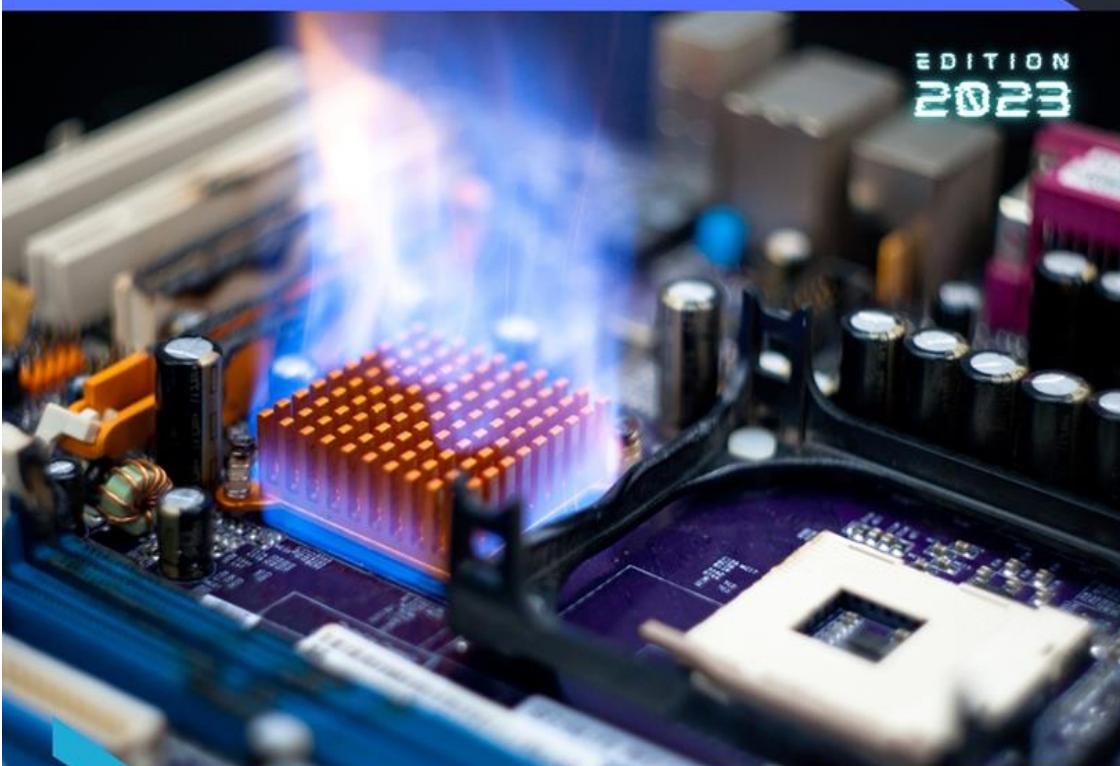


EXPLORING COMPUTER SYSTEM

THE ILLUSTRATED GUIDE TO UNDERSTAND COMPUTER HARDWARE

EDITION
2023



Book By

**Mohd Redzuan Rosly
Nor Aznira Yusoff**

EXPLORING

Computer System

Information & Communication Technology
Politeknik Sultan Mizan Zainal Abidin
Dungun, Terengganu
2023

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PREFACE

Computers are the most complex machines that have ever been created. Very few people really know how they work. This book tells you how they work; no technical knowledge is required. It explains the operation of a simple, focusing on computer hardware and software related.

This book shows that computer hardware isn't so complicated and can be easily understood by anyone.

This is a short book, but it must be studied carefully. This means that you will have to read some parts more than once to understand them. Get as far as you can. You will be much more knowledgeable about how computers work when you are done than when you started, even if you are not able to get through the whole text.

This is a technical book though it is aimed at a non-technical audience. Though this book takes considerable effort to understand, it is very easy for what it explains. After you have studied this book, it will seem simple if you go back and read it.

Good Luck!

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Chapter 1

Computer Hardware

This chapter discusses the following topics:

- *Basic Cable and Connector Types*
 - *Power Supply Types and Features*
 - *PC Components & Devices*
 - *SOHO Multifunction Devices/Printers*
 - *Various Print Technologies*
-

1.1.1 BASIC CABLE AND CONNECTOR TYPES

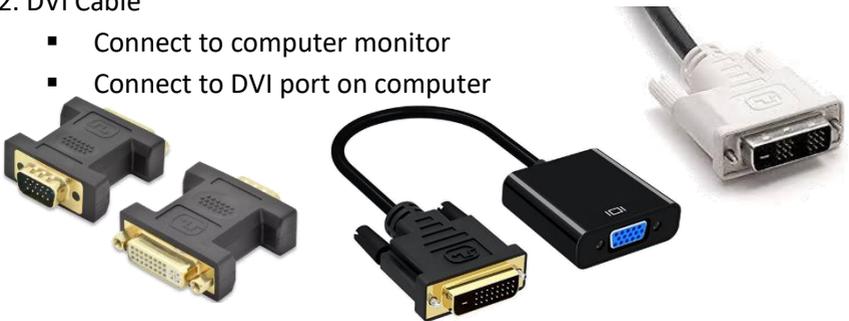
1. VGA Cable

- Also known as D-sub cable, analog video cable
- Connect computer monitor, television
- VGA port on computer.



2. DVI Cable

- Connect to computer monitor
- Connect to DVI port on computer



3. HDMI Cable

- Connect to computer monitor, television
- It can transmit both display and sound.



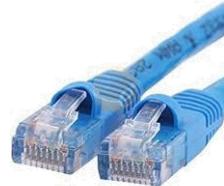
4. PS/2 Cable

- Connect to PS/2 keyboard, PS/2 mouse
- Connect to PS/2 ports on computer
- Purple PS/2 port: keyboard
- Green PS/2 port: mouse



5. Ethernet Cable / Network Cable

- Also known as RJ-45 cable
- Connect to router, network switch
- Connect to Ethernet port on computer



6. Audio Cable 3.5mm

- Also known as phone connector
- It transmit analogue mono or stereo signals in home audio.



7. USB Cable

- two popular formats: USB 2.0 and USB 3.0
- USB 2.0 ports have black tips while USB 3.0 cables have a blue tip, and sometimes you can find a SS "Super Speed" label on it.



8. Computer Power Cord (Power Supply Cable)

- Connect to: AC power socket, power supply unit, computer monitor.

****Note:** Always turn off your power supply unit before connecting a power cord to it.



9. ThunderBolt / USB-C Cable

- Mostly seen on laptops and Apple Macs.
- High speed and are capable of carrying Data, video and other information.
- 2 current types of Thunderbolt:
 1. Older version: Thunderbolt 2 has a *lightning symbol* and carries Data and video.
 2. Mini Display Port : only carry Video.



10. Display Port

- Display Port is the best to use if you require a fast, high-resolution image.
- The best option cable: has better quality over HDMI



INTERNAL CABLES

- ✚ Power supply connectors - SATA, Molex, and Berg.
- ✚ Front panel cables connect the case buttons and lights to the motherboard.
- ✚ Data cables connect drives to the drive controller.

- Floppy disk drive (FDD) data cable
- PATA (IDE) data cable (40 conductor)
- PATA (EIDE) data cable (80 conductor)
- SATA data cable
- SCSI data cable



1.1.2 EXTERNAL PORTS AND CABLES

1.1.2.1 Video Ports and Cables

- ✚ A video port connects a monitor cable to a computer.
- ✚ Video ports and connector types:
 - DVI, DisplayPort, RCA, DB-15, BNC, RJ-45, MiniHDMI, Din-6
- ✚ Display cable types:
 - High-Definition Multimedia Interface (HDMI) - Carries digital video and digital audio signals.



- DVI - Carries analog, digital, or both analog and digital video signals.



- Video Graphics Array (VGA) / Video Port - connects a monitor cable to a computer.



1.1.2.2 Other Ports and Cables

- Serial port transmits one bit of data at a time.



- USB port is a standard interface for connecting hot-swappable peripheral devices to a computer.

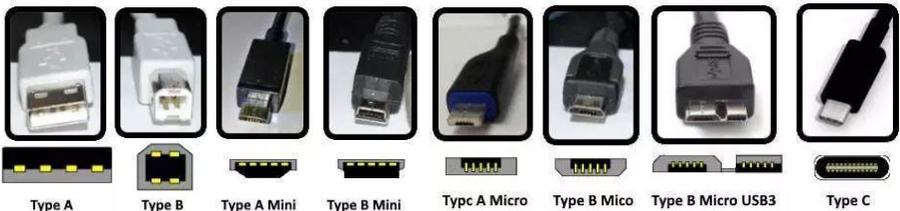


- multiple USB versions based on transmit data at speeds up



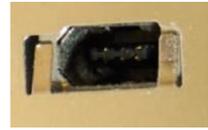
USB 1.0	USB 2.0	USB 3.0	USB 4.0
12 Mbps	480 Mbps	5 Gbps	40 Gbps

USB CONNECOR TYPES



Type A Type B Type A Mini Type B Mini Type A Micro Type B Micro Type B Micro USB3 Type C

- FireWire port is a high-speed, hot-swappable interface that can support up to 63 devices.



- A parallel port is used to connect parallel devices, such as a printer or scanner, and can transmit 8 bits of data at one time.



- A network port, also known as an RJ-45 port, connects a computer to a network. The maximum length of network cable is 328 feet / 100 m.



- A PS/2 port connects a keyboard or a mouse to a computer. The PS/2 port is a 6-pin mini-DIN female connector.



- An audio port connects audio devices to the computer.
 - Line In – Connects to an external source, such as a stereo system.
 - Microphone – Connects to a microphone.
 - Line Out – Connects to speakers or headphones.



Microphone Line-in Line-out



- iv. Gameport/MIDI – Connects to a joystick or MIDI-interfaced device.



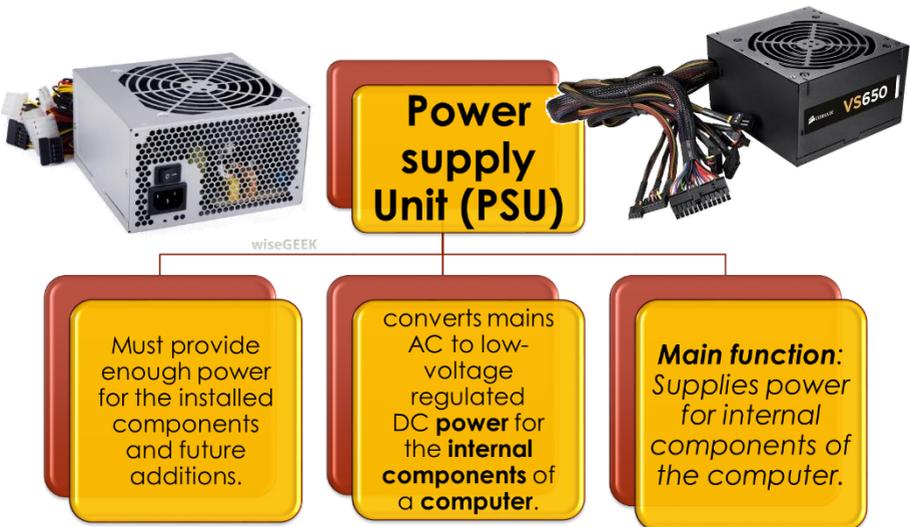
- o A telephone cable (RJ11) is used to connect a modem to a telephone outlet.



- o A SCSI port can transmit data at rates in excess of 320 Mbps and can support up to 15 devices.
 - SCSI devices must be terminated at the endpoints of the SCSI chain.



1.2 POWER SUPPLY TYPES AND FEATURES



1.2.1 TYPES OF POWER SUPPLY UNIT

THERE ARE 3 TYPES OF POWER SUPPLY UNIT IN COMMON USE:

- ✚ AT Power Supply
 - used in very old PCs.
 - Supplies use P8 and P9 power connectors.



- ✚ ATX Power Supply
 - ATX power supplies have a 20-pin motherboard power connector.
 - Supplies use a single P1 connector.



- ✚ ATX-2 Power Supply
 - ATX2 power supplies have a 24-pin motherboard power connector.
 - ATX2 power supplies have 2 separates +12v rails.
 - This is a safety feature, to avoid having too much current on a single rail.



1.2.2 POWER SUPPLY FEATURES AND FUNCTION

- ✚ The power supply unit (PSU) delivers the power to the components in the case.
- ✚ Standard power supplies turn the incoming AC (Alternating Current) into DC (Direct Current) voltages.
- ✚ The more components you have in your PC the greater the power required from the power supply.

1.2.2.1 UNINTERRUPTIBLE POWER SUPPLY (UPS) OR BATTERY BACKUP

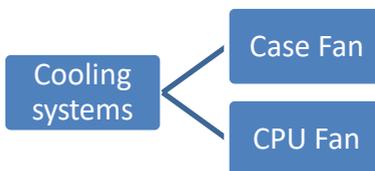
- ✚ An uninterruptible power supply (UPS) or battery backup,
- ✚ Primarily used to provide a backup power source to important desktop computer hardware components.
- ✚ Supplies power from separate source when power is not available.



1.3 PC COMPONENTS & DEVICES

1.3.1 INTERNAL PC COMPONENTS

- Motherboards
- CPUs
- Cooling systems
- ROM
- RAM
- Memory Modules
- Adapter cards and Expansion Slots
- Storage drives and RAID
Internal cables

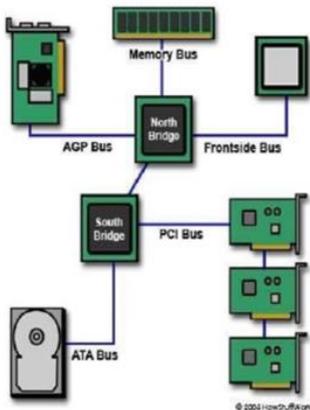


a) Motherboards

- ✚ The motherboard is the main printed circuit board.
- ✚ Contains the buses, or electrical pathways found in a computer.
- ✚ Buses allow data to travel among the various components.



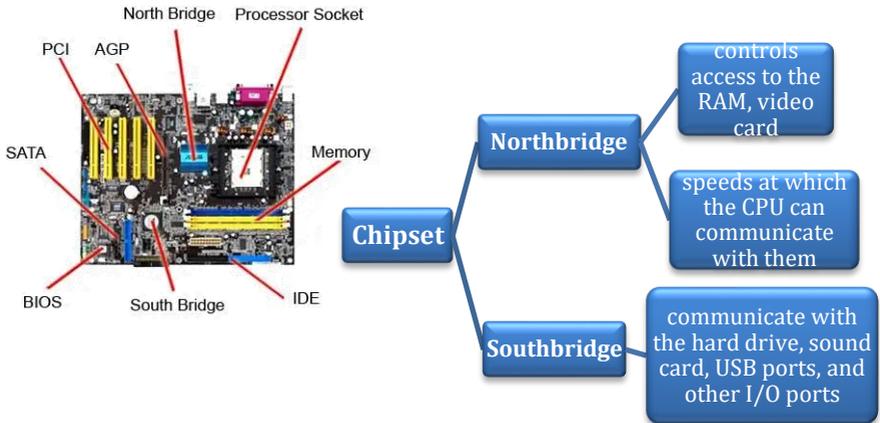
Busses Found On Motherboard



- ✓ front side bus (FSB),
- ✓ back side bus .
- ✓ The memory bus
- ✓ The IDE or ATA bus connects
- ✓ The AGP bus connects
- ✓ The PCI bus connects

Motherboard Form Factors

- ✚ The form factor determines how individual components attach to the motherboard and the shape of the computer case.
- ✚ A newer motherboard form factor, ATX, improved on the AT design.



b) Central Processing Unit (CPU) / Processor

- ✚ The brain of the computer.
- ✚ The CPU executes a program, which is a sequence of stored instructions.
- ✚ Two major CPU architectures related to instruction sets:
 - i. Reduced Instruction Set Computer (RISC) – Architectures use a relatively small set of instructions.
 - ii. Complex Instruction Set Computer (CISC) – Architectures use a broad set of instructions, resulting in fewer steps per operation.
- ✚ The storage location in the CPU is called Register.
- ✚ CPUs Technology:
 - hyperthreading or hypertransport
 - To enhance the performance of the CPU.
 - The amount of data that a CPU can process at one time depends on the size of the processor data bus.
- ✚ Speed of the CPU is measured in cycles per second-megahertz (MHz) or gigahertz (GHz).



- ✚ Overclocking is a technique used to make a processor work at a faster speed than its original specification.
- ✚ The latest processor technology has resulted to incorporate more than one CPU core onto a single chip.
 - Dual Core CPU - Two cores inside a single CPU
 - Triple Core CPU - Three cores inside a single CPU
 - Quad Core CPU - Four cores inside a single CPU
 - Hexa-Core CPU - Six cores inside a single CPU
 - Octa-Core CPU - Eight cores inside a single CPU



c) Cooling Systems

- ✚ A case fan makes the cooling process more efficient.
- ✚ A heat sink draws heat away from the core of the CPU.
- ✚ A fan on top of the heat sink moves the heat away from the CPU.



d) ROM (Read-only memory)

- ✚ ROM chips are located on the motherboard.
- ✚ Basic instructions for booting the computer and loading the operating system are stored in ROM.
- ✚ ROM chips retain their contents even when the computer is powered down called non-volatile
- ✚ ROM is sometimes called firmware.

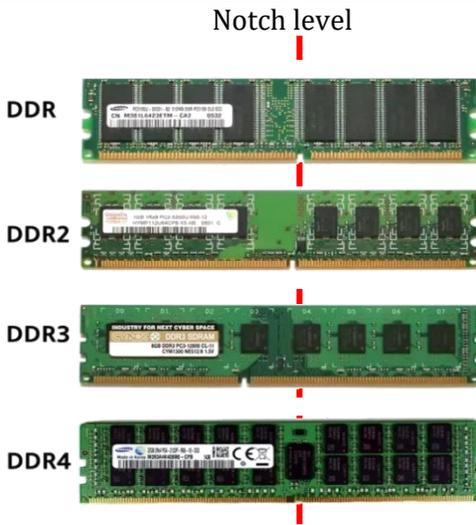


e) RAM (Random-access memory)

- ✚ RAM is temporary storage for data and programs that are being accessed by the CPU.
- ✚ RAM is volatile memory, which means that the contents are erased when the computer is powered off.
- ✚ More RAM means more capacity to hold and process large programs and files, as well as enhance system performance.

f) Memory Modules

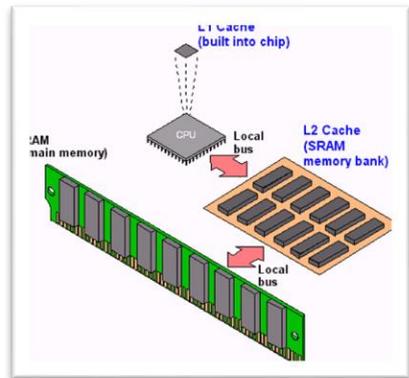
- ✚ Memory modules are memory chips that have been soldered onto a special circuit board for easy installation and removal.
- ✚ Dual Inline Package (DIP) is an individual memory chip.
- ✚ Single Inline Memory Module (SIMM) is a small circuit board that holds several memory chips.
- ✚ Dual Inline Memory Module (DIMM) is a circuit board that holds SDRAM, DDR, DDR2, DDR3 and DDR4 SDRAM chips.
- ✚ RAMBus Inline Memory Module (RIMM) is a circuit board that holds RDRAM chips.
- ✚ Small Outline DIMM (SODIMM) is a smaller, more condensed version of DIMM which is ideal for use in laptops, printers, and other devices where conserving space is desirable.



Cache and Error Checking

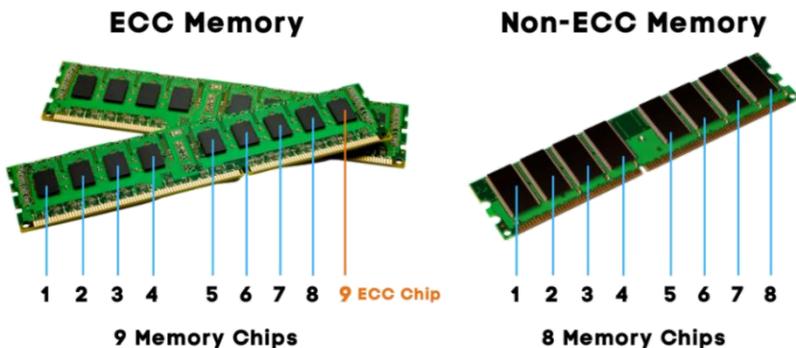
✚ Cache

- SRAM is used as cache memory to store the most frequently used data in the processor (CPU).
- SRAM provides the processor with faster access to the data than retrieving it from the slower DRAM, or main memory.
- L1 cache is internal cache and is integrated into the CPU.
- L2 cache is external cache and was originally mounted on the motherboard near the CPU. L2 cache is now integrated into the CPU.
- L3 cache is used on some high-end workstations and server CPUs.



✚ Error Checking

- Memory errors occur when the data is not stored correctly in the RAM chips.
- The computer uses different methods to detect and correct data errors in memory.
- Three different methods of memory error checking are:
 - Non-parity memory does not check for errors in memory.
 - Parity memory contains eight bits for data and one bit for error checking. The error-checking bit is called the parity bit.
 - Error Correction Code (ECC) memory can detect multiple bit errors and correct single bit errors in memory.



g) Adapter Cards and Expansion Slots

- ✚ Adapter cards increase the functionality of a computer by adding controllers for specific devices or by replacing malfunctioning ports.

✚ Examples of adapter cards:



Wireless NIC



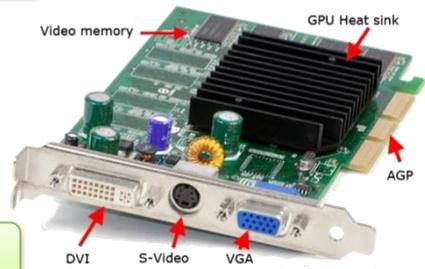
Parallel



Digital video adapter



Serial card

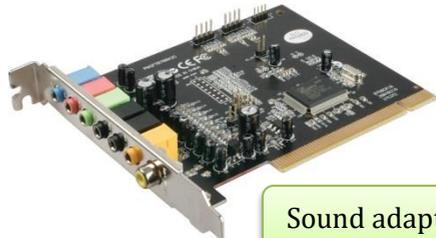


Network Interface Card (NIC)

Video Card



USB card



Sound adapter

✚ Types of expansion slots:

- Peripheral Component Interconnect (PCI)
- Advanced Graphics Port (AGP)
- PCI-Express
- Mini PCI (laptops)

h) Storage Drives and RAID

- ✚ Hard disk drive (HDD) is a magnetic storage device.
- ✚ The storage capacity is measured in gigabytes (GB) or terabytes (TB).
- ✚ Magnetic hard drives have driven motors designed to spin magnetic platters and move the drive heads.
- ✚ Solid state drives (SSDs) have no moving parts, which results in faster access to data, higher reliability, and reduced power usage.



Hard Disk Drive



Solid State Drive

- ✚ Floppy disk drive (FDD) is storage device that uses removable 3.5-inch floppy disks that can store up to 1.44 MB of data.



- ✚ Optical drive is a storage device that uses lasers to read data on the optical media.
 - The three types are CD, DVD, and BD (Blu-ray).



- ✚ Flash drive is a removable storage device that connects to a USB port.
 - A flash drive uses a type of memory that requires no power to maintain the data.



RAID (Redundant Array of Independent Disk)

- ✚ RAID provides a way to store data across multiple hard disks for redundancy.

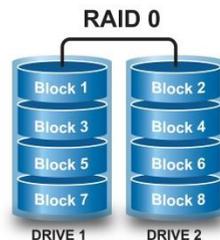
- Provides fault tolerance against hard disk crashes and also improve system performance.
- RAID breaks up or copies the data user want to save across multiple hard disks.
- This approach prevents a system failure due to the crash of a single drive.
- It also improves performance, because multiple disks can work together to save large files simultaneously.

- ✚ Technology used in RAID

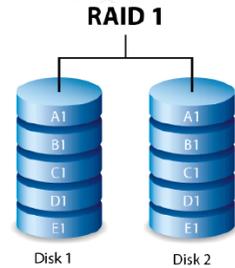
- Mirroring: The copying of data to more than one disk.
- Striping: Splitting of data across more than one disk.
- Error correction/Parity: Redundant data is stored to allow problems to be detected and possibly fixed (known as fault tolerance).

- ✚ RAID 0 (striped disks)

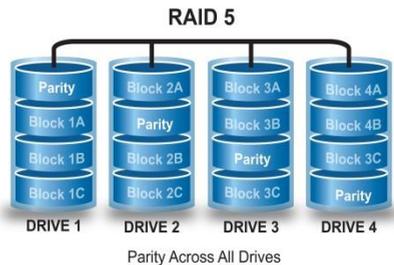
- Distributes data across several disks in a way that gives improved speed and no lost capacity, but all data on all disks will be lost if any one disk fails.



- ✚ RAID 1 (mirrored settings/disks)
 - Duplicates data across every disk in the array, providing full redundancy.
 - Two (or more) disks each store the same data.



- ✚ RAID 5 (striped disks with parity)
 - Combines three or more disks in a way that protects data against loss of any one disk.



1.1.4 INPUT AND OUTPUT DEVICES

a) Input Devices

- ✚ Input devices are used to enter data or instructions into a computer:
 - Mouse and Keyboard
 - Keyboard, video, mouse (KVM) switch
 - used to control more than one computer using a single keyboard, monitor, and mouse.
 - Gamepad and joystick
 - Digital camera and digital video camera
 - Biometric scanning device
 - Touch screen
 - Scanner



b) Output Devices **Monitors and Projectors:**

- Cathode-ray tube (CRT)
- Liquid crystal display (LCD)
- A light-emitting diode (LED)
- An Organic LED (OLED)
- Printers and Fax Machines
- Scanners
- Speakers and headphones
- Plasma
- Digital light processing (DLP) is a technology used in projectors.

c) Monitor Characteristics **Monitor Resolution** refers to the level of image detail that can be reproduced.

- Higher resolution settings produce better image quality.

 **There are several factors that affect image quality:**

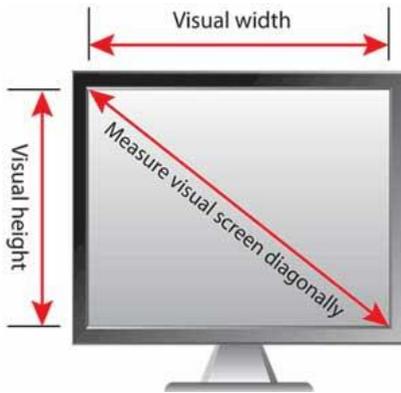
- **Pixels** – the tiny dots that comprise a screen. Each pixel consists of red, green, and blue.
- **Dot Pitch** – Dot pitch is the distance between pixels on the screen.
 - A lower dot pitch number produces a better image.
- **Contrast ratio** – The contrast ratio is a measurement of the difference in intensity of light between the brightest point (white) and the darkest point (black).
- **Refresh Rate** – The refresh rate is how often per second the image is rebuilt.
 - A higher refresh rate produces a better image and reduces the level of flicker.

- Interlace/Non-Interlace

Interlaced	Non-interlaced
<ul style="list-style-type: none"> • monitors create the image by scanning the screen two times. 	<ul style="list-style-type: none"> • monitors create the image by scanning the screen, one line at a time from top to bottom.
<ul style="list-style-type: none"> • The first scan covers the odd lines, top to bottom, and the second scan covers the even lines. 	<ul style="list-style-type: none"> • Most CRT monitors today are non-interlaced.

- Horizontal Vertical Colors (HVC) – The number of pixels in a line is the horizontal resolution.
 - The number of lines in a screen is the vertical resolution.
 - The number of colors that can be reproduced is the color resolution.
- Aspect Ratio – Aspect ratio is the horizontal to vertical measurement of the viewing area of a monitor.
- Native resolution – Native resolution is the number of pixels that a monitor has.
 - A monitor with a resolution of 1280x1024 has 1280 horizontal pixels and 1024 vertical pixels.
 - Native mode is when the image sent to the monitor same to monitor resolution.
 - Monitors have controls for adjusting the quality of the image such as brightness, contrast, position and reset.

- ✚ Measurement concept to determine size of monitor screen.



Diagonally,
from the top
left corner
to the bottom
right corner.

1.3.3 COMPUTER ASSEMBLY PROCESS

A) OPEN CASE AND INSTALL POWER SUPPLY

Open the Case

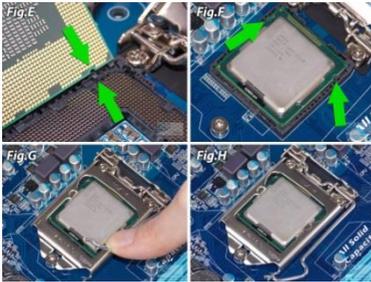


Install the Power Supply

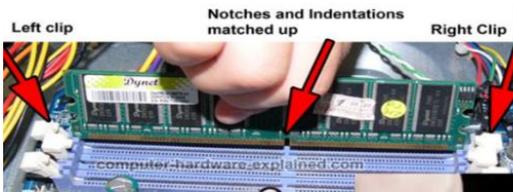


B) INSTALL THE CPU, HEAT SINK, FAN AND RAM

Install CPU, Heat Sink and Fan



Install RAM



Hold RAM at both ends

C) INSTALL THE MOTHERBOARD



D) INSTALL OPTICAL & HARD DRIVE

Install an Optical drive



Install a Hard Disk Drive (HDD)



E) INSTALL ADAPTER CARDS

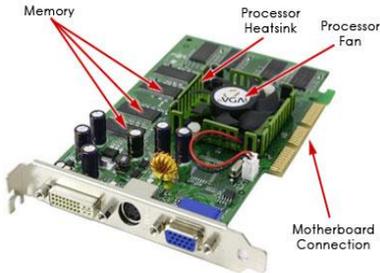
Install a Sound Card



Install a Network Card

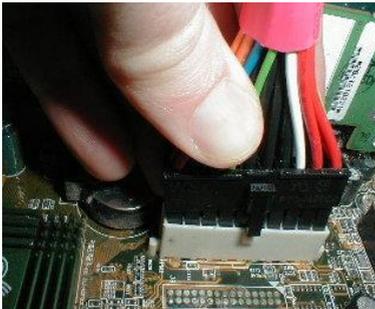


Install a Video Adapter Card



F) INSTALL THE CABLES

Install Power Cable



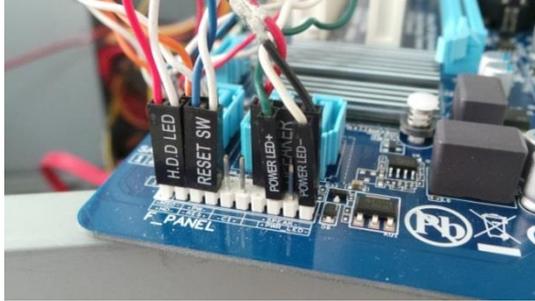
Internal Data Cables



IDE Cable



Front Panel Cables



Case Assembly

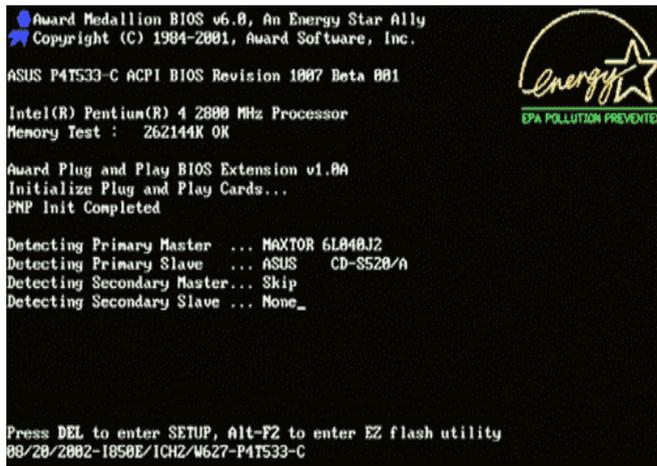


External Cables



1.3.4 POST AND BIOS

- ✚ **POST (Power On Self-Test)**
 - The BIOS includes instructions on how to load basic computer hardware and includes a test referred to as a POST that helps verify the computer meets requirements to boot up properly.
 - If the computer does not pass the POST, you will receive a combination of beeps indicating what is malfunctioning within the computer.
 - If the computer passes the POST, the computer may give a single beep as it starts and continue to boot.



```
Award Medallion BIOS v6.0, An Energy Star Ally
Copyright (C) 1984-2001, Award Software, Inc.

ASUS P4T533-C ACPI BIOS Revision 1007 Beta 001

Intel(R) Pentium(R) 4 2800 MHz Processor
Memory Test : 262144K OK

Award Plug and Play BIOS Extension v1.0A
Initialize Plug and Play Cards...
PNP Init Completed

Detecting Primary Master ... MAXTOR 6L040J2
Detecting Primary Slave ... ASUS CD-S520/A
Detecting Secondary Master... Skip
Detecting Secondary Slave ... None_

Press DEL to enter SETUP, Alt-F2 to enter EZ flash utility
00/20/2002-1050E/1CH2/W627-P4T533-C
```

- ✚ **BIOS (Basic Input/Output System)**
 - BIOS are a special program that helps the computer processor interact, checking and control all internal components in the computer.
 - BIOS are NOT affected by the virus.

- In A good example of a BIOS manufacturer is AMIBIOS and Phoenix.



a) Bios Beep Codes and Setup

AMI BIOS beep codes

	Descriptions
1 short	DRAM refresh failure
2 short	Parity circuit failure
3 short	Beep Code
4 short	System timer failure

Phoenix BIOS beep codes

Beep Code	Description and what to check
1-1-1-1	Unconfirmed beep code. Reseat RAM chips or replace RAM chips as possible solution
1-1-1-3	Verify Real Mode.
1-1-2-1	Get CPU Type.
1-1-2-3	Initialize system hardware.

BIOS COMPONENT INFORMATION

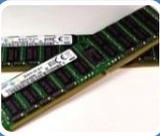
CMOS is the device that holds the BIOS program in a computer system.

- ✚ These are some of the common component information items that are displayed in the BIOS:



CPU

- CPU manufacturer
- speed
- the number of installed processors.



RAM

- RAM manufacturer
- speed
- number of slots
- which slots the RAM modules are installed.



Hard Drive

- Hard drives manufacturer
- size
- type of the hard drives
- number of hard disk controllers



Optical Drive

- Optical Drives manufacturer
- type of optical drives.

1.3.5 CONFIGURE BIOS

a) BIOS Configurations

- ✚ The purpose of adjusting the clock speed within the BIOS configuration settings is to allow the computer to run slower and cooler.
- ✚ To enter the CMOS Setup, press a certain key or combination of keys during the initial startup sequence.
- ✚ Most systems use:
 - "Esc,"
 - "Del,"
 - "F1,"
 - "F2,"
 - "Ctrl-Esc" or
 - "Ctrl-Alt-Esc" to enter setup.
- ✚ There is usually a line of text at the bottom of the display:
"Press _____ to Enter Setup."

b) BIOS Security Configurations

- ✚ This feature lets your password-protect the BIOS to prevent unauthorized users from making changes.
- ✚ The options available are:
 - *Set Supervisor Password:* A password will be required to enter the BIOS after you choose setup.
 - *Set User Password:* A different password assigned to users is required to boot the PC, and if a Supervisor Password has also been selected, permits the user to only adjust the date and time in the BIOS.

1.4 SOHO MULTIFUNCTION DEVICES/PRINTERS

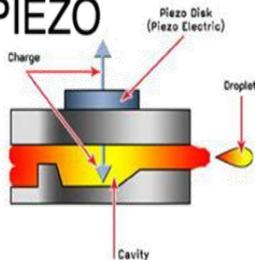
1.4.1 TYPES OF PRINTERS

- a) Inkjet Printers
- b) Laser Printers
- c) Thermal Printers
- d) Impact Printers

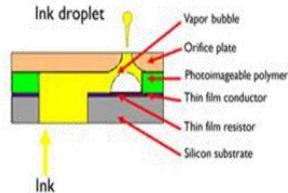
a) Inkjet Printers

- ✚ Commonly used for personal computer.
- ✚ Use ink-filled cartridges that spray ink onto a page through tiny holes, or nozzles.
- ✚ Two types of inkjet nozzles:

PIEZO



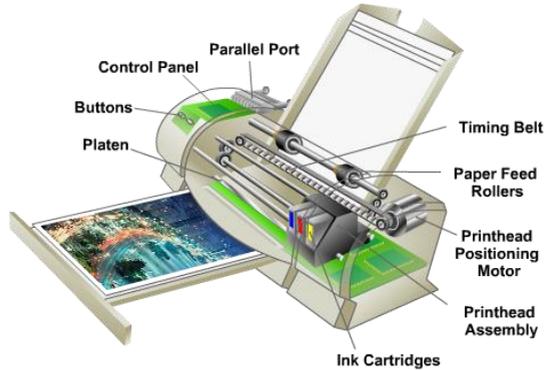
THERMAL



- **Piezoelectric** - crystals are in the ink reservoir at the back of each nozzle.
- A charge is applied to the crystal causing it to vibrate.
- This vibration of the crystal controls the flow of ink onto the paper.

- **Thermal** - A pulse of electrical current is applied to heating chambers around the nozzles.
- The heat creates a bubble of steam in the chamber which forces ink out through the nozzle.

- ✚ They produce high quality prints, are easy to use, and are less expensive than laser printers.
- ✚ A feeding mechanism draws paper in, and the paper passes by the print head where ink is sprayed onto it.



✚ Advantages:

- Initial low cost
- High resolution
- Quick to warm up

✚ Disadvantages:

- Nozzles are prone to clogging
- Ink cartridges are expensive.
- Ink is wet after printing.

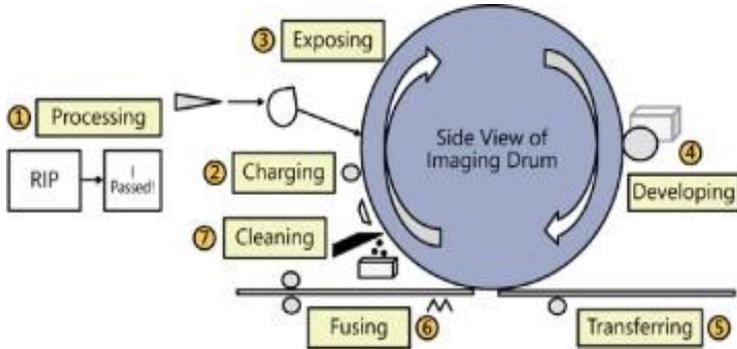
- ✚ When an inkjet color printer is printing different colors from those that are shown on the screen.
 - Click Calibrate the Device and Clean the Print Cartridges.

b) Laser Printers

- ✚ A laser printer is a high-quality, fast printer that uses a laser beam to create an image.
- ✚ Laser printer is a type of non-impact printer.
- ✚ Laser printers use electrophotography print technology.

✚ It uses the following process:

- i. Processing
- ii. Charging
- iii. Exposing
- iv. Developing
- v. Transferring
- vi. Fusing
- vii. Cleaning



✚ Advantages:

- Low cost per page
- High ppm
- High capacity
- Prints are dry

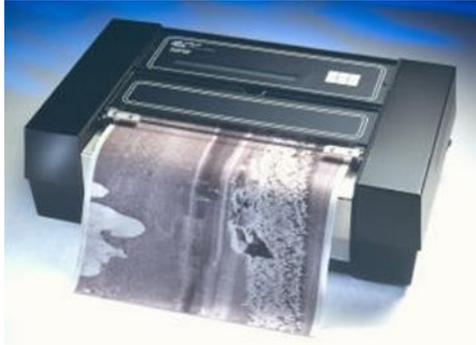
✚ Disadvantages:

- High-cost startup
- Expensive toner cartridges
- Require high level of maintenance

✚ The corrective action that should be taken if a printer is printing faded images is to replace the toner cartridge.

c) Thermal Printers

- ✚ A thermal transfer printer uses heat-sensitive ribbon, which the print head melts onto the paper.
- ✚ Thermal printers have a longer life because there are few moving parts.



 Advantages:

- Longer life because there are few moving parts.
- Quiet operation.
- No cost for ink or toner.

 Disadvantages:

- Paper is expensive.
- Paper has a short shelf life.
- Images are poor quality.

d) Impact Printers

- ✚ Impact printers have print heads that strike an inked ribbon, causing characters to be imprinted on the paper
- ✚ There are two types:
 - Daisy-wheel
 - Dot-matrix



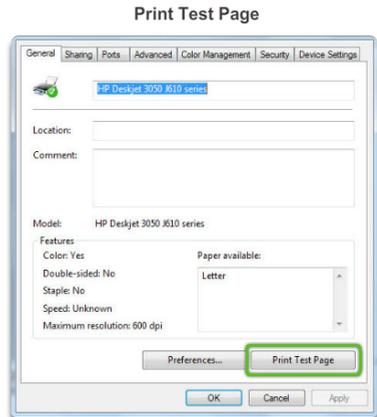
- ✚ Advantages:
 - Uses cheaper ink than inkjet or laser printers.
 - Uses continuous feed paper.
 - Has carbon-copy printing ability.

- ✚ Disadvantages:
 - Noisy.
 - Low-resolution graphics.
 - Limited color capability.

1.4.2 INSTALL AND UPDATE DEVICE PRINTER

- ✚ When purchasing a printer, the installation and configuration information is usually supplied by the manufacturer.
 - Installation CD that includes drivers, manuals, and diagnostic software.

- ✚ Test Page Printing
 - After installing a printer, you should print a test page to verify that the printer is operating properly.
 - The driver software is installed and working correctly
 - The printer and computer are communicating.



1.4.3 CONFIGURE OPTIONS AND DEFAULT SETTING

- ✚ Common Configuration Settings
 - Paper type - Standard, draft, gloss, or photo.
 - Print quality - Draft, normal or photo.
 - Color printing - Multiple colors is used.
 - Black-and-white printing - Only black ink is used. (monochrome)
 - Grayscale printing – printing using only black ink in different shades.
 - Paper size - Standard paper sizes or envelopes and business cards.
 - Paper orientation - Landscape or portrait.
 - Print layout - Normal, banner, booklet, or poster.
 - Duplex - Two-sided printing.

1.5 VARIOUS PRINT TECHNOLOGIES

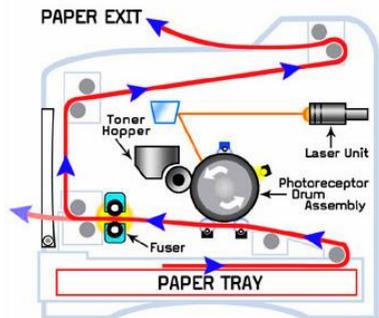
- ✚ Printers are commonly used output devices that produce a hard copy of document stored in electronic form.
- ✚ Various direct printing methods are compared in terms of jet mechanism, printing algorithm, and their applications.

a) Laser printer

- ✚ Laser printers are used for high volume work.
- ✚ They are available in black and color.
- ✚ Use toner (powdered ink) in printing.
- ✚ These operate in a similar manner to a photocopier.
- ✚ Laser printers produce images using dots.



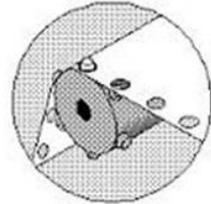
- ✚ The image is created using a laser beam and a mirror - lens arrangement on a drum which is coated with magnetically charged toner and then transferred from the drum to the paper.
- ✚ The paper is then fed through a heated fuser which fuses the toner to the paper as ink.



There are two important types of paper feed mechanisms. These are:

i. Tractor-feed printers

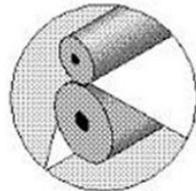
- ✚ Have two sprocket wheels on either side of the printer that fit into holes in the paper.
- ✚ As the wheels revolve, the paper is pulled through the printer.
- ✚ Tractor feed is also called pin feed.
- ✚ It is most used with line printers that use paper with perforation on either end of the paper.
- ✚ Usually, the paper roll is continuously fed to the printer.
- ✚ Other names for tractor-feed stationery include fan-fold paper, sprocket feed paper, and pin feed paper.



Tractor Feed

ii. Friction-feed printers

- ✚ Use rollers to squeeze a sheet of paper and pull it through the printer.
- ✚ The rollers are usually made of plastic or hard rubber.
- ✚ It is most used with laser and inkjet printers.



Friction Feed

b) Impact printers

- ✚ Impact printers are capable of printing multipart forms since they can give necessary impact to print to multiple forms simultaneously.
- ✚ ECP (Extended Capability Port) has less control overhead and best suited for transferring large chunks of data, such as between the computer and laser printer.

c) Inkjet Printers

- ✚ Inkjet Printers is the generic name given for contact less printing using ink.
- ✚ Friction feed is most used with laser printers, and Inkjet printers.
- ✚ One needs to check the calibration for the inkjet printer if it is not printing properly.
- ✚ If it doesn't help, then check the ink cartridge if it requires replacement.

d) Thermal printers

- ✚ Thermal printers require a special kind of paper, called thermal paper.
- ✚ This paper is sensitive to heat, and the printing is produced by thermal heat applied on the paper by the print head.

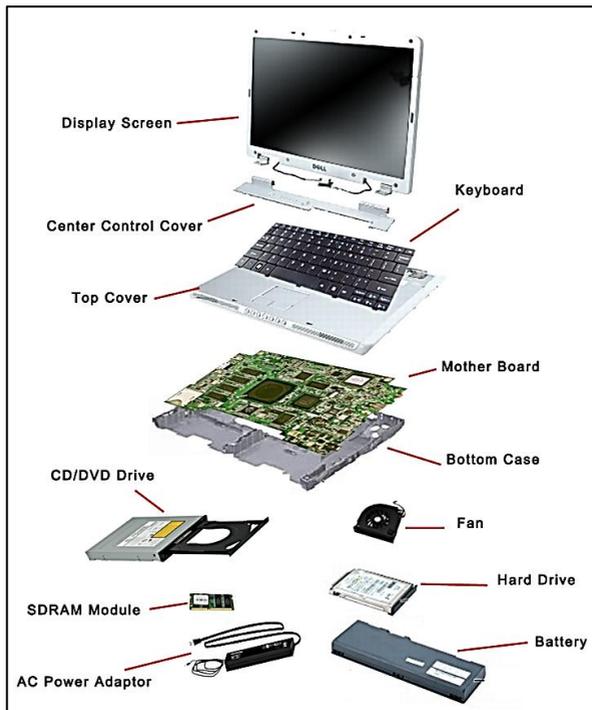
Chapter 2

Mobile Devices

This chapter discusses the following topics:

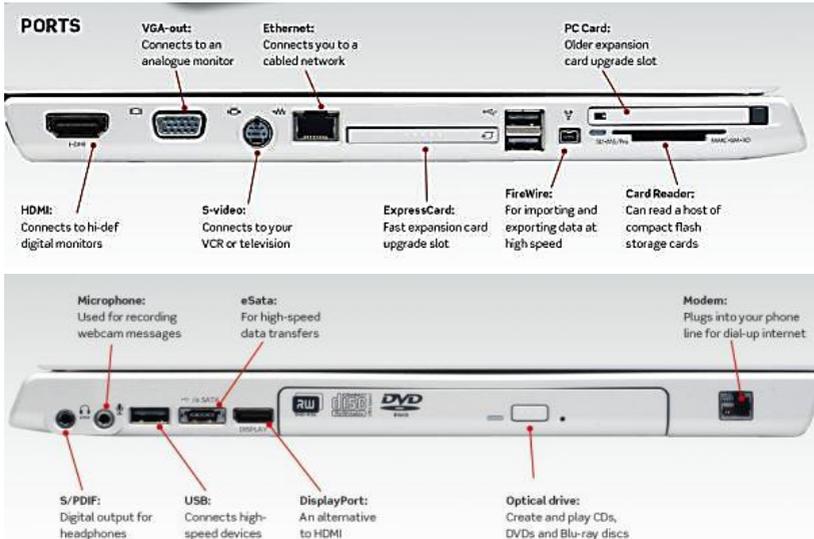
- *Laptop & Components*
- *Various Types of Other Mobile Devices Characteristics*
- *Accessories & Ports of Other Mobile Devices*
- *Basic Mobile Device Network Connectivity*
- *Mobile Device Synchronization*

2.1 LAPTOPS & COMPONENTS



2.1.1 IDENTIFY LAPTOPS COMPONENTS

a) External Features Unique to Laptops



- The most common ports are as shown in the diagram.
 - HDMI - Connects to hi-definition digital Monitors
 - S-Video - Connects to your VCR or Television
 - Express Card - Fast Expansion card upgrade slot
 - FireWire - for importing and exporting the data at high speed.
 - Card Reader - Can read a host of compact flash storage cards
 - S/PDIF - Digital output for phones
 - USB - Connects high speed devices
 - DisplayPort - An alternative to HDMI
 - Optical Drive - Create and play CDs, DVDs, and blue ray discs
 - Modem - plugs into your phone line for dial-up internet

b) Common Input Devices and LEDs in Laptop



Keyboard



Mouse



Joy Stick



Mic



Barcode Reader



Stylus/Pen



Web Camera



Touch pad

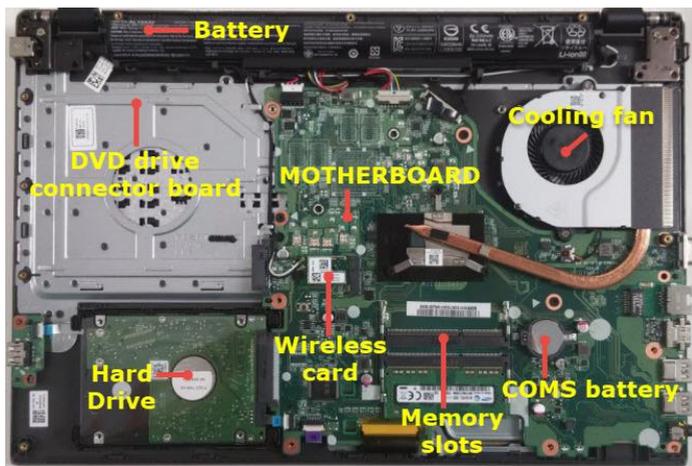


Touch Screen



Finger Print reader

c) Internal Components

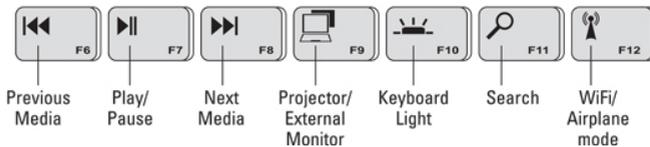
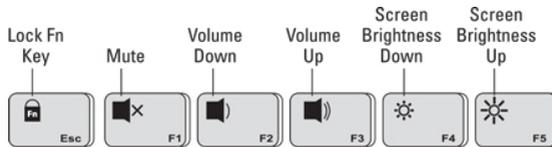


Memory	<ul style="list-style-type: none">• More expensive than desktop RAM• SODIMMs, MicroDIMMs• Flash memory
Optical Drive	<ul style="list-style-type: none">• Smaller than desktop optical drives
Wireless card	<ul style="list-style-type: none">• Integrated into Motherboard
Motherboard	<ul style="list-style-type: none">• Similar to desktop except:• Smaller• Reduced power consumption• More integrated components• More power options
Processor	<ul style="list-style-type: none">• Lower power consumption than desktop CPUs• Lower hwat generation than desktop CPUs• Surface-mounted or socket-based
Storage Drive	<ul style="list-style-type: none">• 1.8-inch, 2.5-inch, 3.5-inch form factors• Slower than desktop storage drive• Newer laptops have SSDs and hybrid drives• Ease of removal varies widely
CMOS Battery	<ul style="list-style-type: none">• Same to desktop

d) Special Function Keys

Function with the Fn key

- ✚ The Fn key is usually works with other keys on the keyboard.
- ✚ These keys map to specific laptop functions.



e) Docking Station vs port replica

- ✚ Port Replicators offer the same functionality found in docking stations but are more universal.
- ✚ Port replicators don't require the laptop to be clipped into a docking port, as docking stations do.
- ✚ Instead, the replicator device connects through a simple USB port, commonly found on any laptop made today.

- ✚ A port replicator is a type of docking station for connecting multiple peripherals to an electronic device such as a laptop computer
- ✚ Port Replicator is simply a device that plugs into a single port, such as USB.
- ✚ But gives you access to common ports like serial, USB, parallel, PS/2 (keyboard and mouse connectors), sometimes even audio jacks.

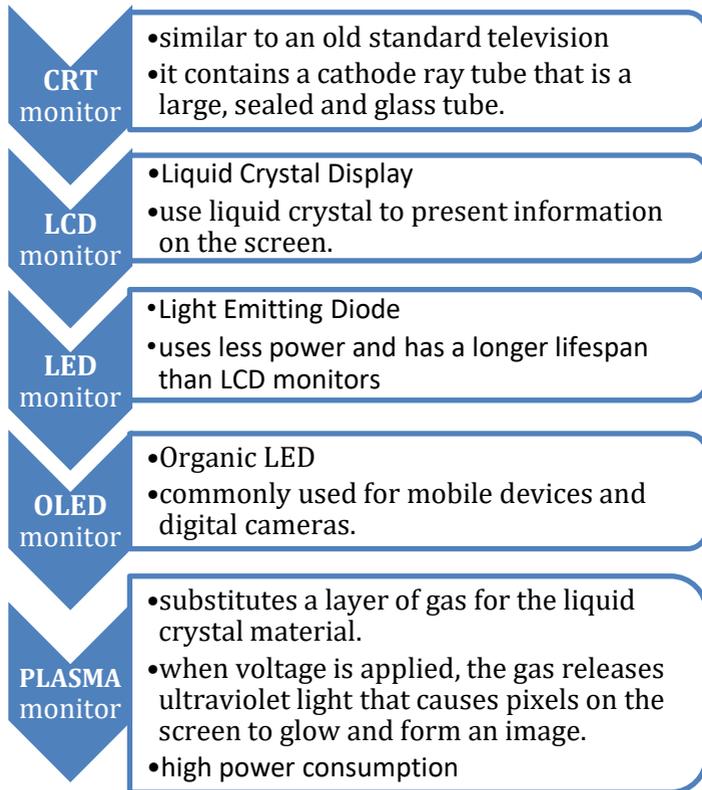


- ✚ Docking Station makes a laptop like a desktop computer.
- ✚ They may contain a DVD/CD Burner, card readers, and drive bays.
- ✚ It is designed to transform a notebook into a desktop computer.



2.1.2 LAPTOP DISPLAYS COMPONENTS

a) Display Types Comparison

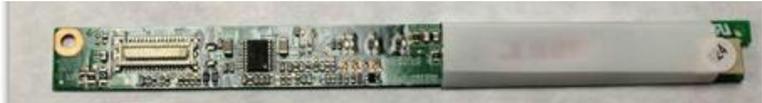


There are four types of laptops displays:

- ✚ LCD - Liquid Crystal Display
- ✚ LED – Light Emitting Diode - uses less power and has a longer lifespan than LCD monitors
- ✚ OLED - Organic LED
- ✚ Plasma – rarely used in laptops due to high power consumption.

b) Backlights and Inverters

- ✚ An inverter and backlight are two important display components.
- ✚ The inverter converts DC power to the higher voltage AC power that is required by the backlight.
- ✚ The backlight shines through the screen and illuminates the display.



Types of backlights

- ✚ LED monitors use LED-based backlights that do not have fluorescent tubes or inverters.
- ✚ LCD monitors use Cold Cathode Fluorescent Lamp (CCFL) technology for the backlight.
- ✚ The fluorescent tube is connected to an inverter.
- ✚ In most laptops, the inverter is behind the screen panel and close to the LCD.
- ✚ The backlight is behind the LCD screen.

c) Wi-Fi Antenna Connectors

Wi-Fi antennas transmit and receive data carried out over wireless signals. Wi-Fi antennas in laptops are typically located above the screen connects to wireless card



2.1.3 LAPTOP POWER SETTINGS

a) Power Management

- ✚ The core of laptop power management is centered on Advanced Power Management (APM).
- ✚ APM specifies two different power saving modes: standby and suspend.
 - Standby mode
 - Light sleep, which consumes more power and is quicker to restore from than the “suspend” mode.
 - Suspend mode
 - Special low-power mode often used on laptops, that preserves the contents of RAM while conserving power.
 - There are two main forms of suspend
 - Suspend-to-RAM and suspend-to-disk.

b) Managing ACPI Settings in the BIOS

- ✚ The Advanced Configuration and Power Interface (ACPI) standards create a bridge between the hardware and OS.
- ✚ ACPI allow technicians to create power management schemes to get the best performance from the computer.
- ✚ Steps to access the ACPI settings in the BIOS:
 - i. Enter BIOS setup
 - ii. Locate and enter the “Power Management settings” menu item.
 - iii. Use the appropriate keys to enable ACPI mode.
 - iv. Save and Exit BIOS setup.

c) Managing Laptop Power Options

- ✚ The Power Options feature in Windows allows you to reduce the power consumption.
- ✚ POWER PLANS
 - Balanced (recommended)
 - Automatically balances performance with energy consumption.
 - Power saver
 - Saves power by reducing system performance.
 - High performance
 - Maximizes system performance and responsiveness.

2.1.4 LAPTOP WIRELESS COMMUNICATION TECHNOLOGIES

- ✚ Laptops use several different communication methods:
 - a) Bluetooth
 - b) Infrared
 - c) Cellular WAN
 - d) Wi-Fi

a) Bluetooth

- ✚ Personal Area Network (PAN)
- ✚ A short-range wireless technology – approx. 33 feet.
- ✚ Operates at 2.4 to 2.485 GHz in the unlicensed Industrial, Scientific, and medical band.
- ✚ Low power, low cost, and small size
- ✚ Bluetooth 5.0 is the latest version of the Bluetooth wireless communication standard in year 2021.

b) Infrared (IR)

- ✚ A short-range, low-throughput wireless technology used as a data transmission medium.
- ✚ Infrared light signals operate in the lowest light frequency.
- ✚ Distances are limited to a few feet or meters.
- ✚ IR cannot penetrate any object that blocks the light signal.

c) Cellular WAN

- ✚ Tethering: can be made using Wi-Fi, Bluetooth, or USB cable.
- ✚ Laptops with integrated cellular WAN capabilities.

d) Wi-Fi (Wireless Fidelity)

- ✚ Wi-Fi is a wireless technology that provides a simple connection from anywhere within the range of a base station.
- ✚ Connection distances of 300 feet (91 meters) or more, depending on the environment.
- ✚ Laptops access the internet by using wireless adapters
 - Mini-PCI - Commonly used by older laptops.
 - Mini-PCI cards have 124 pins and are capable of 802.11a, 802.11b and 802.11g wireless LAN connection standards.
 - Mini-PCIe - Most common type of wireless card in laptops.
 - Mini-PCIe cards have 54 pins and support all wireless LAN standards.
 - PCI Express Micro - Commonly found in newer and smaller laptops, such as Ultrabook, because they are half the size of Mini-PCIe cards.

2.2 VARIOUS TYPES OF OTHER MOBILE DEVICE

2.2.1 MOBILE DEVICES HARDWARE

- ✚ A mobile device is any device that is hand-held, light, and typically uses a touchscreen for input.
- ✚ Mobile devices use an operating system to run applications (apps), games, play movies and music.
- ✚ Examples:
 - Android
 - Apple

a) Non-Field Serviceable Parts

- ✚ Mobile devices do not have field-serviceable parts.
- ✚ Broken devices usually sent to the manufacturer for repair or replacement.
- ✚ There are a few mobile device parts that are NOT replaceable in mobile device:
 - Battery
 - Memory card
 - Subscriber Identity Module (SIM) card

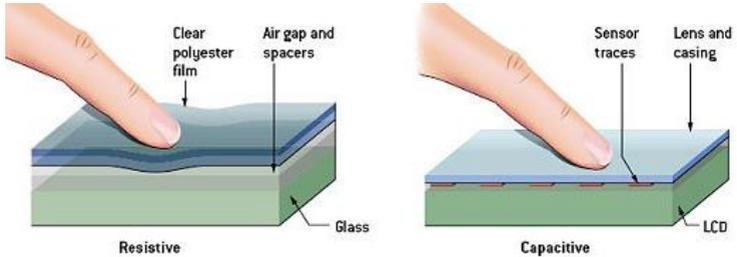
b) Non-Upgradeable Hardware

- ✚ Mobile device hardware is typically not upgradeable.
- ✚ Many of the components in a mobile device are connected directly to circuit boards (built-in).

c) Touchscreens

- ✚ Most mobile devices use touchscreens to allow users to physically interact with the screen.

- ✚ Two types of touchscreens:
 - Capacitive
 - Consists of a glass screen coated with a conductor.
 - Resistive
 - Consists of transparent layers of material capable of conducting electricity.

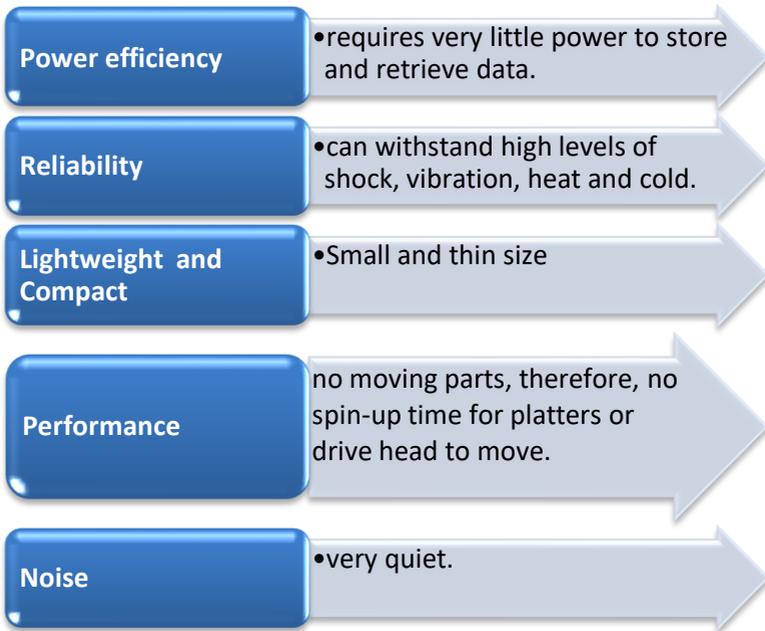


- ✚ Multi-touch - the ability to recognize when two or more points of contact are made on the screen.



d) Solid State Drives (SSDs)

- ✚ The circuit board, flash memory chips, and memory controller in SSDs are installed directly inside the mobile device.
- ✚ Advantages of using flash memory storage:



2.3 ACCESSORIES AND PORTS OF OTHER MOBILE DEVICES

a) Expansion Cards

- ✚ The advantage of expansion card is to improve the performance of computer activity.
- ✚ PC Card or Express Card slots used to add functionality such as:

- Wi-Fi connectivity
- Ethernet access
- USB and FireWire ports
- External hard drive access
- Additional memory



✚ Express Card is the newer model of expansion card and is most used:

- ExpressCard /34 - 34 mm wide
- ExpressCard /54 - 54 mm wide



b) Flash Memory

- ✚ External Flash Drive
- ✚ Flash Cards and Flash Card Readers

c) SODIMM Memory

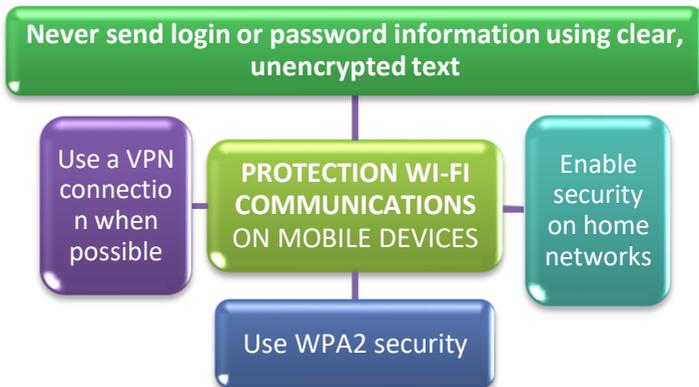
- ✚ smaller profile memory chip used by laptops
- ✚ 72-pin and 100-pin configurations for support of 32-bit transfers.
- ✚ 144-pin, 200-pin, and 204-pin configurations for support of 64-bit transfers.



2.4 BASIC MOBILE DEVICE NETWORK CONNECTIVITY & APPLICATION SUPPORT

2.4.1 NETWORK CONNECTIVITY CONFIGURATION

a) Wireless Data Network



b) Cellular Communications

✚ 1G (1979)

- primarily used analog standards.
- Generally had poor battery life.
- The maximum speed of 1G is 2.4 Kbps.

✚ 2G (1991)

- Switched from analog to digital standards.
- Standards included Global System for Mobile (GSM), Integrated Digital Enhanced Network (iDEN), and Code Division Multiple Access (CDMA).
- Provided small data service like SMS and MMS.
- Charges based on long distance calls and real time billing.

- The max speed of 2G with General Packet Radio Service (GPRS) is 50 Kbps or 1 Mbps with Enhanced Data Rates for GSM Evolution (EDGE)

3G (2001)

- Enable cell phones to send and receive text, photos, video, access the Internet and use the Global Positioning System (GPS).
- 3G has Multimedia services support along with streaming.
- The goals were to facilitate greater voice and data capacity, support a wider range of applications, and increase data transmission at a lower cost.
- Mobile speeds of 384kbps for a "true" 3G. The theoretical max speed for HSPA+ is 21.6 Mbps.

4G (2010)

- Its purpose is to provide high speed without buffering.
- Provide ultra-broadband Internet access, allowing users to download files much faster, video conference and watch hi- definition television.
- Standards include Mobile WiMAX and Long-Term Evolution (LTE).
- The max speed of a 4G network is 100 Mbps or 1 Gbps.

5G (2019)

- Currently under development.
- 5G promises significantly faster data rates, higher connection density, much lower latency.
- The max speed of 5G is aimed at being as fast as 35.46 Gbps, which is over 35 times faster than 4G.

2.4.2 MOBILE BLUETOOTH ACTIVATION

a) Bluetooth for Mobile Devices

- ✚ Bluetooth technology provides a simple way for mobile devices to connect to each other.
 - Wireless, automatic, and uses very little power.
 - Up to eight Bluetooth devices can be connected at any one time.
- ✚ How mobile devices use Bluetooth:
 - Hands free headset, Keyboard or mouse, Stereo control, Car speakerphone.
 - Tethering – connecting to another mobile device or computer to share a network connection.
- ✚ Information that can be accessed when Bluetooth discoverable mode.
 - Bluetooth class
 - Bluetooth
 - Name
 - Service that the device can use

b) Bluetooth Pairing

- ✚ Bluetooth Pairing - two Bluetooth devices establish a connection to share resources.
- ✚ Pairing process:
 - Both devices on.
 - One device search for other devices.
 - Other device must be in discoverable (visible) mode.
 - PIN may be requested to authenticate the pairing process.
 - PIN is stored after initial pairing, so it does not have to be entered the next time the device tries to connect.

2.5 MOBILE DEVICE SYNCHRONIZATION

2.5.1 MOBILE DEVICE SYNCHRONIZATION

- ✚ Data synchronization is the exchange of data between two or more devices, while maintaining consistent data on those devices.

2.5.2 TYPES OF DATA TO SYNCHRONIZE

- ✚ Types of data that are typically synchronized:
 - ✓ Contacts
 - ✓ Email
 - ✓ Calendar entries
 - ✓ Pictures
 - ✓ Music
 - ✓ Apps
 - ✓ Video
 - ✓ Browser links and settings
- ✚ Synchronization of data on an iOS device requires installation of iTunes.
 - iTunes is a media player application that downloads, plays, and organizes content for use with iOS devices and computer.
 - iTunes manages iOS devices by activating them and restoring if there is a malfunction.
 - iTunes is used to upgrade the iOS.

2.5.3 SYNCHRONIZATION CONNECTION TYPES

- ✚ USB and Wi-Fi connections are the most common connection types used to synchronize data between devices.
- ✚ Cross-Platform Data Synchronization – Synchronization of data between different operating systems requires:
 - Third-party applications that can synchronize between Outlook and iTunes
 - Applications such as Dropbox.

Chapter 3

Virtualization, Cloud Computing & Green Computing

This chapter discusses the following topics:

- *Cloud Computing Concepts*
- *Virtualization*
- *Green Computing*
- *Protecting the Environment Responsibility*

3.1 CLOUD COMPUTING CONCEPTS



- ✚ Most people are familiar with cloud computing - at the very least in its form as cloud storage.

- ✚ iCloud, Dropbox, and Google Drive are some of the most well-known cloud storage solutions, replacing the need for an external, physical extra hard drive.

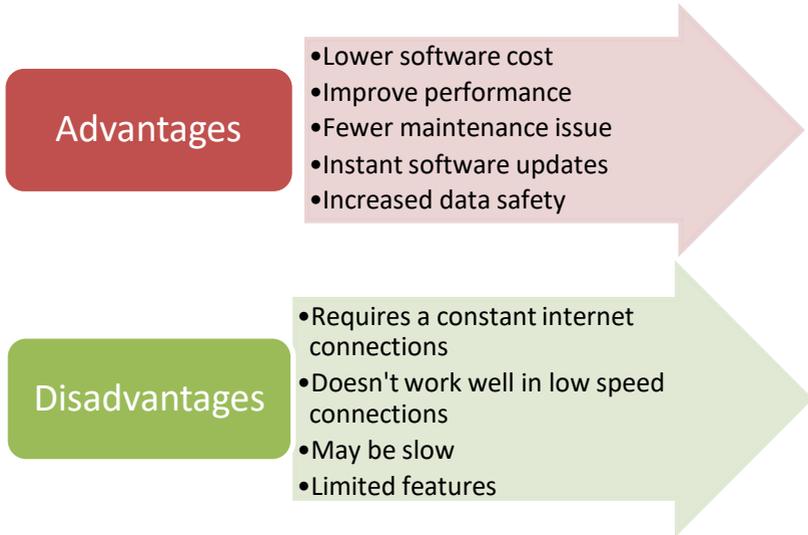
3.1.1 CLOUD COMPUTING

- ✚ Cloud computing is a term referred to storing and accessing data over the internet.
- ✚ It doesn't store any data on the hard disk of your personal computer.
- ✚ In cloud computing, you can access data from a remote server.

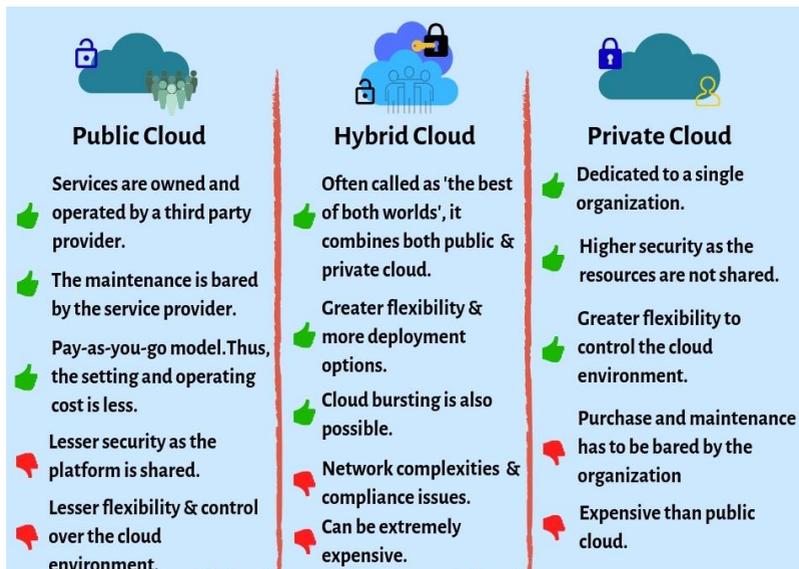
3.1.2 TOP BENEFITS OF CLOUD COMPUTING



3.1.3 THE ADVANTAGES AND DISADVANTAGES OF USING CLOUD COMPUTING

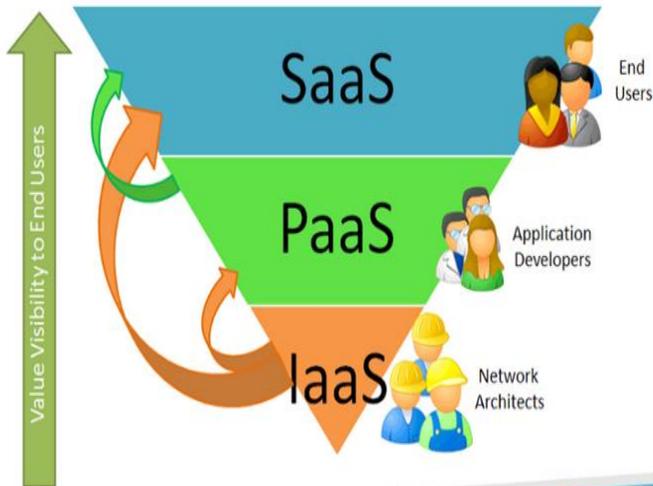


3.1.4 TYPES OF CLOUD COMPUTING



3.1.5 CLOUD COMPUTING SERVICES

Cloud computing basics concept includes all of the following concepts:



SaaS (Software as a service) – Is the business model of software license, which involves the development and support of the software vendor. Customers also have the opportunity of paid use of it, usually through the Internet.

PaaS (Platform as a Service) – An integrated platform for the development, deployment, testing and support of web-applications. Presented as a service on the basis of the concept of cloud hosting service.

IaaS (Infrastructure as a Service) – A computer infrastructure, typically presented in the form of virtualization. Is a service within the concept of cloud hosting.

 **Software as a Service (SaaS)**

- SaaS providers supply the hardware and deliver web-based software over an Internet connection.
- The user requires only a machine with a web browser to connect.
- On demand software.
- Central management of data and applications
- Example: Gmail, Slack and Microsoft Office 365.
- It has the most users in cloud computing user's hierarchy.
- A good example of SaaS is Google Docs.

 **Platform as a Service (PaaS)**

- PaaS is a cloud computing infrastructure that creates a development environment upon which applications may be build.
- User only manage the Data and Application.
- PaaS offers developers an inexpensive method with no servers, no software, and no maintenance.
- someone else handles the platform, you handle the product.
- Google App Engine is an example of PaaS.

 **Infrastructure as a Service (IaaS)**

- IaaS is a cloud computing service model in which hardware is virtualized in the cloud.
- IaaS offers the flexibility to manage our website resources and upgrading process would be easiest.
- Load balancer and Data Storage are provided by IaaS.
- Example: Amazon Web Services (AWS), Microsoft Azure and Google Compute Engine.

3.2 CLIENT-SIDE VIRTUALIZATION

3.2.1 INTRODUCTION

- Virtualization is when one physical machine hosts multiple activities.
- Main function of Virtualization is the ability to install and run multiple operating systems concurrently on a single physical machine

3.2.2 BENEFITS OF VIRTUALIZATION IN CLOUD COMPUTING



3.2.3 THE IMPORTANCE OF VIRTUALIZATION

- Virtualization gives you, ability to use your server resources in efficient way.
- Virtualization can increase IT, flexibility and scalability while creating significant cost savings.

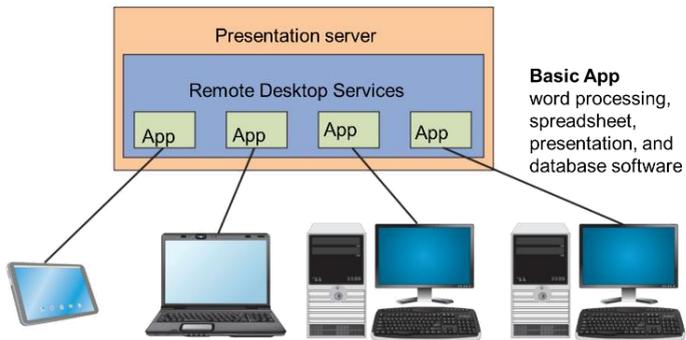
3.2.4 CLIENT-SIDE VIRTUALIZATION

- Using client-side virtualization, a personal computer provides multiple virtual environments for applications.
- Client-side virtualization can be implemented using several methods:

1. Presentation Virtualization
2. Application Virtualization
3. Client-side Desktop Virtualization

3.2.4.1 Presentation virtualization.

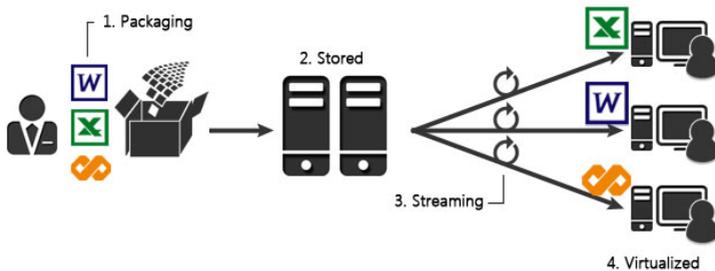
- It is a form of SaaS cloud computing.
- A remote application running on a server is controlled by a local computer.
- The user remotely controls the application running on the server and the application data is also stored on the server.
- Microsoft Remote Desktop Services presents applications to the user at a local computer.



3.2.4.2 Application virtualization.

- ✚ An application can be made available to users without having to install the application on the user's computer.
- ✚ Application Virtualization from Servers
 - The administrator uploads software packs on the server and the users launch the application.
 - Server streams it to the users in real-time.

- The application is virtualized as if it is installed in the local machine.



3.2.4.3 Client-side desktop virtualization.

- Software installed on a desktop or laptop manages virtual machines (VM).
- Each VM has its own operating system installed.
- VirtualBox and VMware Player are two examples of freeware that can be installed on a computer and used to manage virtual machines.
- This type of software is called a hypervisor or virtual machine manager (VMM).

3.3 GREEN COMPUTING

3.3.1 INTRODUCTION

- ✚ Green Computing is the efficient use of computing devices in order to sustain our environment.
- ✚ Aspect that covers Green Computing:
 - Environmental
 - Entertainment
 - Social

3.3.2 THE GOALS OF GREEN COMPUTING

- ✚ Reduce the use of hazardous materials.
- ✚ Maximize energy efficiency during the product's lifetime.
- ✚ To cut down the energy used.
- ✚ To minimize the harmful materials.
- ✚ To use as many biodegradable materials as possible.
- ✚ To extend as far as possible the life of the equipment.

3.3.3 APPROACHES TO GREEN COMPUTING

- ✚ Product longevity.
- ✚ Software and deployment optimization.
- ✚ Power management.
- ✚ Materials recycling.
- ✚ Telecommuting.

3.3.3.1 Product longevity.

- ✚ The longer a product is in use, the fewer of that product that need to be created.
- ✚ It designed to provide stable memory architectures for long-life applications.

3.3.3.2 Software and deployment optimization.

- ✚ An efficiency way for saving energy include:
 - Algorithmic efficiency: running a program efficiently and effectively via a subtle power control on each computing resources.
 - Resource allocation: scheduling of activities and the resources required by considering both the resource availability and the project time.

- Virtualization: combine several physical systems into virtual machines on one single, powerful system.
- The example of Green Operating System is Linux.

3.3.3.3 Power management.

- ✚ Allows an operating system to directly control the power saving aspects of its underlying hardware.
- ✚ Allows a system to *automatically turn off components* such as monitors and hard drives after set periods of inactivity.
- ✚ Involving:
 - Operating System Support: *encouraging users to save power.*
 - Power supply: *must be at least 80% efficient.*
 - Storage: *Smaller physically drives, less power usage.*
 - Video card: *more powerful, more energy usage.*
 - Display: *LED is better than LCD and CRT.*

3.3.3.4 Materials recycling.

- ✚ Computer systems that have outlived their function can be repurposed or donated to various charities and non-profit organizations.
- ✚ Recycling computing equipment can keep harmful materials such as lead, mercury, and hexavalent chromium out of landfills.
- ✚ Example: Refilling printer cartridges is greener than recycling them.

3.3.3.5 Telecommuting

Telecommuting

- Reduces greenhouse gas emissions related to transportation
- Increases worker satisfaction
- Reduces costs for office space
- Reduces Heat
- Conserves Energy



Allows you to work from anywhere you want while holding down the responsibilities of an office.

Employees working from home reduce the fuel emission that is created during commuting by vehicles.

3.3.4 ADVANTAGES OF GREEN COMPUTING

- + Reduce energy usage
 - Lower carbon dioxide emissions, stemming from a reduction in the fossil fuel used in power plants and transportation.
- + Conserving resources
 - Less energy is required to produce, use, and dispose of products.
- + Changing government policy to encourage recycling and lowering energy usage.
 - Encourage recycling and lowering energy use by individuals and businesses.
- + Reduce the risk existing in the computer
 - Such as chemical known to cause cancer, nerve damage and immune reactions in humans.

3.4 RESPONSIBILITY IN PROTECTING THE ENVIRONMENT

3.4.1 PERSONAL RESPONSIBILITY AS A COMPUTER USER IN PROTECTING THE ENVIRONMENT

Refers to adapting one's activities to cut energy use entirely

a) Conserving energy

- ✚ Hibernate your computer.
 - Configure your computer to “hibernate” automatically after 30 minutes or so of inactivity.
- ✚ Sleep mode use less energy.
 - Enables the “sleep mode” features on your computer, allowing it to use less power during period of in activity.
- ✚ The main reasons people conserve energy are:
 - To gain more control over their energy bill
 - To reduce the demand on the earth's natural resources.
- ✚ Examples of Energy Conservation in the Business World
 - Printing.
 - recycling used paper by sending emails instead of printing memos.
 - Lighting.
 - Turning lights off when the last person leaves at the end of the workday.
 - Companies should also consider installing motion detectors in less-frequented areas.

- Heating and cooling.
 - Turn off air conditioning or heating during the last hour of the day.
- Carpool.
 - Setting up a carpool system allows employees to share rides to work limiting the number of vehicles in use daily.

the process of converting waste materials into new materials and objects

b) Recycling

- ✚ Waste reduction, reuse, and recycling allow us to:
 - use fewer raw materials
 - conserve natural resources
 - preserving landfill space
 - minimizing energy use.
- ✚ Send the old computer parts that are no longer in working order to recycling centers that accept e-waste.

3.4.2 ECOLOGICAL DANGER AND THE USE OF ECOLOGICAL SOUND PRODUCT

- ✚ There are several effects computer use has on the environment and human health.
 - People print unnecessary large amounts of files which wastepaper and harm trees.
 - People who never turn off the device which wastes electricity.
 - Computers are made of heavy metals and dangerous chemicals.

- ✚ Heavy metals including:
 - Lead:
 - Can be found in the Cathode Ray Tube, the glass of the monitor and the solder in the circuit board of the CPU.
 - can harm the kidneys and reproductive systems.
 - Even low levels of lead can be harmful to a child's mental development.
 - Mercury:
 - Can be found in the circuit boards and internal switches.
 - can include symptoms itching/burning skin, skin discoloration, shedding of the skin.
 - It is linked to brain and kidney damage and harmful to developing fetus.
 - Brominated Flame Retardants:
 - May cause thyroid damage and harm fetal development.
 - Beryllium:
 - it is a carcinogen that can cause lung disease.
 - Cadmium:
 - Can be found in a coating on monitor glass, batteries, chip resistors and cables/wires.
 - Cadmium can damage kidneys and bones.
 - PCV:
 - This emits highly toxic dioxin when incinerated.

Chapter 4

Hardware Troubleshooting

This chapter discusses the following topics:

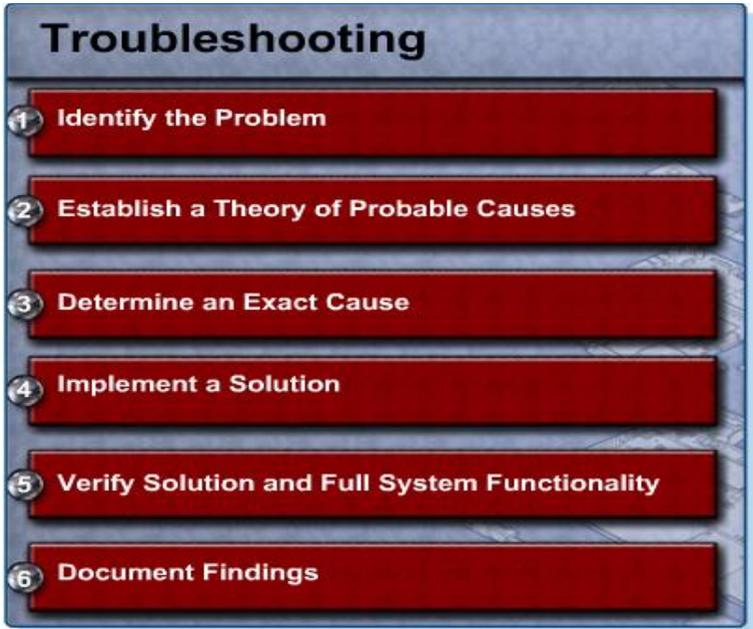
- *Troubleshooting Process*
 - *Troubleshoot Hard Drives, RAID Arrays and Internal Components*
 - *Troubleshoot Video, Projector and Display Issues.*
 - *Troubleshoot Common Mobile Device Issues*
 - *Troubleshoot Common Wired and Wireless Network Problems.*
-

4.1 TROUBLESHOOTING PROCESS

- ✚ Troubleshooting
 - An approach to finding a problem
 - is needed to identify the symptoms
 - A skill that will improve over time

- ✚ Troubleshooting is the process of diagnosing and fixing problems.
- ✚ Computer Troubleshooting may involve hardware or software and can sometimes involve both at the same time.
- ✚ The basic theory of troubleshooting is that you start with the most general possible problems, and then narrow it down to more specific.

4.1.1 TROUBLESHOOTING PROCESS STEPS



Step 1: Identify the Problem

<p>Open-ended Questions</p> <p>* Allow them to explain problem</p>	<ul style="list-style-type: none"> ✓ Can you describe what happens when the computer boots? ✓ What is the first screen you see when you turn on the computer? ✓ What sound does the computer make as it starts?
<p>Closed-ended Questions</p> <p>* Yes or No answer</p>	<ul style="list-style-type: none"> ✓ Has anyone else used this computer? ✓ Is any media installed in optical drive? ✓ Does the computer have a USB drive attached?

Step 2: Establish a Theory of Probable Cause

Common causes of hardware problems * List the easiest to hardest	<ul style="list-style-type: none"> ✓ Loose cable connection ✓ Faulty RAM ✓ Incorrect device driver ✓ Fans are dirty ✓ Incorrect jumper settings ✓ CMOS battery problem
---	--

Step 3: Test the Theory to Determine Cause

Common steps to determine cause * Test easiest theory first	<ul style="list-style-type: none"> ✓ Disconnect and reconnect the cables ✓ Replace the RAM ✓ Roll back or reinstall the device driver ✓ Clean the fans ✓ Reset the jumpers ✓ Replace the CMOS battery
--	---

Step 4: Establish a Plan of Action and Implement the Solution

If no solution is achieved in the previous step *Try quick and easy stuff first	<ul style="list-style-type: none"> ✓ Other Technicians ✓ Technical Websites ✓ Manufacturer FAQs ✓ News Group ✓ Computer Manuals ✓ Device Manuals ✓ Online Forums ✓ Internet Search
--	--

Step 5: Verify Solution

Verify Solution and Full	<ul style="list-style-type: none"> ✓ Access all drives and shared resources ✓ Print a document
--------------------------	--

System Functionality	<ul style="list-style-type: none">✓ Read and write to all storage devices✓ Validate the amount of RAM, the CPU, speed, and the date and time✓ Test network connectivity✓ Execute commonly used applications
Step 6: Documents	
Document Findings, Actions and Outcomes	<ul style="list-style-type: none">✓ Discuss the solution implemented with the customer✓ Document the steps taken to solve the problem in the work order.✓ Document any components used in the repair✓ Document the time spent to resolve the problem

4.2 TROUBLESHOOT HARD DRIVES, RAID ARRAYS AND INTERNAL COMPONENTS.

4.2.1 TROUBLESHOOT HARD DRIVE

i) Slow performance

- ✚ For a slow drive
 - Use system tools to define and possibly repair the problem.
 - These tools would include defragmentation.
 - The process of defragmentation moves the associated files together in a contiguous arrangement that is easier and faster for the drive to read, and creating clear free space to write data in.

- ✚ The result is faster reads and writes.
- ✚ This is a once-a-month preventative maintenance activity.

ii) Drive not recognized

- ✚ The drive was not auto detected, and the setup data needs to be configured manually.
- ✚ The drive has been damaged and cannot be recognized by the system.
- ✚ The drive must be change to a new one.

iii) OS not found *and/or* Failure to boot

- ✚ The drive is improperly set up.
- ✚ Drive is damaged beyond repair.
- ✚ OS must be re-installed.

iv) RAID not found

- ✚ This would indicate that the RAID controller has failed
- ✚ One or more disks is misconfigured.

4.2.2 TROUBLESHOOT MOTHERBOARD, RAM, CPU AND POWER

i) unexpected shutdowns

- ✚ Can be caused by anything from:
 - a bad power supply
 - a system memory
 - the processor or even the motherboard.

Actions:

- ✚ shut it off and move on to something else until the system components and heat sinks are cool to the touch.
- ✚ Restart the machine.

ii) BIOS time and settings resets

- ✚ System day, date and time reverts to something irrational.
- ✚ At this point in your studies, you will have covered the BIOS settings on a PC and how it is stored modified and maintained.

Actions:

- ✚ *Change the CMOS Battery*
- ✚ The information stored in the BIOS is kept constant when the device is off by a small watch battery more specifically a CR2032.



iii) Continuous reboots

- ✚ Sometimes a continuous series of reboots will be caused by a failed update or software corruption.
- ✚ The continuous reboot situation is more often caused by a failing motherboard component, the processor, RAM, or motherboard.

iv) No power

- ✚ A no power condition is diagnosable by the general lack of noise, fan, drives and lights.

Actions:

- ✚ Check all your power sources, wall outlet and power strip.

v) Overheating

- ✚ The greatest danger is heat.
- ✚ Fortunately, there are sensors built into the motherboard that can detect extremes temperature and either issue a warning or shut down the system.

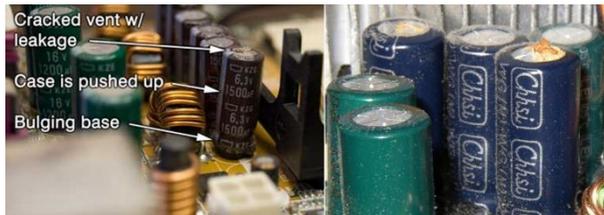
- ✚ The cause of overheating is due to clogged air ducts where internal circulation is obstructed or excessive dust accumulation.
- ✚ When you hear an odd sound coming from the case it is probably the heat sensor.

Actions:

- ✚ Clean a dust from motherboard and CPU fan.

vi) Distended capacitors

- ✚ Capacitors store energy until they are released.
- ✚ When looking at the top of the capacitor you can see the pressure relief scores.
- ✚ These cross shaped indentations serve to create a weak area that will allow the capacitor to vent as opposed to exploding.
- ✚ You can see that two of the capacitors have already failed here.



4.3 TROUBLESHOOT VIDEO, PROJECTOR AND DISPLAY ISSUES

i) VGA mode

- ✚ Windows cannot load due to video card difficulties, which is typically of an inaccurate or outdated driver.

Action:

- ✚ Access VGA mode by pressing F8 for 7-10 seconds after the POST screen appears on startup screen.
- ✚ Once the Windows Advanced Options menu appears, choose the Enable VGA Mode option.

ii) No image on screen

- ✚ A variety of possible causes for this condition.
- ✚ That would entail power fans lights all running.

Action:

- ✚ Do check the monitor for Power indicator lights and check the cable connections carefully.
- ✚ If everything is in order, change a new monitor.

iii) Overheat shutdown

- ✚ A slight layer of dust in the fin housing under the fan blades blocking airflow that could be sufficient to impede the cooling capacity of the cooling unit.
- ✚ Variations in temperature especially hot may cause the system to shut down protectively.

Action:

- ✚ Easy enough to clean and important enough to check regularly.

iv) No display

- ✚ First, check your monitor function key combination.
- ✚ Determine the keystrokes and cycle through them.
- ✚ If the LCD doesn't begin to display, then your next step would be to get a known good external monitor and connect it.

v) Dim display

- ✚ The screen reduced the display brightness level.
- Action:**
- ✚ The worst case on this one is replacing the backlight.
- ✚ Look for the brightness controller.
- ✚ Then look on the keyboard for a brightness button or slider.
- ✚ If that does not work, try uninstalling the video drivers in Device Manager check for newer version of the driver manufacturer's website and install it.
- ✚ Also keep in mind that some laptops are configured to dim the display when the unit is switched to battery power.

4.4 TROUBLESHOOT COMMON MOBILE DEVICE ISSUES

i) Touchscreen non-responsive

- ✚ First if you have a screen protector, remove it.
- ✚ Now turn the device off.
- ✚ Then clean the screen and your hands thoroughly.
- ✚ Don't reinstall the screen protector until it can be ruled out as a problem.
- ✚ Restart the device and recalibrate the screen.

ii) Apps not loading

- ✚ If you have a condition where apps will not load or load slowly.
- ✚ First, check the battery
 - Is it overheating?
 - Is the device warm to the touch?
- ✚ Remove the battery and allow it to cool to room temperature.

- ✚ If the battery is swollen, replace it immediately.
- ✚ If it is not swollen, reinstall the battery and re-evaluate the condition.



iii) Slow performance

- ✚ This could be a combination of too many apps exhausting your resources.
- ✚ Restart it and use your application manager to see exactly what gets loaded at startup.
- ✚ Adjust the apps for resource usage and monitor the device for a recurrence of the heat issue.
- ✚ If the steps above don't work, restore the system back to factory setting.

iv) Frozen system/hang

- ✚ "Frozen" usually related to a smartphone or tablet.
- ✚ A system lockup or freeze cannot be recovered.
- ✚ The only option is to do a soft reboot.

v) No sound from speakers

- ✚ The user may have turned down the volume or muted the speakers.
- ✚ Check the Sound device in Device Manager, Check the drivers and update them.
- ✚ If all the above failure, try the Hardware Troubleshooter in Control Panel.
- ✚ If these methods fail, try a set of headphones or external speakers.
- ✚ If they don't work, you may have a hardware problem.

4.5 TROUBLESHOOT COMMON WIRED AND WIRELESS NETWORKS PROBLEM

i) No wireless connectivity

- ✚ Determine whether it is a local host, network, internet, or e-mail problem.
- ✚ Try pinging a known good host.
- ✚ If didn't connect.
- ✚ Release and renew your IP address. Use the *ipconfig /release* command to clear the IP address data then use *ipconfig /renew* to attain a new configuration.

ii) IP Conflict

- ✚ An IP Conflict occurs when two IP based machines use the same address.
- ✚ Duplicate addresses are not tolerated by the TCP/IP addressing scheme.

iii) Intermittent wireless

- ✚ If you have a wireless router, move around the workspace until you get the best signal.
- ✚ Make sure the location is practical for the user.
- ✚ Often repositioning the lid slightly will get you a stronger signal.

iv) Limited & Local Connectivity

- ✚ Check the IP address assigned to the device.
- ✚ If it starts with 169.254.xxx.xxx you know it has an assigned an address and cannot communicate with the DHCP server.

Action:

-  Check lights on NIC and devices.
-  Test or swap out the cable.
-  Open a command prompt using cmd in the search window.
-  ping a localhost (ping 127.0.0.1).
-  Then ping a Google (ping 8.8.8.8) to validate connectivity.

v) Slow transfer speeds

-  In a situation where your resources are impacted by the number of users on a segment or link.
-  The number of users increases the speed will decrease.

Chapter 5

Operational Procedures

This chapter discusses the following topics:

- Documentation Best Practice
 - Basic Disaster Prevention and Recovery Methods
 - Common Safety Procedures, Environmental Impacts and Appropriate Controls.
 - Communication Techniques and Professionalism
 - Remote Access Technologies
-

5.0 INTRODUCTION

Standard Operating Procedure (SOP)



A **standard operating procedure** (SOP) is a set of step-by-step instructions compiled by an organization to help workers carry out complex routine **operations**.



Clients expect you to solve their problems, not make them worse by injuring yourself or those around you.

5.1 TYPES OF SOFTWARE DOCUMENTATION

- ✚ Main categories in Software documentation.
 - Product documentation
 - Describes the product that is being developed and provides instructions on how to perform various tasks with it.

- Process documentation
 - A step-by-step graph of a business process.
- User documentation
 - includes tutorials, user guides, troubleshooting manuals, installation, and reference manuals.
- ✚ Basic requirements for good documentation practices will include, but not be limited to, the following components:
 - i. Fit for context.
 - ii. Clearly written and to the point.
 - iii. Visual where possible.
 - iv. Up to date.
 - v. Discoverable & tracked.
- ✚ Some examples of proper documentation
 - i. doctor's note with date
 - ii. hospital bill or record
 - iii. jury duty form
 - iv. funeral home document for a death in the family
 - v. tow slip with date and time.
- ✚ Benefits of Document Management Systems
 - i. Easy access to documents
 - ii. Increased productivity
 - iii. Reduce paper waste
 - iv. Reduced errors and omissions.
 - v. Better content quality.
 - vi. Cost reduction
 - vii. Enhanced auditing and tracking capabilities

5.2 BASIC DISASTER PREVENTION AND RECOVERY METHODS

✚ Disaster Prevention

- ✚ A set of pre-disaster activities that are undertaken in anticipation of a disaster to ensure appropriate and effective actions are taken in the aftermath.

✚ Disaster Recovery Plan (DRP)

- The main phases / activities:
 - recovery and reconstruction strategy formulation
 - damage and needs assessment
 - implementation mechanism
 - monitoring and evaluation

✚ What is a Disaster?

- ✚ Any event that creates an inability on the part of an organization.

- ✚ Disasters may either be *natural* or *man-made*.

✚ **Natural:**

Examples:

- Flood
- Earthquake
- Landslides
- Tsunamis
- Volcanic
- Hurricane



Man-Made:

Examples:

- Fire
- Transport Accident
- Oil spills
- Nuclear explosion



Types of backups include:

**TYPES OF BACKUP:
FULL, DIFFERENTIAL, AND INCREMENTAL**

Full Backups: Entire data set, regardless of any previous backups or circumstances.



Differential Backups: Additions and alterations since the most recent full backup.



Incremental Backups: Additions and alterations since the most recent incremental backup.



Initial Full Backup • 1st Backup 2nd Backup 3rd Backup 4th Backup 5th Backup

Data subject to backup

 **Full back up:**

- Backup all files on the drive.
- Takes the longest time to record because every file is copied.
- Takes the shortest time to restore because everything is on a single tape.
- requires the biggest storage.

 **Differential backup:**

- Records only those files that have changed since the last FULL BACKUP.
- Takes less time to record than a Full backup.
- Takes less time to restore than an Incremental backup.

 **Incremental backup:**

- Records only those files that have changed since the LAST BACKUP.
- Takes the shortest time to record.
- Generally, takes the longest time to restore.

 **Cloud Storage vs. Local Storage Backups**

▪ **Local storage**

- You can access it when you wish.
- It is physically available to you.
- If there is a failure, the time to repair will usually be less than if you backup the data to the cloud.

- **Disadvantages: costly:** servers, racks, tape drives, electricity, and so on.

▪ **Cloud Storage**

- It is a big platforms such as Amazon Web Services (AWS), Azure, Google Cloud and so on.
- **More secure** than DropBox, OneDrive, and Google Drive because they are designed for business use.

▪ **Disadvantages of Cloud Storage**

- You Need an Internet Connection.
- Extra Storage Space Comes at a Cost.
- Security and Privacy Concerns With Some Providers.

5.3 SAFETY PROCEDURES, ENVIRONMENTAL IMPACTS, AND APPROPRIATE CONTROLS

 SAFETY PROCEDURES:

Safety

- Safe working conditions help prevent injury to people and damage to computer equipment.

Grounding

- A way to transport any excess electrical discharge away from the component.

Workstations

- Workstations that have been designed to meet all health and safety regulations should be **comfortable**.

 Basic safety precautions to use when working on a computer:

- i. Remove your watch and jewelry and secure loose clothing.
- ii. Turn off the power and unplug equipment before performing service.
- iii. Cover sharp edges inside the computer case with tape.
- iv. Never open a power supply or a CRT monitor.
- v. Do not touch areas in printers that are hot or that use high voltage.
- vi. Know where the fire extinguisher is located and how to use it.
- vii. Keep food and drinks out of your workspace.
- viii. Keep your workspace clean and free of clutter.
- ix. Bend your knees when lifting heavy objects to avoid injuring your back.

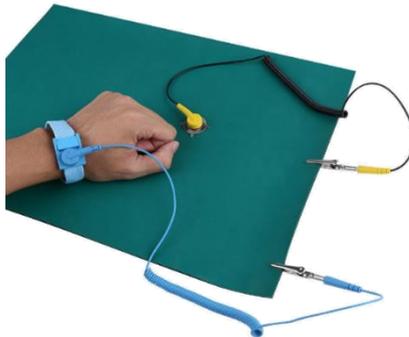
✚ ESD Prevention and Equipment Grounding

✚ *Electrostatic discharge (ESD)* occurs when two objects of different voltages encounter each other.

- *Function:* To protect components from ESD, including the following:
- *Procedure:*
 - i. *Use an antistatic wrist strap:*



- ii. *Use an antistatic mat:* Place the computer on top of the mat. Connect the mat via the antistatic wrist strap.



- iii. *Self-grounding:* Touch the chassis of the computer before handling any components. This is also a good habit to get into when an antistatic strap is not available.
 - iv. *Use antistatic bags:* When installing or removing components, keep them inside the

bag until you are ready to work with them. Keep the bag itself on top of the antistatic mat.



- ✚ Electromagnetic interference (EMI) is the intrusion of outside electromagnetic signals in a transmission media, such as copper cabling.
 - In a network environment, EMI distorts the signals so that the receiving devices have difficulty interpreting them.
 - Sources of EMI:
 - Any source designed to generate electromagnetic energy.
 - Man-made sources like power lines or motors
 - Natural events such as electrical storms, or solar and interstellar radiations

- ✚ *Electrical Safety*
 - Turn off the power and disconnect the device from the AC outlet.
 - Power supplies and CRT monitors contain high voltage.
 - CAUTION!!!
 - Do not wear the antistatic wrist strap when repairing power supplies or CRT monitors.

- Only experienced technicians should attempt to repair power supplies and CRT monitors.
- To avoid an electrical shock and to prevent damage to the computer, turn off and unplug the computer before beginning a repair.

 *Fire Safety*

- Buildings should be outfitted with smoke detectors and fire extinguishers.
- The proper type of fire extinguisher for an electrical fire is a Class C extinguisher.
- Proper use of a fire extinguisher can prevent a small fire from getting out of control.

 *Physical Safety*

- *Physical safety considerations include the following:*
 - Securing cables*
 - Using caution with heavy items*
 - Not touching hot components*
 - Use safety equipment*
 - Considering workplace ergonomics*

 *Environmental Impacts and Appropriate Controls*

- *Computers and peripherals contain materials that can be harmful to the environment.*
- *Hazardous materials are sometimes called toxic waste.*
- *These materials can contain high concentrations of heavy metals such as cadmium, lead, or mercury.*
- *Material Safety and Data sheet*
 - Products that use chemicals require material safety data sheets (MSDSs).

- MSDS is a fact sheet that summarizes information about material identification.
- These are documents that give information about substances (for example, the ink in inkjet cartridges).
- Information in the MSDS includes:
 - i. Proper treatment if the substance is ingested or meets the skin.
 - ii. How to dispose of the substance.
 - iii. How to store the substance.

 Equipment Disposal

- Recycling and proper disposal are also important.
- Batteries should not be thrown away with normal trash because they contain chemicals.
- Ink and toner cartridges can usually be sent back to the manufacturer, or office supply stores and printer repair outfits often will take them for later recycling.
- Cell phones, smartphones, and tablets should be disposed of properly as well.

 *Power Protection Devices*

- Unsteady voltages are called power fluctuations.
- Types of AC power fluctuations can cause data loss or hardware failure:
 - i. *Blackouts*: Complete loss of AC power.
 - ii. *Brownouts*: Reduced voltage level of AC power that lasts for a period.
 - iii. *Noise*: Interference from generators and lightning.
 - iv. *Spike / Sags*: Sudden increase in voltage that lasts for a short period and exceeds 100 percent of the normal voltage on a line. Example: lightning strikes.

- v. *Surges*: Unexpected increase in voltage above the normal flow of electrical current.
- o Type of Power Protection Devices:
 - i. *Surge suppressor*: Helps protect against damage from surges and spikes. A surge suppressor diverts extra electrical voltage that is on the line to the ground.



- ii. *Standby power supply (SPS)*: Helps protect against potential electrical power problems by providing a backup battery to supply power when the incoming voltage drops below the normal level.
 - The battery is on standby during normal operation.
 - When the voltage decreases, the battery provides DC power to a power inverter, which converts it to AC power for the computer.
 - If the switching device fails, the battery cannot supply power to the computer.



iii. *Uninterruptible power supply (UPS):* Helps protect against potential electrical power problems by supplying a consistent level of electrical power to a computer or other device.

- The battery is constantly recharging while the UPS is in use.
- The UPS provides a consistent quality of power when brownouts and blackouts occur.



5.4 COMMUNICATION TECHNIQUES AND PROFESSIONALISME

i. *Use proper language and avoid jargon, acronyms, and slang, when applicable.*

- ✚ Speak slowly, clearly, and professionally so the customer can fully understand what you are saying.

- ii. *Maintain a positive attitude/project confidence.*
 - Even if the customer thinks the situation is hopeless or the customer is frustrated, be positive.

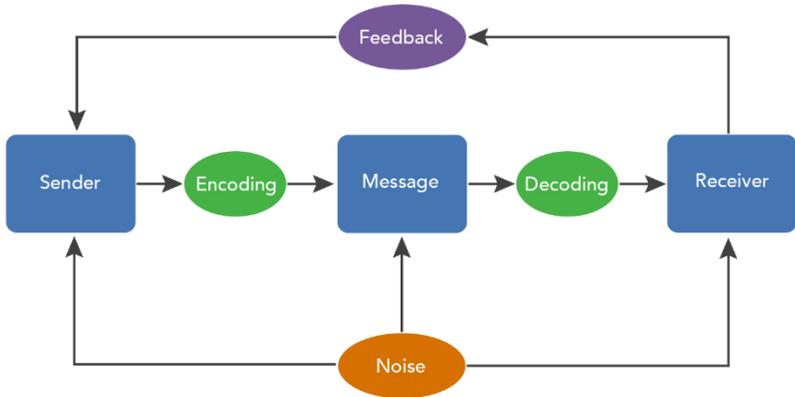
- iii. *Actively listen (taking notes) and avoid interrupting the customer*
 - Write down key points related to the problem the customer is having. Don't interrupt the customer, even if you think you know what the problem is before the customer has fully explained the situation.

- iv. *Be culturally sensitive*
 - Understand that customers come from all walks of life. Be aware that cultural differences and similarities exist. Be respectful and kind

- v. *Be on time (if late, contact the customer)*
 - If you are running late, contact the customer, apologize, and let the customer know that you will be late. Actively listen (taking notes) and avoid interrupting the customer

- vi. *Avoid distractions*
 - Phone calls should be screened and left to go to voicemail unless it is an emergency.

✚ The communication processes



- The situation that the communication process was completed is when the receiver understands the message.
- Effective Communication
 - i. Sharing of activity
 - ii. Listening
 - iii. Politeness

5.5 REMOTE ACCESS TECHNOLOGIES

Remote Desktop: enables a user to see and control the GUI of a remote computer.

✚ *Remote Assistance*

- This means that connections can be made via Remote Assistance invitations, by e-mail, or via instant messaging.
- This is often implemented in help-desk scenarios in which a user invites a technician to take control of her computer so that it can be repaired.

 *Remote Desktop Connection*

- Can select whether other users can connect to, and control, your computer at any time without an invitation from you.
- The remote users can make connections to your computer-by-computer name or by IP address.
- Can select the users who are allowed to connect to your computer.
- To make a Remote Desktop connection to a remote computer, first make sure that the remote computer has Remote Desktop enabled

 *More Third-Party Tools*

- There are plenty of other tools that are available for the remote control of systems as well as simply screen sharing systems, or simply sharing files.
- Virtual Network Computing (VNC) product such as RealVNC can use to remotely control Linux computers, macOS systems, and Android-based smartphones and tablets.
- Other remote-control tools include TeamViewer, AnyDesk, LogMeIn, Chrome Remote Desktop, and the list goes on.

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