIOS then locates software held on a peripheral device (designated as a 'boot device'), such as a hard disk or a CD, and loads and executes that software, giving it control of the PC.
- This process is known as *booting*, or booting up, which is short for bootstrapping.
- BIOS software is stored on a non-volatile ROM chip built into the system on the mother board.
- The BIOS software is specifically designed to work with the particular type of system in question, including having a knowledge of the workings of various devices that make up the complementary chipset of the system.
- In modern computer systems, the BIOS chip's contents can be rewritten allowing BIOS software to be upgraded

POST

- The computer *power-on self-test (*POST*)* tests the computer to make sure it meets the necessary system requirements and that all hardware is working properly before starting the remainder of the boot process.
- If the computer passes the POST the computer will have a single beep (*with some computer BIOS manufacturers it may beep twice*) as the computer starts and the computer will continue to start normally.

•However, if the computer fails the POST, the computer will either not beep at all or will generate a beep code, which tells the user the source of the problem.

Computer shutdown

After using the computer, you can exit from it, which is also referred to as shutting down the computer. The steps may be different depending on your operating system.

Computer Hibernate

Hibernation in computing is powering down a computer while retaining its state.
Upon hibernation, the computer saves the contents of its random access memory (RAM) to a hard disk or other non-volatile storage. Upon resumption, the computer is exactly as it was upon entering hibernation.
Hibernation saves electrical power. After hibernating, the hardware is completely powered down (just like for a regular shutdown). Therefore a hibernated machine uses no more electrical power than one which is switched off. Meanwhile, hibernation is a means of avoiding the burden of saving unsaved data before shutting down and restoring all running programs after powering back on.
Hibernation is used in laptops, which have limited battery power available. It can be set to happen automatically on a low battery alarm. Most desktops also support hibernation, mainly as a general energy saving measure. When used to save power, hibernation is similar to sleep mode and saves more power at the cost of slower resumption

Computer Sleep

Sleep mode can go by many different names, including **Stand By** (for Microsoft Windows 98-Server 2003), **Sleep** (for Mac OS 8-Mac OS X, Windows Vista, Windows 7, Windows Server 2008), and **Suspend** (Windows 95, Linux). When placed in this sleep mode, aside from the RAM, which is required to restore the machine's state, the computer attempts to cut power to all unneeded parts of the machine. Because of the large power savings, most laptops automatically enter this mode when the computer is running on batteries and the lid is closed.
A computer must consume some power while sleeping to run the circuits required to recognize and act on a wake-up event;

Using libraries to access your files and folders

When it comes to getting organized, you don't need to start from scratch. You can use libraries, a feature new to this version of Windows, to access your files and folders, and arrange them in different ways. Here's a list of the four default libraries and what they're typically used for:

☐**Documents library**. Use this library to organize and arrange word-processing documents, spreadsheets, presentations, and other text-related files. For more information, see Managing your documents.

By default, files that you move, copy, or save to the Documents library are stored in the My Documents folder.

☐**Pictures library**. Use this library to organize and arrange your digital pictures, whether you get them from your camera, scanner, or in e-mail from other people. For more information, see Managing your pictures.

By default, files that you move, copy, or save to the Pictures library are stored in the My Pictures folder.

☐**Music library**. Use this library to organize and arrange your digital music, such as songs that you rip from an audio CD or that you download from the Internet. For more information, see Managing your music.

By default, files that you move, copy, or save to the Music library are stored in the My Music folder.

Videos library. Use this library to organize and arrange your videos, such as clips from your digital camera or camcorder, or video files that you download from the Internet. For more information, see Managing your videos.

By default, files that you move, copy, or save to the Videos library are stored in the My Videos folder

Seek Time

Seek time is one of the three delays associated with reading or writing data on a computer's disk drive, and somewhat similar for CD or DVD drives. The others are rotational delay and transfer time. In order to read or write data in a particular place on the disk, the read/write head of the disk needs to be physically moved to the correct place. This process is known as *seeking*, and the time it takes for the head to move to the right place is the *seek time*. Seek time for a given disk varies depending on how far the head's destination is from its origin at the time of each read or write instruction; usually one discusses a disk's *average seek time*.

Rotational delay or **rotational latency** is the time required for the addressed area of a computer's disk drive (or drum) to rotate into a position where it is accessible by the read/write head. The term applies to rotating storage devices (such as a hard disk or floppy disk drive, and to the older drum memory systems).

Interface standard for Hard drives

Hard drives have different ways to interface with the computer. The interface standards define how hard drives and other drives such as CD, DVD, tape, and Blu-ray drives interface with a computer system. The standards define data speeds and transfer methods between the drive controller, the BIOS, the chipset on the motherboard, and the OS. The standards also define the type of cables and connectors used by the drive and the motherboard or expansion cards. The three current methods used by internal hard drives are

- Parallel ATA (PATA) or EIDE(Integrated Drive Electronics)
- Serial ATA (SATA)
- SCSI.

External hard drives can connect to a computer by way

- external SATA (eSATA)
- SCSI
- FireWire
- USB
- variation

Parallel ATA (PATA) or EIDE(Integrated Drive Electronics)

Parallel ATA, also called the **EIDE (Enhanced IDE)** standard or, more loosely, the IDE (Integrated Drive Electronics) standard, allows for one or two IDE connectors on a motherboard, each using a 40-pin data cable. These ribbon cables can accommodate one or two drives, as shown in Figure .

Serial ATA (SATA)

Serial ATA interfaces are much faster than PATA interfaces and are used by all types of drives, including hard drives, CD, DVD, Blu-ray, and tape drives. A motherboard can have two, four, six, or more SATA connectors, which are much easier to configure and use than PATA connectors. SATA supports **hot-swapping**, also called **hot-plugging**. With hot-swapping, you can connect and disconnect a drive while the system is running. A SATA drive connects to one internal SATA connector on the motherboard by way of a SATA data cable. An internal SATA data cable can be up to 1 meter in length, has 7 pins, and is much narrower compared to the 40-pin parallel IDE cable

SCSI (Small Computer System Interface)

Other than ATA, another interface standard for drives and other devices is SCSI, which is primarily used in servers. SCSI standards can be used by many internal and external devices, including hard drives, CD-ROM drives, DVD drives, printers, and scanners. **SCSI**stands for **Small Computer System Interface**, and is a standard for communication between a subsystem of peripheral devices and the system bus. The SCSI bus can support up to 7 or 15 devices, depending on the SCSI standard. SCSI devices tend to be faster, more expensive, and more difficult to install than similar ATA devices. Because they are more expensive and more difficult to install, they are mostly used in corporate settings and are seldom seen in the small office or used on home PCs

Partitioning hard disk

• A partition is a division of a hard drive. Windows can track up to four partitions on a drive and keeps this tracking information in a partition table that is written in the first 512-byte sector of the drive.
• create a partition on the drive in a process called high-level formatting or operating system formatting.
• During this process, you specify the size of the partition and what file system it will use.
• A file system is the overall structure an OS uses to name, store, and organize files on a drive.
• In a file system, a cluster is the smallest unit of space on a disk for storing a file and is made up of one or more sectors. A file system tracks how these clusters are used for each file stored on the disk.
• A partition can be a primary partition or an extended partition.
• A drive can have one, two, or three primary partitions, also called volumes.
• One of these primary partitions can be designated the active partition, which is the partition that startup BIOS turns to for an OS to load.
• One of the four partitions on a drive can be an extended partition which can hold one or more logical drives.(An extended partition can be divided into one or more logical drives. **)**
• A logical drive is sometimes called a logical partition.
• Partitions are created during the Windows installation, by using the Disk
• Primary and extended partitions can be created on a hard drive when the drive is first installed, when an OS is first installed, or after an existing partition becomes corrupted.
• When an OS is first installed, the installation process partitions and formats the drive, if necessary.
• After Windows is installed, you can use the Disk Management tool to view and manage partitions on a drive.

File System

• A file system is used to manage files and folders on the volume or logical drive.
• A cluster is a group of sectors used to hold a file, and the number of sectors in a cluster is determined by the file system used and the size of the drive.
• A file is stored in one or more clusters. The last cluster might have sectors that go unused, and this wasted space is called slack.
• File systems supported by Windows include NTFS, FAT32, and exFAT.
• Installing a file system on a volume or logical drive is called formatting.
• Formatting can be done using Disk Management, Windows Explorer, or the Format command.

FATFile system(file allocation table)

FAT is by far the most simplistic of the file systems supported by Windows. The FAT file system is characterized by the file allocation table (FAT), which is really a table(that tracks howspace on a disk is used to store files) that resides at the very "top" of the volume. To protect the volume, two copies of the FAT are kept in case one becomes damaged. In addition, the FAT tables and the root directory must be stored in a fixed location so that the system's boot files can be correctly located. A disk formatted with FAT is allocated in clusters, whose size are determined by the size of the volume. When a file is created, an entry is created in the directory and the first cluster number containing data is established. This entry in the FAT table either indicates that this is the last cluster of the file, or points to the next cluster. Updating the FAT table is very important as well as time consuming. If the FAT table is not regularly updated, it can lead to data loss. It is time consuming because the disk read heads must be repositioned to the drive's logical track zero each time the FAT table is updated.

Advantages of FAT

It is not possible to perform an undelete under Windows on any of the supported file systems. Undelete utilities try to directly access the hardware, which cannot be done under Windows . However, if the file was located on a FAT partition, and the system is restarted under MS-DOS, the file can be undeleted. The FAT file system is best for drives and/or partitions under approximately 200 MB, because FAT starts out with very little overhead.

Disadvantages of FAT

Preferably, when using drives or partitions of over 200 MB the FAT file system should not be used. This is because as the size of the volume increases, performance with FAT will quickly decrease. It is not possible to set permissions on files that are FAT partitions. FAT partitions are limited in size to a maximum of 4 Gigabytes (GB) under Windows and 2 GB in MS-DOS.

NTFS (New Technology file system)

NTFS is the file system that the Windows NToperating system uses for storing and retrieving files on a hard disk.NTFS is designed to provide greater security and to support more storage capacity than the FAT32 file system.NTFS offers a number of improvements over FAT in terms of performance, extendibility, and security. There are no special locations on the disk, such as FAT tables .

Features of NTFS include:

- ☐ cluster, not just a governing table (as FAT)
- ☐ Support for very large files (up to 2 to the 64th power or approximately 16 billion bytes in size)
- ☐ An access control list (ACL) that lets a server administrator control who can access specific files
- ☐ Integrated file compression
- ☐ Support for names based on Unicode
- ☐ Support for long file names
- ☐ Data security on both removable and fixed disks

Advantages of NTFS

NTFS is best for use on volumes of about 400 MB or more. This is because performance does not degrade under NTFS, as it does under FAT, with larger volume sizes. The recoverability designed into NTFS is such that a user should never have to run any sort of disk repair utility on an NTFS partition.

Disadvantages of NTFS

It is not recommended to use NTFS on a volume that is smaller than approximately 400 MB, because of the amount of space overhead involved in NTFS. This space overhead is in the form of NTFS system files that typically use at least 4 MB of drive space on a 100 MB partition. Currently, there is no file encryption built into NTFS. Therefore, someone can boot under MS-DOS, or another operating system, and use a low-level disk editing utility to view data stored on an NTFS volume. It is not possible to format a floppy disk with the NTFS file system; Windows NT formats all floppy disks with the FAT file system because the overhead involved in NTFS will not fit onto a floppy disk

Formatting storage devices

• Before a primary partition or volume can be used, it must be formatted using a file system.
• For the extended partition, each logical drive must be formatted with a file system.
• Three choices for a file system:
– Windows XP offers the FAT32 or the NTFS file system.

Disk management
• To manage Hard Drivess(Initializing, Partitioning, Formatting)
• To mount a drive
• To troubleshoot problems with a hard drive

To create a new volume on a drive, right-click in the unallocated space

- ❖ select New Simple Volume from the shortcut menu
- ❖ follow the directions on-screen to select the size of the volume
- ❖ assign a drive letter and name to the volume, and select the file system.
- ❖ In Windows XP, the size of a partition or volume cannot be changed unless you use third-party software.
- ❖ You can use Disk Management to delete a partition. To do so, right-click the partition and select Delete Partition from the shortcut menu

How to mount a drive
• A mounted drive is a volume that can be accessed by way of a folder on another volume so that the folder has more available space.

• A mounted drive is useful in these sample situations:
- ➢ You need to expand the space on a drive, such as when drive C is too small and you want to enhance that space using space on another volume
- ➢ you want to put all user data on another volume or hard drive other than the Windows volume (the C:\Users folder is the mount point in this situation);
- ➢ you have run out of drive letters A through Z.

• Make sure the volume that is to host the mounted drive uses the NTFS file system. The folder on this volume, called the mount point, must be empty. Use Windows Explorer to create a new folder or empty an existing folder. In our example, we are mounting a drive to the C:\Data folder.

What are the devices

- Hardware
- attached to a computer that expands its functionality
- Printers, modem ,scanner, webcam ,digital camera, barcode reader

Network card, video cards, sound card, USB card, wireless card(Expansion cards

Device Driver

- In computing, a device driver or software driver is a computer program allowing higher-level computer programs to interact with a hardware device. (All devices communicate with Windows through a piece of software called a device driver.)
- A driver typically communicates with the device through the computer bus or communications subsystem to which the hardware connects.
- Drivers are hardware-dependent and operating-system-specific.

- Some hardware drivers come with as a CD with hardware (Printers, scanner etc)
- Others come with as a CD with OS (in built network cards, video card, modem)
- When you buy expansion cards, drivers come with a CD
    - Can download & install using internet

Device Manager

- Device Manager (devmgmt.msc) is your primary Windows tool for managing hardware.
- It gives a graphical view of hardware devices configured under Windows and the resources and drivers installed on your computer.
- Using Device Manager, you can disable or enable a device, update its drivers, uninstall a device, and undo a driver update (called a driver rollback).
- For instance, when a device driver is being installed, Windows might inform you of a resource conflict, or the device simply might not work. You can use Device Manager as a useful fact-finding tool for resolving the problem.
- You can also use Device Manager to print a report of system configuration.

Uses of Device Manger

- Determine whether the hardware on your computer is working properly.
- Change hardware configuration settings.
- Identify the device drivers that are loaded for each device, and obtain information about each device driver.
- Change advanced settings and properties for devices. Install updated device drivers.
- Enable, disable, and uninstall devices.
- Roll back to the previous version of a driver.
- View the devices based on their type, by their connection to the computer, or by the resources they use.
- Show or hide hidden devices that are not critical to view, but might be necessary for advanced troubleshooting.

- For Windows XP, click **Start, right-click My Computer, select Properties from the** shortcut menu, and then select the **Hardware tab from the System Properties window.** Finally, click **Device Manager.**

Troubleshooting

- if you have a problem with an installed device is to use Device Manager to uninstall the device.
- Right-click the device and click **Uninstall on the shortcut** menu.
- Then reboot and reinstall the device, looking for problems during the installation that point to the source of the problem.
- Sometimes reinstalling a device is all that is needed to solve the problem.
- To find out more information about a device, right-click the device and select **Properties** on the shortcut menu.
- The Windows is reporting that the device cannot start and suggests how to search for a solution.

Processing Interrupts

- Os responds to requests to use memory & other devices, keeps track of which programs have access to which devices, & coordinates everything that the hardware does so that various activities do not overlap & cause the computer to become confused & stop working.
- OS uses interrupt requests (IRQs) to help the CPU coordinates process.
- Ex. If you tell the OS to list files in a folder, it sends IRQ to the computer's CPU

Considering factors when installing a software

- Compatibility of software with OS /version
- License key (internet required to online update or register)
- Prerequisite component installed (Microsoft .NET frame work, java virtual machine)
- Hardware requirements
    - RAM size
    - Processor speed
    - Hard disk space (remaining volume)

Installing Software

- Software comes with CD or you can download from internet
- Must have license key to install software
- Must have administrative rights to install software
- Two ways to install software
    - Run setup.exe file come with the software & follow the instruction
    - Using control panel, add remove program

Uninstall software

- If you don't want a application any more, can remove the program from computer
- Two ways
    - Using control panel, add remove program
    - Start menu-> all programs -> go to the software that you want uninstall & select the uninstall short cut

Backup

- A backup is an extra copy of a data or software file that you can use if the original file becomes damaged or destroyed.
- Losing data due to system failure, a virus, file corruption, or some other problem really makes you appreciate the importance of having backups.
- when you store important data on any media—such as a flash drive, external hard drive, or CD—always keep a copy of the data on another media.

Never trust important data to only one media

Planning for recovery

- Decide on the backup media (tape, CD, DVD, flash drive, another hard drive, or other media).
- Even though it's easy to do, don't make the mistake of backing up your data to another partition or folder on your same hard drive.
- When a hard drive crashes, most likely all partitions go down together and you will have lost your data and your backup.

Back up to another media and, for extra safety, store it at an off-site location

- Backing up data takes time and backup media is expensive, you can use a selective backup plan where you only back up data that changes often.
- Run scheduled backups (during the night)(back up once a day, once a week, or once a month.)
- your backups, always record your regular backups in a log with the following information:
    - **Folders or drives backed up**
    - **Date of the backup**
    - **Type of backup**
    - **Label identifying the tape, disk, or other media**
- If you discover that data has been lost days or weeks ago, you can use this backup log or table to help you recover the data. Keep the records in a notebook.
- You can also store the records in a log file (a file where events are logged or recorded) each time you back up. Store the file on a flash drive or another PC

System Restore Point

- System Restore is a component of Windows operating systems that allows for the rolling back of system files, registry keys, installed programs, etc., to a previous state in the event of system malfunction or failure.

User Account

- A user account is a collection of information that tells Windows which files and folders you can access, what changes you can make to the computer, and your personal preferences, such as your desktop background or screen saver.
- User accounts let you share a computer with several people, while having your own files and settings.
- Each person accesses his or her user account with a user name and password.
- There are three types of accounts. Each type gives users a different level of control over the computer:
    - **Standard accounts** are for everyday computing.
    - **Administrator accounts** provide the most control over a computer, and should only be used when necessary.

- **Guest accounts** are intended primarily for people who need temporary use of a computer.

Hardware needs software to work

•Computer user must interact with a computer in a way that both the user & software understand
•Software must convert instruction(entries made by way of a keyboard or mouse) into a form that hardware can understand

Converting Binary

•All counting & calculations use the binary number system
•When text is stored in a computer , every letter or other character is first converted to a code using 1s & 0s.
•Common coding method for text is ASCII (American Standard Code for Information Technology)

Hardware inside the computer case

•Most storage & all processing data & instruction are done inside the computer case
•Looking the inside of the case
  ◦A motherboard containing the CPU, memory, & other components
  ◦A hard drive and optical drive(CD & DVD) used for permanent storage
  ◦A power supply with power codes supplying electricity to all devices inside the case
  ◦Adapter cards used by CPU to communicate with devices inside & outside the case
  ◦Cables connecting devices to adapter cards & motherboard

Adapter Cards

•Also called expansion card or simply cards
•Is a circuit board that holds microchips or integrated circuits(IC) & the circuitry that connects these chips
•All cards contain micro chips manufactured using CMOS(Complementary metal oxide semiconductor technology)

Motherboard

•Largest & most important circuit board
•Also called mother board or system board
•Contain sockets to hold CPU
•All devices communicate with the CPU
•All devices installed directly (port) or indirectly to motherboard (expansion card)
•A device that is not installed directly on mother board called, peripheral device
•Some ports on motherboard stick outside the case (keyboard, mouse)

Processing components in Motherboard

•Processor or CPU
•Chipset –supports the processor by controlling many motherboard activities
•RAM –temporary storage, hold data & instruction as they are processed

Components that allow processor to communicate with other devices

•Wires on the motherboard used for communication
•Expansion slots to connect expansion cards to motherboard
•The system clock that keeps communicate in synchronize
•Connections for data cables to device inside case
•Ports for device outside the case

Programming & setup data stored in motherboard

- Flash ROM- a memory chip used to permanently store instructions that control basic hardware function
- CMOS RAM- chip that holds configuration data

Processor & chipset

- CPU is the chip inside the computer that performs most of actual data processing.
- Chipset , a group of microchips on the motherboard that control the flow of data & instruction to & fromprocessor
- chipset assist the CPU, responsible for the careful timing & coordination of activities
- CPU manufactures- Intel & AMD, motorola

ATA – Interface standard

- Regardless of the internal technology, use the interface between an internal hard drive & the motherboard, ATA(AT attachement) standard
- Use to connect CD, DVD, Hard drive
- Two major ATA standard
  - Serial ATA(SATA)
  - Parallel ATA(PATA)

SATA

- The newer & faster
- SATA cable are flat & thin
- One end connects to the devices & other end to the mother board connector
- eSATA-external SATA standard allows for a port on the computer case to connect an external eSATA harddrives & other devices
- Motherboard offer 2 to 8 SATA & eSATA

Motherboard that uses SATA might also have parallel ATA connector for older devices

- External drives, including hard drives, optical drives & other drive might use a USB connection, a Fire Wire connection (which is faster than USB) or an eSATA connection(faster than fire wire

Parallel ATA(PATA)

- Sometimes called EIDE(Enhanced IDE) or IDE
- Slower than SATA
- Allow for only two connectors on a Motherboard for two data cables
  - IDE ribbon cable has two connection at the end for IDE device & a connection in the middle of the cable for a second IDE device.
- Using this system, a motherboard can accommodate up to 4 IDE devices on a system
- Typically one IDE connector for hard drive, other for CD drive

Mother Board computer used for communication among devices

- Line on both top & bottom surface called **traces**
- Traces means Circuits or paths that enable data , instructions & power to move from component to component on the board
- This system of path ways used of communication & the port & methods used for transaction are collectively called bus

BUS line

- Lines are 8, 16, 32, 64 or 128 bits wide
- Line of the bus that are used for data called data bus
- Main bus on motherboard that communicate with CPU, memory & chipset called system bus

Expansion Slots

- PCI – Peripheral Component Interconnect – used for Input/output devices
- PCI Express (PCIe)-slots that come in several lengths & are used by high speed Input/output devices
- AGP – (Accelerated Graphic ports) –used for video card/graphic card
    - PCI slots used in both newer & older motherboard
- AGP slots available in older motherboard
- In newer motherboard use PCIe slots for Video card (PCIe ×1 to PCIe ×16)

Expansion card

- Card are mounted in expansion slots on motherboard
- Card has techniques to communicate with the slot it in the motherboard & CPU
    - Video/ Graphic card- provide one or more ports for monitor
- Network card – Provide a port for a network cable to connect the PC to a network
- Modem card –provide ports for phone lines

Power Supply

- Motherboard has one primary connection to receive power from power supply
- This power is used by the motherboard, CPU & other component that receive the power from ports & expansion slots
- Other power connection on the motherboard to power a small fan that cools CPU

Instruction stored in the motherboard & other board

- Some very basic instruction are stored on the motherboard
    - To start the computer
    - To use some simple hard device(monitor & keyboard)
    - Search a OS stored storage device
- These data have stored on specific ROM chips on the board called BIOS(Basic Input/output system)
- Some adapter card such as video card also have ROM BIOS chip
- Some software embedded in to hardware is referred to as firmware

ROM BIOS

- Three purpose
    - Used to manage simple devices called **system BIOS**
    - Used to start the computes called **start up BIOS**
    - used to change some settings on the motherboard called **BIOS setup** or **CMOS setup**

CMOS RAM

- Motherboard settings are stored in small amount of RAM located on the firmware chip called CMOS RAM or CMOS(Complementary Metal Oxide Semiconductor)
- Settings stored in CMOS RAM
    - Current date & time
    - Which hard drive are present
    - Have parallel port configured
- CMOS RAM is volatile memory
- When computer turned off, CMOS RAM is powered by a small battery located on the motherboard close to firmware

So motherboard configuration is not lost where PC is turned off

- ROM chips on motherboards today are made of non volatile memory & can be reprogrammed called flash ROM

Control Unit

All computer operations are controlled by the control unit

- Reads & Interprets Program Instructions

- Directs the Operation of the Processor
- Controls the flow of programs and data into and out of memory
- The timing signals that govern the I/O transfers are also generated by the control unit.
- Control unit is usually distributed throughout the machine instead of standing alone.
- **Operations of a computer:**
  - Accept information in the form of programs and data through an input unit and store it in the memory
  - Fetch the information stored in the memory, under program control, into an ALU, where the information is processed
  - Output the processed information through an output unit
  - Control all activities inside the machine through a control unit

Registers

Primary roles

Hold data for currently executing program that is needed quickly or frequently (general-purpose registers)
Store information about currently executing program and about status of CPU (special-purpose registers)

- PC-program counter
- AC- Accumulator
- MAR –Memory Address Register
- MDR- Memory Data Register
- CIR /IR– Current Instruction Register
- Stack pointer
- Status Register/ Flag Register
- AX (AH,AL)
- BX(BH, BL)
- Etc.

Program Counter (PC)

- A special register, determines the location in memory (memory address) from which the next instruction will be fetched.
- Usually, the counter is just incremented to the next value.
- Branches (if statements, while statements, calls on methods, etc.) change the program counter to say where to find the next instruction.
- Move PC value to the MAR when instruction fetch

Accumulator

- The **Accumulator** is an internal CPU register used as the default location to store any calculations performed by the **arithmetic and logic unit**.
- is a special purpose register that is there in the ALU.

MAR Registers

- The CPU uses the two registers MAR and MDR to access the main memory.
- Reading data from memory
- Writing data to memory
- MAR
  - Contains the memory address of the current memory location accessed by the CPU.

Bus Structures

- There are many ways to connect different parts inside a computer together.
- A group of lines that serves as a connecting path for several devices is called a *bus*.
    - Address
    - Data
    - Control

Computer Speed and power are determined by:

- Microprocessor speed
- Bus lines
- Cache

Microprocessor speeds can be measured in a variety of ways:

- Megahertz
- MIPS
- Megaflops
- Fsb

Speed Issue

- Different devices have different transfer/operate speed.
- If the speed of bus is bounded by the slowest device connected to it, the efficiency will be very low.
- How to solve this?

A common approach – use buffers

Processor Clock Cycle

- Clock, clock cycle, and clock rate
- A Crystal Oscillator on the Motherboard
- The execution of each instruction is divided into several steps, each of which completes in one clock cycle.
    - Hertz – cycles per second
    - Measured in MHz or GHz
    - Megahertz = 1,000,000 cycles/sec
    - Gigahertz = 1,000,000,000 cycles/sec
    - One clock cycle is calculated by dividing 1 by the MHz or GHz
    - Example: (800 MHz CPU)

  1/800,000,000 =0.00000000125 or 1.25 nanoseconds
- The shorter the clock cycle the faster the processor

Processor Types

Two types:

1. Socket type
2. Slot type.

- Pin arrangement in the Socket type processor is known as **Pin Grid Array** (PGA).
- Slot type processor is also known as **Single Edged Contact Cartridge** (SECC).

Processor Manufacturers

- Intel (Integrated Electronics)
- AMD (Advanced Micro Devices)
- VIA

- Cyrix
- TRANSMETA
- MOTOROLA

Dual-Core

A **dual-core** CPU combines two independent processors and their respective caches and cache controllers onto a single silicon chip

Introduction to Network

- A **computer network**, often simply referred to as a network, is a collection of computers and devices interconnected by communications channels that facilitate communications among users and allows users to share resources.
- Networks may be classified according to a wide variety of characteristics.
- A computer network allows sharing of resources and information among interconnected devices.

Types of network

- LAN
- WAN
- MAN
- Hybrid

Local Are Network (LAN)

- Local Area Network generally called LAN is implemented within a single building or campuses of up to few Km s in size.
- They are widely used to connect personal computers and workstations in a company, office, factory to locally share computer files & resources efficiently and make internal communications possible.
    - Contains printers, servers and computers
    - Systems are close to each other
    - Contained in one office or building
    - Organizations often have several LANS

LAN are designed to

- Operate within a limited geographic area
- Allow multi-access to high bandwidth media
- Control the network privately under local administration
- Provide full time connectivity to local services
- Connect physically adjacent devices

LANs consist of the following components

- Computers
- Network interface cards
- Peripheral devices
- Networking media
- Network devices

Wide Are Network (WAN)

- WANs interconnect LANs, which then provide access to computers or file servers in other locations.
- WANs connect user networks over a large geographical area; they make it possible for businesses to communicate across great distances. WANs allow computers, printers, and other devices on a LAN to be shared with distant locations.
- WANs provide instant communications across large geographic areas.
    - Two or more LANs connected
    - Over a large geographic area
    - Typically use public or leased lines
        - Phone lines
        - Satellite
    - The Internet is a WAN

WANs are designed to do the following:

- Operate over a large and geographically separated area
- Allow users to have real-time communication capabilities with other users
- Provide full-time remote resources connected to local services
- Provide e-mail, Internet, file transfer, and e-commerce services

Metropolitan are Network(MAN

- Wireless bridge technologies that send signals across public areas can also be used to create a MAN.
- A MAN usually consists of two or more LANs in a common geographic area.
- For example, a bank with multiple branches may utilize a MAN
- Typically, a service provider is used to connect two or more LAN sites using private communication lines or optical services.
- A MAN can also be created using wireless bridge technology by beaming signals across public areas.

Hybrid Network Area

- Campus Area Networks (CAN)
    - A LAN in one large geographic area
    - Resources related to the same organization
    - Each department shares the LAN
- Home Area Network (HAN)
    - Small scale network
    - Connects computers and entertainment appliances
    - Found mainly in the home
- Personal Area Network (PAN)
    - Very small scale network
    - Range is less than 2 meters
    - Cell phones, PDAs, MP3 players

Networking Devices

- Equipment that connects directly to a network segment is referred to as a device.
- These devices are broken up into two classifications.

- end-user devices
- network devices

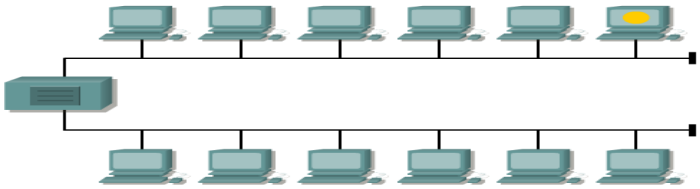
- End-user devices include computers, printers, scanners, and other devices that provide services directly to the user.
- Network devices include all the devices that connect the end-user devices together to allow them to communicate.

Network Interface Card

A network interface card (NIC) is a printed circuit board that provides network communication capabilities to and from a personal computer. Also called a LAN adapter.
LAN cards or network adapters are the building blocks of a computer network. No computer can communicate without a properly installed and configured LAN card. Every LAN card is provided with a unique IP address, subnet mask, gateway and DNS (if applicable). An UTP/STP cable connects a computer with the hub or switch. Both ends of the cable have the RJ-45 connectors one is inserted into the LAN card and one in the hub/switch. LAN cards are inserted into the expansion slots inside the computer. Different LAN cards support different speed from 10/100 to 10/1000.

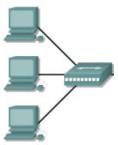
Repeater

A repeater is a network device used to regenerate a signal.
Repeaters regenerate analog or digital signals distorted by transmission loss due to attenuation.
Any electrical signal reaching the repeater from one segment, will be amplified and retransmitted to the other segment.



- Any electrical signal reaching the repeater from one segment, will be amplified and retransmitted to the other segment.
- Using repeaters slows the signal's propagation, and thus the amount of repeaters should be limited.

Hub

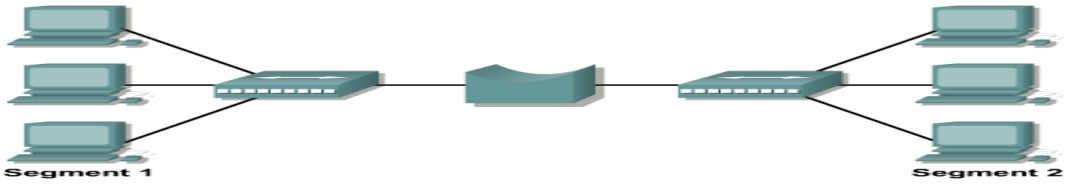


Hubs concentrate connections. In other words, they take a group of hosts and allow the network to see them as a single unit.
This is done passively, without any other effect on the data transmission.

The central connecting device in a computer network is known as a hub. There are two types of a hub i.e. active hub and passive hub. Every computer is directly connected with the hub. When data packets arrives at hub, it broadcast them to all the LAN cards in a network and the destined recipient picks them and all other computers discard the data packets. Hub has five, eight, sixteen and more ports and one port is known as uplink port, which is used to connect with the next hub.

Bridge

A bridge is a physical unit, typically a box with two ports in it, that you use to connect network segments.
You can use a bridge to join two existing LANs or to split one LAN into two segments.
Bridges convert network transmission data formats as well as perform basic data transmission management.
Bridges, as the name implies, provide connections between LANs.



- A **bridge** device filters data traffic at a network boundary. Bridges reduce the amount of traffic on a LAN by dividing it into two segments.

Bridges operate at the data link layer (Layer 2) of the OSI model. Bridges inspect incoming traffic and decide whether to forward or discard it. An Ethernet bridge, for example, inspects each incoming Ethernet frame - including the source and destination MAC addresses, and sometimes the frame size - in making individual forwarding decisions

- Not only do bridges connect LANs, but they also perform a check on the data to determine whether it should cross the bridge or not. This makes each part of the network more efficient.

Switch

- *switch* has largely replaced the bridge in the modern network.
- It is also replacing routers in many instances.
- A switch is a box with multiple cable jacks, making it look similar to a hub.
- In fact, some manufacturers have hubs and switches of various sizes that are identical in appearance, except for their markings.
- The difference between a hub and a switch is that a hub forwards every incoming packet out through all of its ports, and a switch forwards each incoming packet only to the port that provides access to the destination system.

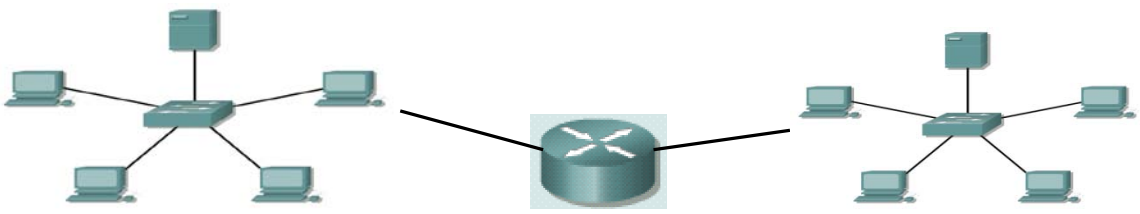
- Workgroup switches add more intelligence to data transfer management.
- Switches can determine whether data should remain on a LAN or not,
- and they can transfer the data to the connection that needs that data.

Like the router, a switch is an intelligent device that maps the IP address with the MAC address of the LAN card. Unlike the hubs, a switch does not broadcast the data to all the computers, it sends the data packets only to the destined computer. Switches are used in the LAN, MAN and WAN. In an Ethernet network, computers are directly connected with the switch via twisted pair cables. In a network, switches use the three methods to transmit the data i.e. store and forward, cut through and fragment free.

Router

Routers have all capabilities of the previous devices. Routers can regenerate signals, concentrate multiple connections, convert data transmission formats, and manage data transfers.

They can also connect to a WAN, which allows them to connect LANs that are separated by great distances.



A router is a communication device that is used to connect two logically and physically different networks, two LANs, two WANs and a LAN with WAN. The main function of the router is to sorting and the distribution of the data packets to their destinations based on their IP addresses. Routers provides the connectivity between the enterprise businesses, ISPs and in the internet infrastructure, router is a main device. Cisco routers are widely used in the world. Every router has routing software, which is known as IOS. Router operates at the network layer of the OSI model. Router does not broadcast the data packets.

Transmission Media

A communication link is established by using some kind of transmission medium. In the most cases it is a pair of electric conductors.

- Communication links are also established using the media such as fiber optic cables & using electromagnetic waves on the free space.

Networking Media

- Copper Media
- Optical Media
- Wireless Media

Copper Media

- Copper cable is used in almost every LAN
- Many different types of copper cable are available
- Each type has advantages and disadvantages
- Proper selection of cabling is key to efficient network operation

Twisted Pair Cables

- Oldest & still most common transmission Media.
- Consist of two insulated copper wires twisted together.
- Can be used for either analog or digital transmission.
- Twisting reduces the effects of the external interferences.
- To avoid magnetic field effect the wires are twisted.
- Common applications.
    - Telephone System ,LAN
- Two types.
    - Shielded Twisted Pair Cables (STP)
    - Unshielded Twisted Pair Cables (UTP)
- Unshielded twisted pair cables (UTP)
    - Commonly used UTP are categorized as CAT3,CAT5 & CAT5e
        - Straight through
        - Crossover
    - Use RJ45 connector for UTP cables
- There are 8 color wires. 4 wires for caring voltage called Tip , 4 wires for grounded called ring

Use straight-through cables for the following connections:

- Switch to router
- Switch to PC or server
- Hub to PC or server

Use crossover cables for the following connections

- Switch to switch
- Switch to hub
- Hub to hub
- Router to router
- PC to PC
- Router to PC

Coaxial cable

- has a single copper conductor at its center.
- A plastic layer provides insulation between the center conductor and a braided metal shield.
- The metal shield helps to block any outside interference .
- difficult to install.

support greater cable lengths between network devices than twisted pair cable

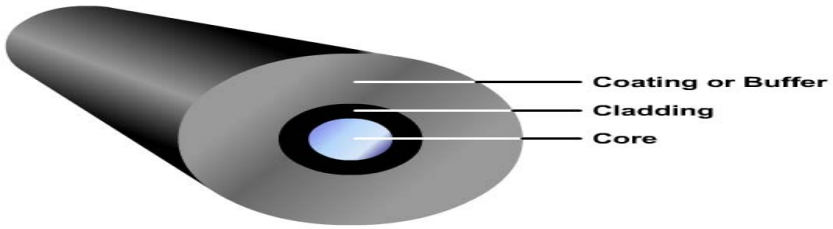
Fiber Optics

- Fiber optic cable is a completely different type of network medium than twisted-pair or coaxial cable.
- Instead of carrying signals over copper conductors in the form of electrical voltages, fiber optic cables transmit pulses of light over a glass or plastic filament.
- Optical fiber is the most frequently used medium for the longer, high bandwidth, point-to-point transmissions required on LAN backbones and on WANs .
- consists of a center glass core surrounded by several layers of protective .

has the ability to transmit signals over much longer distances (upto 2Km)than coaxial and twisted pair

- has the capability to carry information at vastly greater speeds.(1000 Mbps)
- Consist of extremely thin cylinder of glasses called core surrounded by claddy.
- More lightly expensive than Cu cables
- Two fibers. one to transmit & one to receive.

High secure from outside interference such as radio transmitter, arc welders, fluorescent light & other sources of electrical noises



Wireless Media

- Transmission of waves take place in the electromagnetic (EM) spectrum.
- The carrier frequency of the data is expressed in cycles per second called hertz(Hz).
- Low frequency signals can travel for long distances through many obstacles but can not carry a high bandwidth of date
- high frequency signals can travel for shorter distances through few obstacles and carry a narrow bandwidth.
- Also the noise effect on the signal is inversely proportional to the power of the radio transmitter.

The three broad categories of wireless media are:

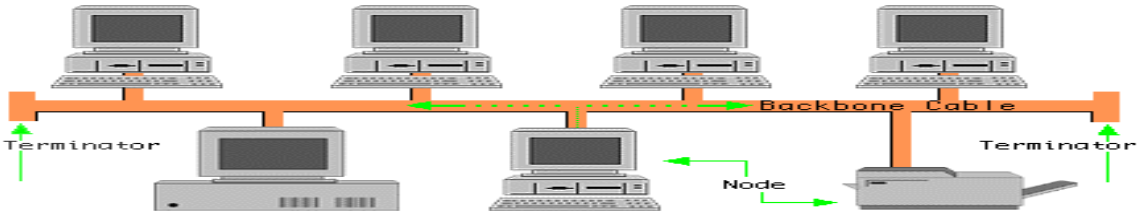
- Radio

- 10 KHz to 1 GHz. It is broken into many bands including AM, FM, and VHF bands.
- Microwave
- Infrared
  - The signal cannot travel through objects. Light may interfere with the signal.

Access Point(AP)

- To solve compatibility problems among devices, an infrastructure mode topology can be set up using an access point (AP) to act as a central hub for the WLAN.
- The AP is hard wired to the cabled LAN to provide Internet access and connectivity to the wired network. APs are equipped with antennae and provide wireless connectivity over a specified area

- **Bus Topology**
  - A bus topology uses one cable as a main trunk to connect all of the system together.
  - A bus topology is very easy to setup & requires no additional hardware such as switch, hub.
  - The cable is also called a trunk, a backbone. With a bus topology, when a computer sends out a single the signal travels the cable link in both direction from the sending computer.
  - When the signal reach the end of the cable length it bounces back & return in the direction it come.



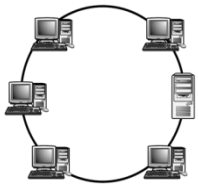
Advantages of a Bus Topology

- Low cost
- Easy to connect a computer or peripheral to bus.
- Requires less cable length than a star topology.
- No need to purchase any additional devices such as switch and hub.

Disadvantages of a Bus Topology

- Entire network shuts down if there is a break in the main cable.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down. (Difficult to troubleshooting).

- **Ring Topology**
  - In a ring topology all computer are connected via a cable that loops in a ring or a circle.
  - It is a circle that has no start & no end. Because there are no ends terminators are not necessary.



Advantages

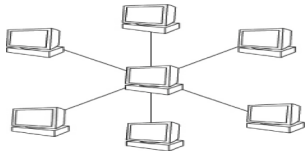
- It is less expensive than star topology.
- Nodes can be easily added or removed.

Disadvantages

- It is more difficult to install and maintain.
  If a node fails, it affects the entire network

- **Star Topology**
  - In star topology all computers are connected through one central device known as a switch or hub.
  - Each workstation has a cable goes from the network card to the hub device.

One of the major benefits of a star topology is that if there is a break down in a cable it causes only the work station not entire network.



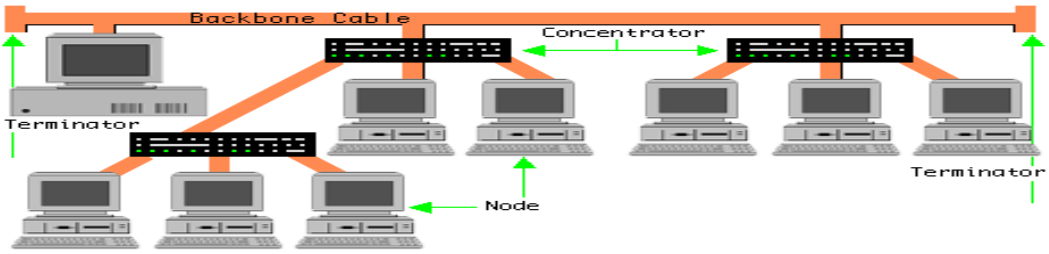
Advantages

- It is easy to install and to maintain.
- Can easily add and remove nodes to and from the network without affecting the network.(scalability)
- If need to add another workstation with a star topology we can simply connect that system an unused part of the hub.
- If any node fails, other nodes are not affected.

Disadvantages

- This type of network depends upon the central Hub. If Hub fails the entire network is failed.(But hub troubleshooting is easier than bus topology)
- Each computer is directly connected to the Hub through a cable, so it becomes more costly.

- **Tree Topology**
  - A tree topology combines characteristics of bus and star topologies.
  - It consists of groups of star-configured workstations connected to a bus backbone cable.
  - Tree topologies allow for the expansion of an existing network



Advantages of a Tree Topology

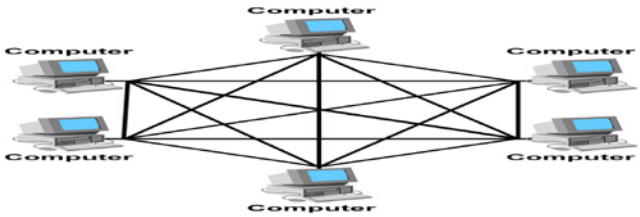
- Point-to-point wiring for individual segments.
- Supported by several hardware and software venders.

Disadvantages of a Tree Topology

- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.
- More difficult to configure and wire than other topologies

- **Mesh Topology**
  - In a **mesh topology,** each computer is connected to every other computer by a **separate cable.**
  - This configuration provides **redundant paths**, so if one computer encounters a problem, the entire network still works.

On a large scale, multiple LANs can be connected using mesh topology with the help of **telephone lines, coaxial cable** or **fiber optic cable**.



Number of cables =n(n-1)/2 =6(6-1)/2 =15

Advantages

- Provides redundant paths between devices
- The network can be expanded without disruption to current users.

Disadvantages

- Requires more cables than the other LAN topologies.
- Complicated implementation

TCP/IP

- The **Internet Protocol Suite** is the set of communications protocols used for the Internet and other similar networks.
- TCP/IP defines the rule computers must follow to communicate with each other over the internet.
- It is commonly also known as **TCP/IP** named from two of the most important protocols in it:
  - the Transmission Control Protocol (TCP) and the Internet Protocol (IP), which were the first two networking protocols defined in this standard.
- TCP/IP (Transmission Control Protocol/Internet Protocol) is the basic communication language or protocol of the Internet. It can also be used as a communications protocol in a private network (either an intranet or an extranet). When you are set up with direct access to the Internet, your computer is provided with a copy of the TCP/IP program just as every other computer that you may send messages to or get information from also has a copy of TCP/IP.
- TCP/IP is a two-layer program. The higher layer, Transmission Control Protocol, manages the assembling of a message or file into smaller packets that are transmitted over the Internet and received by a TCP layer that reassembles the packets into the original message. The lower layer, Internet Protocol, handles the address part of each packet so that it gets to the right destination. Each gateway computer on the network checks this address to see where to forward the message. Even though some packets from the same message

Internet

- TCP/IP is a two-layer program. The higher layer, Transmission Control Protocol, manages the assembling of a message or file into smaller packets that are transmitted over the Internet and received by a TCP layer that reassembles the packets into the original message. The lower layer, Internet Protocol, handles the address part of each packet so that it gets to the right destination. Each gateway computer on the network checks this address to see where to forward the message. Even though some packets from the same message

Understanding the Internet

- The Internet allows accessing resources
- The Web simplifies the Internet
- The Web connects documents
  - Hypertext creates links between documents
  - Documents are stored on a web server
  - HTTP delivers documents

- Web site is a collection of documents
    - Document is a web page
    - Pages are published to the web

- Hypertext Markup Language
    - Creates web pages
    - Describes how pages should look
    - Content enclosed in tags
    - <tag>content</tag>
- Browsers
    - Read and translate the HTML
    - Display web content
- Uniform Resource Locator (URL)
    - Address of a web page
    - Helper applications
    - Plug-ins
    - Enhance a browser's functionality
- Streaming audio and video
    - Sends the file in small chunks
    - Chunks downloaded while others play

WWW

- The **World Wide Web**, abbreviated as **WWW** and commonly known as **the Web**, is a system of interlinked hypertext documents accessed via the Internet.
- With a web browser, one can view web pages that may contain text, images, videos, and other multimedia and navigate between them via hyperlinks

Hyperlink

- In computing, a **hyperlink** (or *link*) is a reference to a document that the reader can directly follow, or that is followed automatically.
- A hyperlink points to a whole document or to a specific element within a document.

Hypetext

- Hypertext is text which contains links to other texts.
- **Hypertext**, made famous by the World Wide Web, is most simply a way of constructing documents that reference other documents.

Accessing The Internet

- Internet Service Provider (ISP)
    - Company that provides Internet access
- Dialup
    - Connects to Internet through phone line
    - Modem connects to the phone line
    - Slow connection
- High-speed access
    - Connect through a special line
    - 2 – 25 times faster than dialup

- DSL, Cable, T1 are common

Internet Connection Types

- **Individual persons - Dialup Connection, ADSL**
- **Small organization – ADSL**
  ISDN
  WIRELESS
- **Large organization – Leased line**

- **Dial-up connections**
  - Standard phone lines and a modem
  - uses the facilities of the PSTN (Public Switched Telephone Network) to establish a dialed connection to an Internet service provider (ISP) via telephone lines.
  - Computer dials a number for your ISP
  - All Internet programs use the connection
  - Applications might need configured
  - A transient connection,

because either the user, ISP
or phone company
terminates the connection

- High-speed broadband connections
  - Any connection faster than dialup
  - Offers speeds 700 Kbps or higher
  - Networks share the broadband connection
    - All users access the same connection
    - T or DSL lines common
  - Home use increasing due to
    - Lower cost
    - Increased availability

- **ISDN (Integrated Services Digital Network)**
  - Offers speeds up to 1.5 Mbps
  - Uses standard phone lines
  - Requires special equipment
  - Simultaneous use of phone and data
  - An international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires (copper wires).
  - Offers circuit-switched connections (for either voice or data), and packet-switched connections (for data)
- **DSL (Digital Subscriber Line)**
  - Offers speeds up to 30 Mbps
  - provides digital data transmission over the wires of a local telephone network
  - Uses modified phone lines
    - Needs special DSL modem

- Simultaneous use of phone and data

- **xDSL**

- - Refers collectively to all types of DSL
- - new digital service that uses high-bandwidt to bring voice, video and data to your business.
  - two main categories being ADSL and SDSL
- - Two other types of xDSL technologies are *High-data-rate DSL (HDSL)* and *Very high DSL (VDSL)*.

- **ADSL (Asynchronous DSL or *Asymmetric DSL*)**
  - Different up and download speeds (i.e. 608/128, 1500/384)
  - Usually used for residential service, since residential customers don't need to upload much

- **SDSL (Synchronous DSL or *Symmetric DSL*)**
  - upstream and downstream speeds are equal (i.e. 1.5M/1.5M)
  - Usually used for business service

ADSL and SDSL are very affordable and cost-effective services
based upon a flat rate and also they are easily and inexpensively installed.

- **Variable DSL**
  - Speed changes based on traffic

- **<u>Cable modems</u>**
  - Speeds up to 3 Mbps
  - Uses cable TV wires
  - Requires a cable modem
  - Simultaneous use of TV and data

<u>Leased line</u>

- A permanent fiber optic or telephone connection between two points set up by a telecommunications carrier
- Sometimes referred to as a 'dedicated line'
- Can be used for telephone, data, or Internet services
- Oftentimes businesses will use a leased line to connect to geographically distant offices because it guarantees bandwidth for network traffic.

e.g. A bank may use a leased line in order to easily transfer financial information from one office to another.

- Do not have telephone numbers because each side of the line is always connected to one another, as opposed to telephone lines which reuse the same lines for numerous conversations through a process called "switching."
- The fee for the connection is a fixed monthly rate. *(The primary factors affecting the monthly fee are distance between end points and the speed of the circuit)*
- provide a guaranteed level of service and speed, offering fast data transfer over a completely secure connection at a price that can be cost effective for very heavy internet users

- **<u>Wireless WAN (WWAN)</u>**
  - Wireless network over a large area
  - Uses radio signals to transfer data
  - Speeds range from 1 to 100 Mbps

- Antennas required
- Subject to atmospheric disturbances

- **Wireless MAN (WMAN)**
  - A type of wireless network that connects several Wireless LANs

WiMAX : A type of Wireless MAN described by the IEEE 802.16 standard.

- **Wi-Fi**
  - Wireless Fidelity
  - wireless networking technology that allows computers and other devices to communicate over a wireless signal.
  - Wi-Fi connection only exists between the device and the router.
  - Most routers are connected to a DSL or cable modem, which provides Internet access to all connected devices.
- **WiMAX**
  - Worldwide Interoperability for Microwave Access
  - A communications technology that uses radio spectrum to transmit tens of megabits per second in bandwidth between digital devices such as laptop computers.
  - Similar to WiFi , WiMAX brings with it the ability to transmit over far greater distances and to handle much more data.

- **Satellite services**
  - Internet access in remote regions
  - Suitable for home and office use
  - Needs a VSAT at the client
    - Very Small Aperture Terminal
    - Connects to the satellite
  - Modem connects to the VSAT
  - Need satellite dish and a service provider contract
  - Can be frustrating to set up
  - Need a phone line for upstream data and limited to analog modem speeds
    Satellite services are not inexpensive

- **Wireless security**
  - Crucial to protect wireless transmissions
  - Encryption protects transmissions
  - Wireless Encryption Protocol is quite weak
  - Wi-Fi Protected Access is stronger
  - MAC address of trusted computers
  - War driving

ISP

- Short for **I***nternet* **S***ervice* **P***rovider,* it refers to a company that provides Internet services, including personal and business access to the Internet.

- For a monthly fee, the service provider usually provides a software package, username, password and access phone number.
- Equipped with a modem, you can then log on to the Internet and browse the World Wide Web and USENET, and send and receive e-mail.
- For broadband access you typically receive the broadband modem hardware or pay a monthly fee for this equipment that is added to your ISP account billing.

What do we Need to Protect

- Data
  - Information we keep on computers (product design, financial records, personnel data)
  - Lost time, lost sales, lost confidence
- Resources
  - Unauthorized use of computer time & space
- Reputation
  - Misrepresentation, forgery, negative publicity

Fundamental Security Objectives

- Four fundamental objectives of Info Security
  - **Confidentiality** - Protection from unauthorized persons
  - **Integrity** - consistency of data; no unauthorized creation, alteration or destruction
  - **Availability** - ensuring access to legitimate users
  - **Legitimate use** - ensuring appropriate use by authorized users

Basic Security Attacks

- **Intrusion** - unauthorized access and use of systems
- **Denial of service** - an attack aimed at preventing use of company computers
  - email bomb or flooding/Internet worm
  - disabled, rerouted or replaced services
- **Information theft** - network taps, database access, hacking into sites to give out more info or to wrong parties

Technical Safeguards

- Security Services
  - **Authentication** (entity, data origin)
  - **Access control** (prevent unauthorized access)
  - **Confidentiality** (disclosure, encryption)
  - **Data integrity** (value of data item)
  - **Non-repudiation** (falsely denying a transaction)

Firewall solution

- **A Firewall** is a Software/Hardware which checks every information coming from the internet or a network and depending upon the **Firewall settings**, it either **blocks or allow** the information to pass through to your computer.
- It prevents the **hackers and malicious software** from getting access to your computer from the internet or a network.
- You can let the intended data to get in and out by setting some exceptions.

Antivirus Software Solution

- Antivirus or anti-virus software is used to prevent, detect, and remove malware.
- Example
    - Kaspersky internet security
    - MacAfee
    - AVG
    - Norton
    - Avira
    - Bit defender
    - Avast
    - Panda

VoIP software

- Voice over IP" -Voice Over Internet Protocol
- is used to conduct telephone-like voice conversations across Internet Protocol (IP) based networks.
- Examples
    - Skype
    - Yahoo messenger
    - Google talk
    - etc

Web Browser

- A browser is a piece of software that runs on your PC.
- The browser allows you, via a connection to the internet via your Internet service provider, to access web pages stored on computers (servers) that are connected to the internet.
    - Internet Explorer
    - Opera
    - Firefox
- A **web browser** or **Internet browser** is a software application for retrieving, presenting, and traversing information resources on the World Wide Web.

Searching the Web

- The Web is unorganized
- Directories
    - Categorize the Internet
- Search engines
    - Find sites by keyword
- Site searches
    - Large sites have an internal search
- Metasearch sites
    - Search several web sites at once
- Sponsored links

Sites pay for better search results

Search Techniques

- Quote the exact phrase
- Use the keyword AND
- Use the keyword NEAR
- Avoid common words
- Use the site's advanced tools

Search engine

- A search engine is a piece of application software that sits on a powerful computer (a server) on the Internet.
- This computer stores information about where web pages are stored on the internet.
    - Google , yahoo, Bing, Ask