CHAPTER 1

INTRODUCTION TO COMPUTER MAINTENANCE

This unit specifies competencies required to perform computer repair and maintenance. It involves performing troubleshooting, disassembling of faulty components, repairing/replacing faulty components, testing of component functionality up gradation and testing of hardware and software

Definition & Terms

What is a Computer? A computer is an electronic device that takes in data and instructions (input), works with the data (processing), and produces information (output).

Basic Terms

Data refers to the raw facts that are fed to a computer.

Information is data that has been processed and can be used for decision making.

Data and Information can take either of the following formats:

•**Text** – These are number, characters or special symbols. They are used when preparing reports, letters, etc.

•**Graphics** – These are images. Used when preparing charts, graphs, pictures

•**Multimedia –** These are audio and video recordings that may or may not combine of text and graphics.

Processing is the act of converting data into information.

Advantages of using computers

- A computer helps you automate various tasks that you cannot do or are very cumbersome to do manually
- It helps you organize your organizations data and information in a better way
- It has much more computing and calculating power than an ordinary human.
- It has a large storage capacity for data and files
- Computers have consistency and reliability of performance without the need of rest that human being need.
- Computers have made communication faster and cheaper
- Computers have made research easy without the need to move physically to libraries.

Limitations of computers

- Though computer is programmed to work efficiently, fast and accurately but it is programmed by human beings to do so
- It is very difficult to make a computer act correctly in all situations since a computer cannot be truly intuitive. Without supervision, computers will operate poorly when dealing with unexpected circumstances, such as information or instructions that are incorrect or incomplete.
- A Computer cannot take care of itself like a human. A computer is dependent still to human beings for this purpose.

Computer Application Areas

Computers are now used in virtually all spheres of life. Here are a few of the application areas:

- **Science & technology (s&t**) - Computers are used in S&T to promote advances that could be useful to mankind, i.e. discovering better and more efficient ways of doing things.
- **Education** - Computers are useful for promoting learning experiences.
- **Banking & finance** - Computers are very useful for handling financial transactions, most especially the storage and processing of huge amounts of information kept by financial institutions.
- **Recreation** - On your average PC, you can play a variety of games,socializing.
- **Security** - information can be encrypted during transit and the use of fire walls and passwords additionally ensures that information stored is safe.

Caring for your computer

Here are some general tips on the care of your PC:

- Computers need air circulation to keep them cool.
- Computers should be kept in a dust free environment.
- Use a surge protector or a UPS, (Uninterruptible Power Supply).
- Do not plug devices into the computer while it is on, unless you are inserting a USB device.
- Monitors, CPU and Printers should be turned off only by the power button on the printer case.
- If at all possible, do not eat or drink around your PC.
- Always use some form of Anti-Virus software.
- Backing up your data periodically will protect your data and make it easier to recover from a
- disastrous event.
- Use Scandisk and Defrag on storage disks to protection of your data.
- Empty your Recycle Bin on a regular basis

Basic computer system Component parts

Hardware –The physical (Tangible) part of a computer. The hardware is made up of the following parts: – Input devices like the keyboard and mouse –Central Processing Unit –Storage devices like hard drives – Output devices like printers and monitors

Software – The non-physical part of a computer. It comprises of instructions fed to the computer to manipulate the hardware. The instructions tell the computer what to do. –system software –application software

Computer Safety

- **Antivirus Software**: Install reputable antivirus and antimalware software on your computer to detect and remove malicious software.
- **Firewalls:** Enable firewalls to monitor and control incoming and outgoing network traffic, helping to prevent unauthorized access to your computer.
- **Software Updates:** Keep your operating system, software, and applications up to date to patch security vulnerabilities.
- **Strong Passwords:** Use strong, unique passwords for your accounts, and consider using a password manager to securely store them.

- **Two-Factor Authentication (2FA):** Enable 2FA wherever possible to add an extra layer of security to your accounts.
- **Secure Wi-Fi:** Use encryption and strong passwords for your Wi-Fi network to prevent unauthorized access to your internet connection.
- **Backup Your Data:** Regularly backup your important files and data to an external hard drive or cloud storage to protect against data loss due to hardware failure, theft, or malware.
- **Phishing Awareness:** Be cautious of suspicious emails, links, and attachments, as they could be attempts to steal your personal information or install malware on your computer.
- **Safe Browsing Habits:** Avoid visiting untrusted websites and clicking on pop-up ads. Stick to secure websites with HTTPS encryption.
- **Privacy Settings:** Review and adjust privacy settings on your devices and online accounts to limit the amount of personal information shared and collected.

Safety Precautions when working inside a computer's case

• Make notes for backtracking
• Stay organized, do not stack boards
• Do not touch board chips – With hands, magnetized screwdriver
• Do not change dual inline package (DIP) switch settings with a graphite pencil
• Protect yourself and the equipment – Never ever touch inside of a turned on computer– Protect against static electricity

Maintenance Tools, Equipment Materials

Computer maintenance is the practice of keeping computers in a good state of repair. Computer valeting is the in-depth cleaning of the physical components of a personal computer.

Hardwaretools are grouped into four categories:

- ESD tools
- Hand tools
- Cleaning tools
- Diagnostic tools

ESD Tools: There are two ESD tools: the antistatic wrist strap and the antistatic mat. The antistatic wrist strap protects computer equipment when grounded to a computer chassis. The antistatic mat protects computer equipment by preventing static electricity from accumulatingon the hardware or on the technician.

Hand Tools: Most tools used in the computer assembly process are small hand tools. They are available individually or as part of a computer repair toolkit. Toolkits range widely insize, quality, and price. Some common hand tools and their uses are:

- **Flat-head screwdrive**r: Used to tighten or loosen slotted screws.
- **Phillips-head screwdriver**: Used to tighten or loosen cross-headed screws.
- **Torx screwdriver**: Used to tighten or loosen screws that have a star-like depression onthe top, a feature that is mainly found on laptops.
- **Hex driver**: Used to tighten or loosen nuts in the same way that a screwdriver tightens orloosens screws (sometimes called a nut driver).
- **Needle-nose pliers**: Used to hold small parts.
- **Wire cutters**: Used to strip and cut wires.
- **Tweezers:** Used to manipulate small parts.
- **Part retriever**: Used to retrieve parts from locations that are too small for your hand tofit.
- **Flashlight**: Used to light up areas that you cannot see well.
- **Wire stripper**: A wire stripper is used to remove the insulation from wire so that it canbe twisted to other wires or crimped to connectors to make a cable.
- **Crimper**: Used to attach connectors to wires.
- **Punch-down tool**: Used to terminate wire into termination blocks. Some cable connectors must be connected to cables using a punch down tool.

Cleaning Tools: Having the appropriate cleaning tools is essential when maintaining and repairing computers. Using the appropriate cleaning tools helps ensure that computer components are not damaged during cleaning. Cleaning tools include the following:

- **Soft cloth:** Used to clean different computer components without scratching or leavingdebris
- **Compressed air:** Used to blow away dust and debris from different computer partswithout touching the components
- **Cable ties:** Used to bundle cables neatly inside and outside of a computer
- **Parts organizer:** Used to hold screws, jumpers, fasteners, and other small parts and prevents them from getting mixed together

Diagnostic Tools: Diagnostic tools are used to test and diagnose equipment. Diagnostic toolsinclude the following:

- A **digital multimeter** is a device that can take many types of measurements. It tests the integrity of circuits and the quality of electricity in computer components. A digital multimeter displays the information on an LCD or LED.

Source: http://electricalacademia.com

Digital multimeter

- A **loopback adapter**, also called a loopback plug, tests the basic functionality of computer ports. The adapter is specific to the port that you want to test.
- The **toner probe**, as shown in Figure 2-4, is a two-part tool. The toner part is connectedto a cable at one end using specific adapters, such as an RJ-45, coaxial, or metal clips.The toner generates a tone that travels the length of the cable. The probe part traces the cable. When the probe is in near proximity to the cable to which the toner is attached, the tone can be heard through a speaker in the probe.
- Although an **external hard drive** enclosure is not a diagnostic tool, it is often used when diagnosing and repairing computers. The customer hard drive is placed into the external enclosure for inspection, diagnosis, and repair using a known-working computer. Backups can also be recorded to a drive in an external enclosure to prevent data corruption during a computer repair.

Software Tools: Like hardware tools, there are a variety of software tools that can be used to help technicians pinpoint and troubleshoot problems. Many of these tools are free and severalcome with the Windows operating system.

Disk Management Tools: Software tools help diagnose computer and network problems anddetermine which computer device is not functioning correctly. A technician must be able to use a range of software tools to diagnose problems, maintain hardware, and protect the data stored on a computer.

The following are some disk management tools:

- **FDISK:** A command-line tool that creates and deletes partitions on a hard drive. The FDISK tool is not available in Windows XP, Vista, or 7. It has been replaced with the Disk Management tool.
- **Disk Management Tool:** Initializes disks, creates partitions, and formats partitions.
- **ScanDisk or CHKDSK:** Checks the integrity of files and folders on a hard drive by scanning the file system. These tools might also check the disk surface for physicalerrors.
- **Defrag:** Optimizes space on a hard drive to allow faster access to programs and data.
- **Disk Cleanup:** Clears space on a hard drive by searching for files that can be safely deleted.

CHAPTER 2
MAINTENANCE

Maintenance Concept

Computer maintenance is the practice of keeping computers in a good state of repair.

Types of Computer Maintenance

- **Corrective maintenance**: Reactive modification of a computer and peripherals performed after delivery and during use to correct discovered problems.
- **Adaptive maintenance**: Modification of a computer and peripherals performed after delivery and during use to keep a computer usable in a changed or changing environment.
- **Perfective maintenance**: Modification of a computer and peripherals performed after delivery and during use to improve performance or maintainability.
- **Preventive maintenance**: Modification of a computer and peripherals performed after delivery and during use to detect and correct latent faults in the computer before they become effective faults.

Active vs passive maintenance

Active maintenance of the PC involves keeping the system clean and free of errors, preventing problems before they start. Many different types of software can be used to do this, but the main ones are as follows: Antivirus, Anti-malware, Defragmenter, Firewall, System cleaner

Passive maintenance involves taking care of the system by providing the best possible environment—both physical and electrical—for the system. Physical concerns are conditions

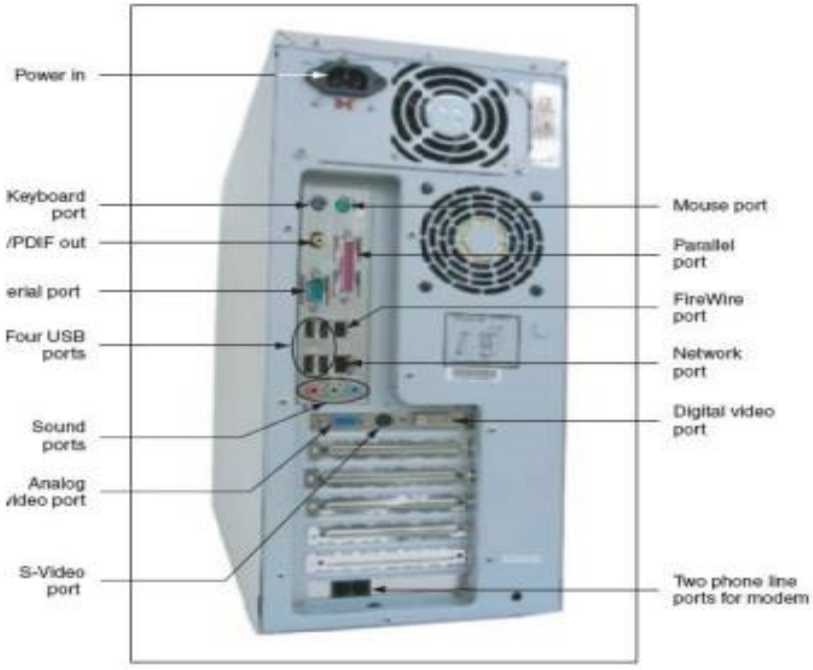
such as ambient temperature, thermal stress from power cycling, dust and smoke contamination, and disturbances such as shock and vibration

CHAPTER 3
COMPUTER INPUT & OUTPUT DEVICES

PC Hardware Components

• Input/output (I/O) devices: external to the case
• Processing, storage devices: internal to the case
• Central processing unit (CPU) – Also called: processor, microprocessor – Reads input, processes data, writes data to storage

I/O devices can be divided into two categories −
Block devices − A block device is one with which the driver communicates by sending entire blocks of data. For example, Hard disks, USB cameras, Disk-On-Key etc.
Character devices − A character device is one with which the driver communicates by sending and receiving single characters (bytes, octets). For example, serial ports, parallel ports, sounds cards etc



Hardware Used for Input and Output

Ports (Connectors)

A computer port is an external connection device used to connect different peripherals to a computer. In daily terms a port is a door that a computer use to communicate (input and output) with the rest of the world, what includes other computers, the Internet, a printer, a keyboard, mouse, digital camera, external modem, etc.

Classification of Connectors:

1. **Size:** They also have a determined size that is rather small, running for example from the size of a penny (for the round ports) to the size of an electric

plug (for a trapezoid shaped one like COM ports)

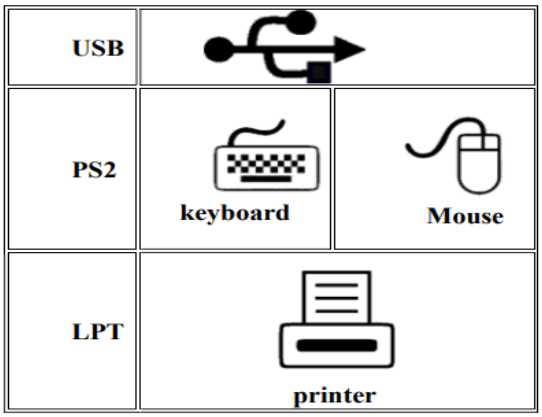
2.Pin configuration

3.Speed

4.Design and shape: ports have specific shapes that are the first and best way of recognizing them. Some are round (DIN/PS2, BNC), some are trapezoid (Dshell, Centronics) and some are rectangular (USB , Firewire)

5. Gender, which is either come with male or female ends.

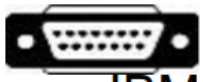
6. Symbol: Some computer ports have a special well-known symbols that identify it, like USB, COM, FireWire or SCSI,



Connectors Types based on shape

1. **D Shell or D-Sub Connectors**: If you look at this connector, it looks similar to a CAPITAL D.


DB-9 (9 pins or sockets) - serial port connector on IBM AT, PS/2 and compatible computers for connecting modems and other RS-232 serial devices, serial mouse & printer, mono monitor


DB-15 (15 pins or sockets) - joystick port on IBM, AT, PS/2 and compatible computers, video connector on most Macintosh computers, and Ethernet cards

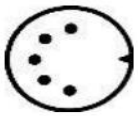

HDDB-15 High Density (15 pins or sockets) - VGA or SVGA video connector on IBM, AT, PS/2 and compatible computers

2. Centronics connector looks like an edge connector surrounded by a metal shell and is used on printers and in SCSI devices.

3. DIN Connectors: The acronym "DIN" stands for Deutsche Industrie Normen (German Industrial Standard) and the connector is a high-frequency coaxial connector.

DIN-3 MINI

DIN-4 MINI



DIN-5

DIN-6 MINI

DIN-8 MINI

DIN-9 MINI

DIN Connector - Female (holes)

DIN Connector - Male (pins)

3. BNC

Is a hollow T shaped connector about 1 centimeter in diameter that has 2 small bumps on its outside. These connectors are used to connect computers to LANS (Local Area Networks)

4. RJ-45 or RJ-13 Connectors

Look like telephone jacks. The phone uses a RJ-13 with 4 wires in it. Most Networks use the RJ-45 connector with 8 wires in it. RJ-13's are used with external modems.

5. USB (Universal Serial Bus) USB is an interface that uses an external bus standard, and is used to connect devices to a computer. It is used to connect mice, modems, keyboards, scanners, printers, digital cameras, etc.

USB Features/ Characteristics

1. Speed: It is much faster than serial and parallel connectors, and supports data transfer rates of 12 Mbps or more.

2. Plug & Play: USB supports Plug-and-Play technology. This means that when you plug a device into USB port, your computer can automatically detect and setup the device for you.

3. Connect multiple devices: Up to 127 peripheral devices can be connected to a single USB port using Daisy Chain were the device has built in USB port that allows it to plug to other device creating chain of devices that can be connected to a single USB port.

4. Hot Plug: It allows adding or removing devices without having to turn off your computer. So it permits you to be able to connect peripherals "on the fly".

CHAPTER 4
MOTHERBOARD AND BUSES

Introduction to Computer Motherboard & Components

This is the main circuit board of the PC. It contains all the basic, core components of the computer. It contains all the basic, core components of the computer. It usually contains:

The CPU, which plugs into a socket designed for a particular CPU's pin arrangement. Because a motherboard has sockets that can only accept certain types of CPU, it is important to make sure when upgrading your CPU that your motherboard can accept it.

Memory chips - these hold data and programs that the CPU is currently using.

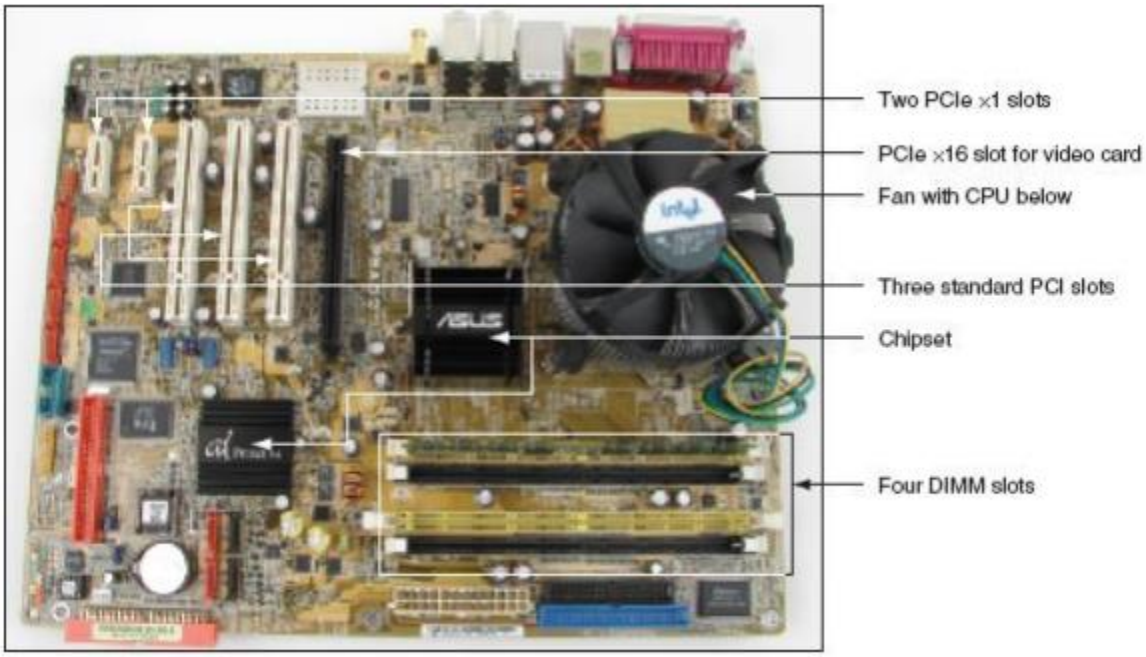
Input/output ports ("I/O") such as connectors that hard disk drives, floppy disk drives and CD-ROM drives plug in to, serial port sockets, parallel port sockets and USB port sockets.

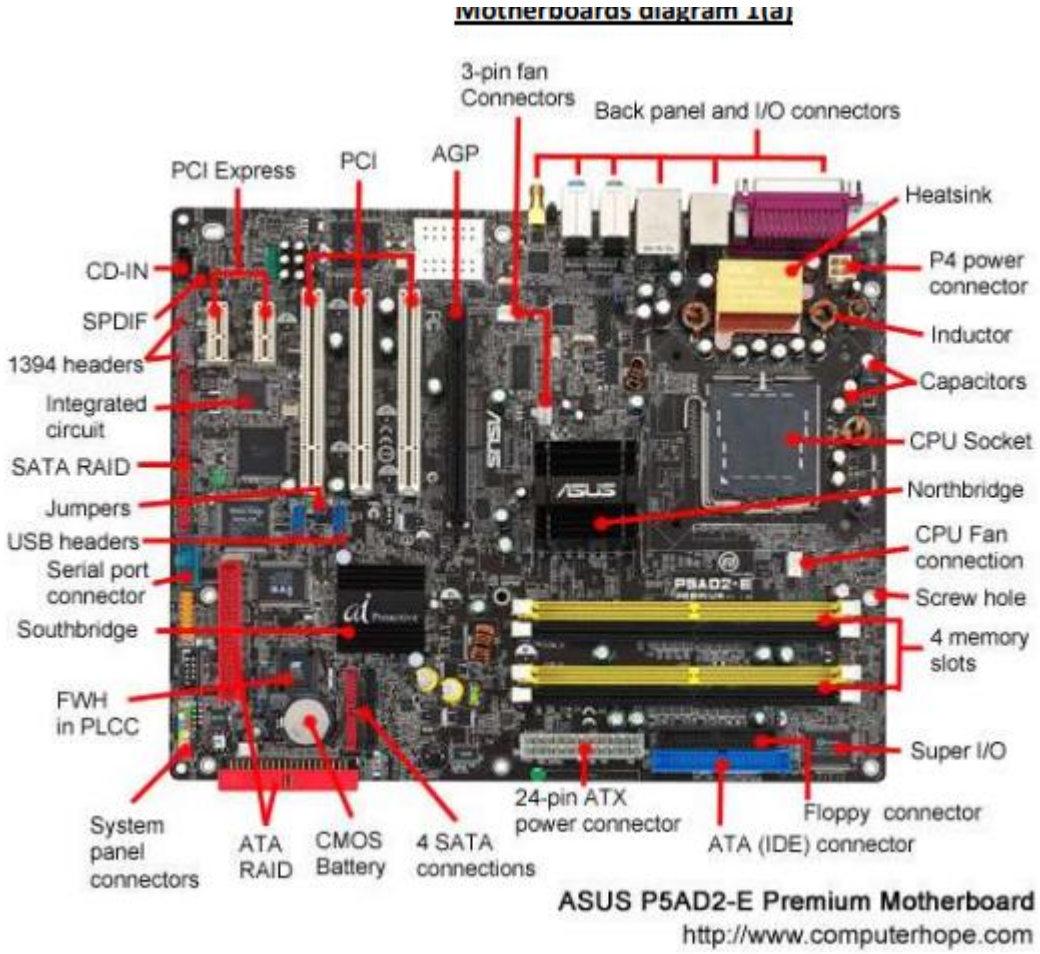
BIOS chips (Basic Input Output System) - the BIOS chips are PROM (Programmable Read Only Memory) chips that contain the most basic information that a computer needs to start up and operate. The BIOS contains bootup information, details of what sort of CPU is installed, what hard disks are available, how the motherboard should behave etc. More details below.

Real time Clock (RTC) so the computer knows the time and date. The RTC needs a battery to keep the clock running when the computer's power is turned off.

Chipset – Group of microchips controlling data flow (North bridge and south bridge)

Some motherboards, especially laptop motherboards, have built-in graphics chips, sound chips and modem chips so expansion cards are not needed.





Types of motherboards (Form Factors)

ATX (Advanced Technology eXtended): ATX is one of the most common form factors for desktop motherboards. It typically measures 12 x 9.6 inches (305 x 244 mm) and offers ample expansion slots for add-on cards and peripherals. ATX motherboards are suitable for standard desktop PCs and gaming rigs.

Micro-ATX (mATX): Micro-ATX is a smaller variant of the ATX form factor, measuring 9.6 x 9.6 inches (244 x 244 mm). While it offers fewer expansion slots compared to ATX, it still provides sufficient connectivity for most users. Micro-ATX motherboards are popular choices for compact desktops and budget-friendly systems.

Mini-ITX: Mini-ITX is the smallest mainstream form factor, measuring just 6.7 x 6.7 inches (170 x 170 mm). Despite its compact size, Mini-ITX motherboards can accommodate a single PCIe slot and multiple SATA connectors. They are commonly used in small form factor (SFF) PCs, home theater PCs (HTPCs), and compact gaming builds.

Extended ATX (E-ATX): E-ATX motherboards are larger than standard ATX boards, typically measuring 12 x 13 inches (305 x 330 mm) or larger. They offer additional expansion slots and features for high-end desktops, workstations, and enthusiast-grade systems. E-ATX motherboards are commonly used in gaming PCs with multiple graphics cards and elaborate cooling solutions.

Mini-STX (Mini Socket Technology Extended): Mini-STX is an ultra-compact form factor designed for small, low-power systems. These motherboards measure around 5.8 x 5.5 inches (147 x 140 mm) and use a unique socket design. Mini-STX boards are commonly found in mini PCs and embedded systems.

Nano-ITX: Nano-ITX is even smaller than Mini-ITX, measuring approximately 4.7 x 4.7 inches (120 x 120 mm). These miniature motherboards are suitable for extremely compact and low-power applications, such as IoT devices, digital signage, and industrial embedded systems.

Chipset

A chipset is the component which routes data between the computer's buses, so that all the components which make up the computer can communicate with each other. The chipset originally was made up of a large number of electronic chips, hence the name. It generally has two components:

The NorthBridge (also called the memory controller) is in charge of controlling transfers between the processor and the RAM, which is way it is located physically near the processor. It is sometimes called the GMCH, forr Graphic and Memory Controller Hub.

The SouthBridge (also called the input/output controller or expansion controller) handles communications between peripheral devices. It is also called the ICH (I/O Controller Hub).

Buses

A bus is a common pathway through which information flows from one component to another.

Functions of Buses in Computers

- Data sharing
- Addressing
- Power
- Timing

Types of buses

1. System bus(front-side bus):- The bus that connects the CPU to main memory on the motherboard. The system bus is also called the **front-side bus**, memory bus, local bus, or host bus.

2. A number of I/O Buses, (Acronym for input/output), connecting various peripheral devices to the CPU -these are connected to the system bus via a ‗bridge‘ implemented in the processors chipset. Other names for the I/O bus include —expansion bus", "**external bus\\ back side bus**

Address Bus, Data Bus, Control Bus

Expansion Bus Types

These are some of the common expansion bus types that have ever been used in computers:

- ISA - Industry Standard Architecture
- EISA - Extended Industry Standard Architecture
- MCA - Micro Channel Architecture
- VESA - Video Electronics Standards Association
- PCI - Peripheral Component Interconnect
- PCMCIA - Personal Computer Memory Card Industry Association (Also called PC bus)

- AGP - Accelerated Graphics Port
- SCSI - Small Computer Systems Interface.

Expansion slots:

These are sockets that expansion cards like network cards, sound cards, graphics cards can be plugged into. There have been various types of slots over the years to cater for increasingly complex expansion cards. The earliest cards were **ISA**, then came **EISA**, then **PCI** and **AGP** (which have special high-priority access to the CPU - AGP is used by fast graphic cards). All expansions slots connect to a bus so data can travel between subsystems and the CPU.

BIOS, or Basic Input/Output System

Is a fundamental component of a computer system that initializes hardware components during the boot process and provides essential low-level system functions. Here are its **key functions:**

- **Power-On Self-Test (POST):** When you power on a computer, the BIOS performs a series of diagnostic tests known as the POST. This checks the integrity and functionality of critical hardware components such as the CPU, memory (RAM), storage devices, and input/output (I/O) devices. If the POST detects any errors, it typically displays error messages or audible beeps to alert the user.
- **Bootstrap Loader**: After completing the POST, the BIOS locates the boot device specified in the BIOS settings (such as a hard drive, SSD, or optical drive) and loads the initial bootstrap loader program from the boot sector of the specified device into memory. This program is responsible for loading the operating system kernel into memory and initiating the boot process.
- **Hardware Initialization**: The BIOS initializes and configures various hardware components connected to the motherboard, including the CPU, memory, expansion cards (such as graphics cards and network adapters), USB controllers, and storage controllers. It detects and configures the settings for these devices, ensuring they are ready for use by the operating system.
- **CMOS Setup Utility:** The BIOS provides access to the CMOS setup utility, which allows users to configure and customize various system settings stored in the CMOS (Complementary Metal-Oxide-Semiconductor) memory chip. These settings include date and time, boot device priority, hardware settings, security options, and power management settings.

Booting a Computer

• Booting – Computer brings itself up to a working state. Without user just pressing on button

- **Hard boot (cold boot)** – Turn on power with on/off switch
- **Soft boot (warm boot)** – Use operating system to reboot

Boot functions (boot Process)

- Startup BIOS runs POST and assigns system resources
- Startup BIOS program searches for and loads an OS
- OS configures system and completes its own loading
- Application software is loaded and executed

Methods of installing BIOS updates

Express BIOS update

- Update from a bootable floppy disk
- Update from a bootable USB drive or bootable CD
- Recovery from a failed update

BIOS and CMOS

- Often the BIOS and CMOS can be confused because instructions may either indicate to enter the "BIOS Setup" or the "CMOS Setup". Although the setup for BIOS / CMOS is the same, the BIOS and CMOS on the motherboard are not.
- The BIOS on the motherboard contains the instructions on how the computer boots and is only modified or updated with BIOS manufacturer, the CMOS is powered by a CMOS battery and contains your system settings and is modified and changed by the user when entering the CMOS Setup.

CMOS battery

The information contained in the CMOS chip is maintained by a battery. If the battery runs low, the CMOS content will be lost and POST will display a "CMOS invalid" or "CMOS checksum invalid" message.

What Is POST?

Stands for Power-on self-test. It is built in diagnostic program which consists of series of diagnostic tests performed at power-on. POST program contained in BIOS ROMs

System Devices Tested by POST

• Basic motherboard components -- CPU and motherboard support circuitry

• Display adapter -Display controller and display memory

• Keyboard -Tests for keyboard response and stuck keys

• System RAM memory -Tests base and extended memory

• Disk drives -Checks for presence and status of disk drives

Types of POST Error Messages:

POST error messages are generated in two forms

-Audio: a series of coded beeps

-Visual: error codes or messages displayed on monitor

• POSTs and error codes vary depending on manufacturer of BIOS ROMs

Beeps	Meaning
1 short beep	Normal POST – system is OK

2 short beeps	POST error – error code shown on screen
No beep	Power supply, system board problem, disconnected CPU, or disconnected speaker
Continuous beep	Power supply, system board, RAM or keyboard problem
Repeating short beeps	Power supply, system board or keyboard problem
1 long, 1 short beep	System board problem
1 long, 2 short beeps	Display adapter problem (MDA, CGA)
1 long, 3 short beeps	Enhanced Graphics Adapter problem (EGA)
3 long beeps	keyboard card error

Factors to consider during motherboard selection

- CPU Socket Type: Ensure the motherboard supports the socket type of your chosen CPU. Common sockets include LGA (Land Grid Array) for Intel CPUs and PGA (Pin Grid Array) for AMD CPUs.
- Form Factor/type: Choose a form factor (ATX, Micro-ATX, Mini-ITX, etc.) that fits your case and offers the desired number of expansion slots and connectivity options.
- Chipset: The chipset determines features like overclocking support, PCIe lanes, USB ports, SATA ports, and RAM compatibility. Select a chipset that meets your requirements and supports future upgrades.
- Memory Support: Check the motherboard's memory slots, maximum capacity, and supported memory speeds (MHz). Ensure compatibility with your chosen RAM modules.
- Expansion Slots: Consider the number and type of expansion slots (PCIe x16, PCIe x1, M.2) for adding graphics cards, sound cards, Wi-Fi adapters, and storage expansion cards.
- Storage Options: Look for SATA ports and M.2 slots for connecting hard drives, SSDs, and NVMe SSDs. Consider RAID support if you plan to use multiple drives.
- I/O Ports: Evaluate the rear I/O panel for USB ports (USB 3.2 Gen 1, USB 3.2 Gen 2, USB-C), audio jacks, Ethernet ports, HDMI/DisplayPort outputs, and other connectors based on your connectivity needs.
- BIOS/UEFI Features: Check the motherboard's BIOS/UEFI interface for user-friendly navigation, advanced tweaking options, and support for firmware updates.
- Brand Reputation and Support: Consider the reputation of motherboard manufacturers for reliability, warranty coverage, customer support, and availability of driver/software updates.

PROCEDURE OF INSTALLING A COMPUTER MOTHERBOARD

Installing a computer motherboard involves several steps to ensure proper installation and connection of components. Here's a general procedure for installing a motherboard:

Prepare Your Workspace:

Choose a clean, well-lit workspace with ample room to work.

Lay down an antistatic mat or use an antistatic wrist strap to prevent electrostatic discharge (ESD) that could damage sensitive components.

Gather all necessary tools and components, including the motherboard, CPU, RAM, GPU (if applicable), storage drives, power supply, and peripherals.

Prepare the Motherboard:

Carefully remove the motherboard from its packaging, handling it by the edges to avoid touching sensitive components.

Verify that the motherboard is compatible with your CPU, RAM, and other components.

Install the CPU and CPU cooler onto the motherboard according to the manufacturer's instructions. Apply thermal paste if necessary.

Install Standoffs:

Place the motherboard onto the case tray to determine the positions of mounting holes.

Install standoffs (metal spacers) into the case tray at locations corresponding to the motherboard's mounting holes. Ensure that the standoffs align with the holes on the motherboard.

Install I/O Shield:

Insert the I/O shield (backplate) into the rectangular cutout on the back of the computer case. Ensure that the ports align correctly with the motherboard's rear I/O connectors.

Mount the Motherboard:

Gently lower the motherboard onto the standoffs, aligning the mounting holes on the motherboard with the standoffs.

Carefully screw in the motherboard screws to secure the motherboard to the standoffs. Do not overtighten the screws, as this could damage the motherboard.

Connect Components:

Install the RAM modules into the appropriate slots on the motherboard, ensuring they are fully seated.

Install the GPU (if applicable) into the PCIe slot on the motherboard and secure it with screws.

Connect the power supply cables to the motherboard, including the main 24-pin ATX power connector, CPU power connector (4 or 8 pins), and any additional power connectors required by the GPU.

Connect front panel connectors (power switch, reset switch, HDD LED, etc.) from the computer case to the corresponding headers on the motherboard.

Connect SATA cables from storage drives (HDDs, SSDs, optical drives) to the SATA ports on the motherboard.

Connect case fans and any other peripherals to the appropriate headers on the motherboard.

Double-Check Connections:

Carefully inspect all connections to ensure they are secure and properly seated.

Check for any loose screws or cables that could potentially cause shorts or damage.

Close the Case:

Once all components are installed and connected, carefully close the computer case and secure it with screws.

Reconnect any external peripherals such as monitors, keyboard, and mouse.

Power On and Test:

Connect the power cable to the power supply and switch on the power.

Power on the computer and enter the BIOS/UEFI setup to verify that all components are detected and functioning correctly.

If everything is working properly, proceed to install the operating system and drivers.

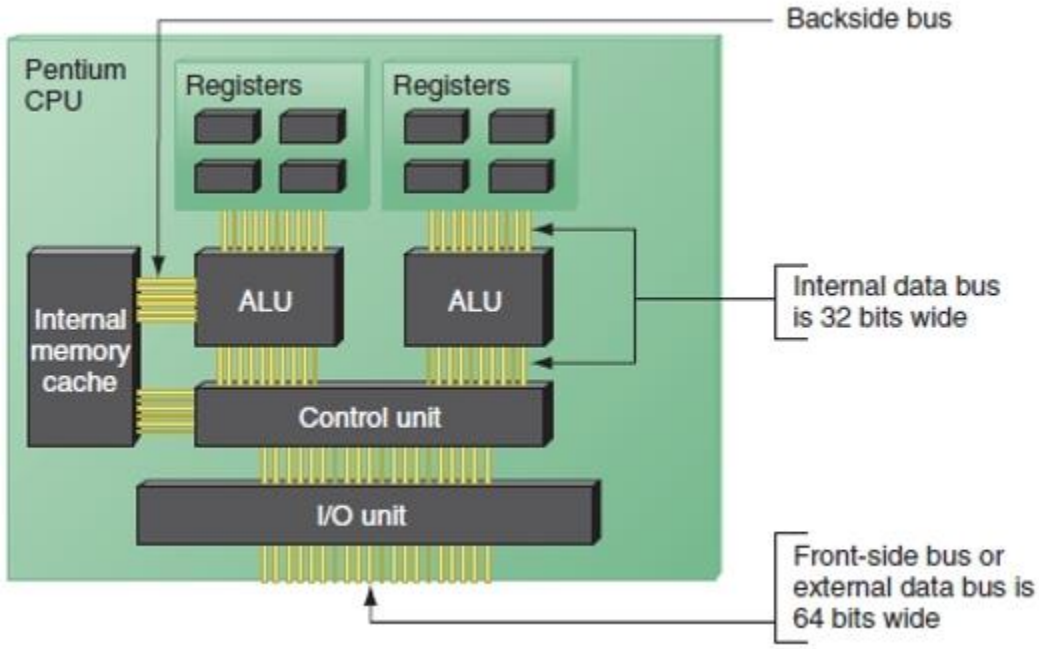
CHAPTER 5
PROCESSOR

The computer CPU is responsible for handling all instructions it receives from hardware and software running on the computer.

- 4-bit Microprocessors
- 8-bit Microprocessors
- 16-bit processors.
- 32-bit microprocessors
- 64-bit processors

Components of the CPU

In the CPU, the primary components are the **ALU (Arithmetic Logic Unit**) that performs mathematical, logical, and decision operations and the **CU (Control Unit)** that directs all of the processors operations.



Microprocessor Characteristics

Instruction set: The set of instructions that the microprocessor can execute

Bandwidth : The number of bits-processed in a single instruction. The amount of data that can be transmitted in a fixed amount of time

Clock speed : Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

Classification of processors based on instruction sets

Complex Instruction Set Computing (CISC):

CISC processors support a wide range of complex instructions that perform multiple operations in a single instruction.

Reduced Instruction Set Computing (RISC):

RISC processors use a simplified instruction set with a smaller number of basic instructions.

Each instruction performs a single operation, leading to simpler hardware design and faster execution.

Specifications to consider when selecting microprocessor chips (MPU)

Data bus - Most microprocessor chips are available with an 8-bit, 16-bit, 24-bit, 32-bit, 64-bit, 128-bit, or 256-bit data bus.

Microprocessor family - Products from many proprietary microprocessor families are commonly available.

Supply voltage - Supply voltages range from - 5 V to 5 V and include intermediate voltages such as - 4.5 V, - 3.3 V, - 3 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3 V, 3.3 V, and 3.6 V.

Clock speed - Clock speed, the frequency that determines how fast devices connected to the system bus operate, is generally expressed in megahertz (MHz).

Random access memory (RAM) - RAM is usually expressed in kilobytes (kB) or megabytes (MB).

Power dissipation - Power dissipation, the device's total power consumption, is generally expressed in watts (W) or milliwatts (mW).

Operating temperature - Operating temperature is a full-required range

Processor Socket and Slot Types

Pin grid array (PGA) socket – Pins aligned in uniform rows around socket

Staggered pin grid array (SPGA) – Pins staggered over socket – Squeezes more pins into a small space

Land grid array (LGA) – Uses lands rather than pins

Differences between duo core and quad core processor types

- ✓ **Cores**

  A dual core processor is equipped with 2 numbers of cores and a quad core processor has 4 cores.

- ✓ **Processing speed**

  The performing speed of a quad core processor is faster than a dual core processor.

- ✓ **Multitasking ability**

  A quad core processor can easily handle four software whereas a dual core processor is able to easily and smoothly control 2 applications.

- ✓ **Generated heat**

  A quad core processor generates more amounts of heat while running for a long time while the dual core processor generates minimal heat.

- ✓ **Consumption of energy**

  A dual core processor consumes very less electricity than a quad core processor.

- ✓ **Graphical ability**

  The quad core processors have more graphical ability than a dual core processor.

- ✓ **Price**

  As the number of the cores gets increased, the price of the processors increases accordingly. Therefore, the price of a quad core processor is higher than a dual core processor.

Causes of Overheating of Microprocessor.

- Processor fan may not be properly connected.
- Heat sink may be not contacted with the processor.
- Jumpers may be configured to over clock the CPU.
- Voltage supply incompatible

How to Install a New Computer Processor on a Motherboard

Prepare Your Workspace: Choose a clean, well-lit workspace with plenty of room to work. Lay down an antistatic mat or use an antistatic wrist strap to prevent electrostatic discharge (ESD) that could damage sensitive components. Gather all necessary tools and components, including the new CPU, motherboard, thermal paste (if not pre-applied), and any required mounting hardware.

Prepare the Motherboard: Place the motherboard on a flat surface, such as the motherboard box or an antistatic bag, with the CPU socket facing up. Locate the CPU socket on the motherboard. It is usually a square or rectangular socket with a protective cover.

Unlock the CPU Socket: If there is a protective cover over the CPU socket, gently lift or slide it out of the way. Some covers may require you to press down on a lever or latch to release them.

Identify CPU Orientation: Examine the CPU to identify the correct orientation for installation. Look for notches, markings, or an arrow indicating the correct alignment.

Handle the CPU Carefully: Hold the CPU by its edges, avoiding touching the pins or contact pads on the bottom. Handle it gently to prevent bending or damaging the pins.

Install the CPU: Align the CPU with the socket on the motherboard, ensuring that the orientation matches the socket. There may be notches or markings on both the CPU and socket to help with alignment. Carefully lower the CPU into the socket, making sure it sits flat and flush.Once properly aligned, gently lower the CPU retention mechanism, such as a lever or latch, to secure the CPU in place. Be sure to follow the manufacturer's instructions for your specific motherboard model.

Apply Thermal Paste (If Necessary): If the CPU cooler does not come with pre-applied thermal paste, apply a small pea-sized amount of thermal paste to the center of the CPU heat spreader. Spread it evenly using a plastic spatula or a clean fingertip.

Install CPU Cooler: Install the CPU cooler onto the motherboard, aligning it with the CPU socket and securing it in place using the provided mounting hardware. Follow the cooler manufacturer's instructions for installation.

Connect CPU Power: Connect the CPU power cable from the power supply to the CPU power connector on the motherboard. This is usually a 4-pin or 8-pin connector located near the CPU socket.

Test and Boot: Once the CPU is installed and the cooler is attached, proceed to install other components such as RAM, GPU, and storage devices. Power on the computer and enter the BIOS/UEFI setup to verify that the CPU is detected and functioning correctly. If everything is working properly, proceed to install the operating system and drivers.

CHAPTER 6
MEMORY

Memory is the electronic holding place for instructions and data that your computer's microprocessor can reach quickly. When your computer is in normal operation, its memory usually contains the main parts of the operating system and some or all of the application programs and related data that are being used.

Characteristics of Computer Memory

1. Electrical Characteristics - The voltage and current requirements depend on the manufacturing technology of the device. The voltage level is not of major concern because most of the semiconductor memory devices operate at TTL voltage levels.

2. Speed - There is a finite time delay between the application of address and the availability of stable and accurate data on the data lines. This memory delay depends on the manufacturing technology and other factors such as size.

3. Capacity representing the global volume of information (in bits) that the memory can store. Memory is small in size and hence its storage is relatively low

Types of Memories

1. Random access memory, generally called RAM is the system's main memory, i.e. it is a space that allows you to temporarily store data when a program is running.

Unlike data storage on an auxiliary memory such as a hard drive, RAM is volatile, meaning that it only stores data as long as it supplied with electricity. Thus, each time the computer is turned off, all the data in the memory are irremediably erased.

2. Read-only memory, called ROM, is a type of memory that allows you to keep the information contained on it even when the memory is no longer receiving electricity. Basically, this type of memory only has read-only access. However, it is possible to save information in some types of ROM memory.

3. Flash memory is a compromise between RAM-type memories and ROM memories. Flash memory possesses the non-volatility of ROM memories while providing both read and write access However, the access times of flash memories are longer than the access times of RAM.

Types of RAM:

Dynamic RAM (DRAM) • Consists of transistors and capacitors. • Refreshes thousands of times per second

Static RAM (SRAM) • Consists of more transistors per memory cell than DRAM. • Does not need to refresh. • Faster and more expensive than DRAM

Types of Memory Modules Packaging

A memory module is a printed circuit board on which memory integrated circuits are mounted.

Memory is made from tiny semiconductor chips and must be packaged into something less fragile and tiny in order to be integrated with the rest of the system.

Types of memory module include:

SIMMS

SIMM stands for Single In-Line Memory Module. Like other types of memory modules, a SIMM consist of memory chips soldered onto a modular printed circuit board (PCB), which inserts into a socket on the motherboard. 72 pin SIMMs transfer 32 bits of data at a time, therefore in modern microcomputers with a 64-bit data bus two SIMMs have to be paired up in order to function.

DIMMS

Dual In-line Memory Modules, or DIMMs, closely resemble SIMMs. Like SIMMs, most DIMMs install vertically into expansion sockets. The principal difference between the two is that on a SIMM, pins on opposite sides of the board are "tied together" to form one electrical contact; on a DIMM, opposing pins rem a in electrically isolated to form two separate contacts.

SO DIMMS - A type of memory commonly used in notebook computers is called SO DIMM or Small Outline DIMM. The principal difference between a SODIMM and a DIMM is that the SO DIMM, because it is intended for use in notebook computers, is significantly smaller than the standard DIMM.

Symptoms that your memory needs an upgrade

Slow Performance: If your computer frequently slows down or becomes sluggish, especially when running multiple programs or demanding tasks, it may be a sign of insufficient RAM. Programs may take longer to load, and the overall system responsiveness may decrease.

Frequent Freezing or Crashing: Insufficient RAM can cause programs to freeze or crash unexpectedly, especially when the system runs out of available memory. You may experience frequent application crashes or system freezes, particularly when multitasking or using memory-intensive applications.

Excessive Disk Thrashing: When the system runs low on RAM, it compensates by using virtual memory, which involves swapping data between RAM and the hard drive. Excessive disk thrashing occurs when the system constantly swaps data between RAM and the hard drive, leading to slower performance and increased wear on the hard drive.

High Memory Usage: Monitor the system's memory usage using Task Manager (Windows) or Activity Monitor (macOS). If you consistently observe high memory usage, close applications, or tasks that are consuming a significant amount of memory, it may indicate that your system needs more RAM.

Inability to Run Certain Applications: Some applications, especially newer or more demanding ones, may require a minimum amount of RAM to run properly. If you encounter error messages or warnings stating that your system does not meet the minimum memory requirements for a particular application, it may be time to upgrade your RAM.

Long Boot Times: Insufficient RAM can prolong the boot time of your computer as the operating system and startup programs compete for limited resources. If you notice unusually long boot times, it could be due to inadequate memory.

Reduced Multitasking Capability: If you frequently multitask, such as running multiple applications simultaneously or working with large files, insufficient RAM may limit your multitasking capability. You may experience delays or slowdowns when switching between tasks or working with multiple windows open.

Gaming Performance Issues: In gaming, insufficient RAM can lead to stuttering, frame rate drops, and overall lower performance, especially in newer games or those with high-resolution textures and complex environments.

Factors to consider before buying a memory for youur system

RAM and connector types: Determine which of the four types of RAM your system uses: DRAM (EDO or FPM), SDRAM, DDR SDRAM, or RDRAM. All four types are mounted on one of three module types: SIMM, DIMM, or RIMM. Most machines support only one type of RAM and have one type of module or connector, so mixing types isn't an option. The few motherboards that do accept two types of RAM allow only a single type to be used at any one time.

Memory speed: SDRAM, DDR SDRAM, and RDRAM are rated to match or exceed the PC's front side bus speed, which is the speed at which data moves between the CPU and RAM. If your system comes with PC66 SDRAM, you can use PC100 SDRAM to replace it and get the faster speed, as long as your PC's front side bus supports the higher rate. But if you mix RAM of different speeds, all RAM will operate at the speed of the slowest chip.

Memory banks: On some PCs, the memory slot closest to the CPU--usually called bank 0--must be filled before the motherboard's other memory slots. On other systems, bank 0 must have the largest RAM module (if you are using modules of different sizes). There's no fixed rule, so check your PC's documentation.

Non-parity or ECC: If your system supports error-correcting code (ECC) and has more than 512MB of RAM, buying ECC memory may be worth the added cost. Large amounts of RAM are more likely to experience occasional, random errors (which may be caused by cosmic rays, among other sources). However, unless your current RAM is ECC, forget it; you can use nonparity and ECC modules together, but error correction will be disabled. To determine your type of memory, count the number of chips on the memory module. If the number is divisible by three, you have ECC or parity memory.

Column address strobe: The lower the CAS rating--or the CL rating--is, the better. SDRAM comes in CL2 or CL3 types, and DDR SDRAM comes in CL2 or CL2.5. Unless your motherboard requires a specific CAS or CL rating, get the lower (faster) rated module. Cost differences should be negligible. Again, if you mix modules of different speeds, they'll all operate at the slowest module's speed.

What is the difference between BIOS and CMOS?

The terms BIOS and CMOS both refer to essential parts of your computer's motherboard. They work together and they're both important, but they are not the same thing. Let's take a look at what the BIOS and CMOS are, and how they're different.

1. The BIOS, or "Basic Input/Output System", is special firmware stored in a chip on your computer's motherboard. It is the first program that runs every time you turn on your computer. The BIOS performs the POST, which initializes and tests your computer's hardware. Then it locates and runs your boot loader, or loads your operating system directly. The BIOS also provides a simple interface for configuring

your computer's hardware. When you start your computer, you may see a message like "Press F2 for setup." This setup is your BIOS configuration interface.

2. When you make changes to your BIOS configuration, the settings are not stored on the BIOS chip itself. Instead, they are stored on a special memory chip, which is referred to as "the CMOS." CMOS stands for "Complementary Metal-Oxide-Semiconductor." It's the name of a manufacturing process used to create processors, RAM, and digital logic circuits, and is also the name for chips created using that process.

CHAPTER 7
STORAGE

Introduction to Storage Disks and Drives

Computer data storage, often called storage or memory, is a technology consisting of computer components and recording media used to retain digital data. It is a core function and fundamental component of computers.

There are two different categories of storage devices:

Primary Storage Devices: Generally smaller in size, are designed to hold data temporarily and are internal to the computer. They have the fastest data access speed, and include RAM and cache memory.

Secondary Storage Devices: These usually have large storage capacity, and they store data permanently. They can be both internal and external to the computer, and they include the hard disk, compact disk drive and USB storage device.

Note: A disk is a device on which data is stored while a drive is a device used to record/read from a disk. Some devices incorporate the disk and drive together (i.e. Hard drive/hard disk drive) but others are in separate (i.e. CD/Floppy disks and drives)

Types of computer storage and Disks

The following are some examples of types of storage devices used with computers.

Magnetic storage/disks devices - Today, magnetic storage are one of the most common types of storage used with computers and are the technology that many computer hard drives use. It uses magnetism as its method of reading and writing data.

- Floppy diskette
- Hard drive
- Super Disk
- Tape cassette
- Zip diskette

Optical storage/disks devices - Another common storage is optical storage, which uses lasers and lights as its method of reading and writing data.

- Blu-Ray disc

- CD-ROM disc
- CD-R and CD-RW disc

Flash memory devices - Flash memory has started to replace magnetic media as it becomes

cheaper and more efficient solution.

- Jump drive or flash drive
- Memory card
- Memory stick
- SSD

Online and cloud - Storing data online and in cloud storage is becoming popular as people need

to access their data from more than one device.

Meaning of Disk management

Disk Management is an extension of the Microsoft Management Console that allows full management of the disk-based hardware recognized by Windows. You can use Disk Management in this version of Windows to perform disk-related tasks such as creating and formatting partitions and volumes, and assigning drive letters.

Disk management - Computer Definition. An umbrella term for a variety of functions for initializing a hard disk, maintaining its health and managing its organization

Disk management Techniques

- disk scan
- disk defragment
- file back up
- file recovery
- get system information

Selecting a Hard Drive

Considerations:

- Drive capacity
- Spindle speed
- Interface standard
- Cache or buffer size
- Average seek time (time to fetch data)
- Hybrid drive
- Manufacturer warranty (keep receipt)
- Price range

Hard Disk Interface(s)

SCSI - SCSI stands for Small Computer System Interface and used a parallel cable to attach both internal and external devices. One of the benefits of SCSI interfaces is that multiple devices could be chained together to a single port. Another benefit is that the interface includes features like error checking and hand shake signals between devices.

IDE - IDE stands for Integrated Drive Electronics and refers more to the standard than the cable type itself. The technology is also often referred to as ATA or PATA. ATA cables can only be up to 18 inches in length and are fairly large and flat, which makes them a poor choice for external devices, so the interface is mainly used for internal devices. The cable uses a combination of 40 or 80 wires in parallel.

SATA - SATA stands for Serial ATA and is an evolution of the original ATA (or IDE) interface. The SATA interface is faster in speed, at up to 3GB/s. Another major benefit of the interface is that the cables and connectors are much smaller, taking up less space inside a computer case and not restricting air flow. There is an external version of SATA known as eSATA for connecting external hard drives and other devices.

NB: Tracks: concentric circles on drive • Sectors (segments): portion of a track

Formatting and Partitioning a Hard Drive

Partition, partitioning: Free space on a hard disk must be partitioned before it can be used by an operating system. Creating a partition reserves a physical portion of the hard drive space for use as a logical drive, or volume, that the operating system can address. Volume: A volume is how the operating system 'sees' your free disk space. Volumes (also called logical drives) are represented in Windows by drive letters such as C:, E:, etc.

Volumes are formed by partitioning the free space of a hard drive. Volumes must be formatted with a file system before data can be stored on them.

Formatting: Formatting is the act of creating a file system on a volume, so that the operating system can store and retrieve data on that volume.

File system: A file system provides a means of organizing and retrieving information written to a hard disk or any other storage medium. A file system is created on a volume when it is formatted. Common Windows file systems include FAT32 (File Allocation Table 32) and NTFS (New Technology File System).

Partition can be thought of as a division or "part" of a real hard disk drive. When you partition a

hard drive, you make it available to an operating system. Multiple partitions on a singe hard

drive appear as separate drives to the operating system.

Disk formatting is the process of preparing a data storage device such as a hard disk drive, solid-state drive, floppy disk or USB flash drive for initial use.

Hard drive setup procedures

- **Primary partition** – This partition is usually the first partition. A primary partition cannot be subdivided into smaller sections. There can be up to four partitions per hard drive.
- **Active partition** – This partition is the partition used by the operating system to boot the computer. Only one primary partition can be marked active.
- **Extended partition** – This partition normally uses the remaining free space on a hard drive or takes the place of a primary partition. There can be only one extended partition per hard drive, and it can be subdivided into smaller sections called logical drives.

- **Logical drive** – This drive is a section of an extended partition that can be used to separate information for administrative purposes.
- **Formatting** – This process prepares a file system in a partition for files to be stored.
- **Cluster** – A cluster is also called a file allocation unit. It is the smallest unit of space used for storing data.
- **Track** – A track is one complete circle of data on one side of a hard drive platter. A track is broken into groups of 512 bytes, called sectors.
- **Cylinder** – A cylinder is a stack of tracks lined up one on top of another to form a cylinder shape.
- **Drive mapping** – Drive mapping is a letter assigned to a physical or logical drive.

CHAPTER 8
POWER SUPPLY

Alternating current (AC) – Oscillatory current driven by an alternating voltage • Example: house current oscillates at 60 Hz

Direct current (DC) – Single direction current driven by constant voltage • Required by computer in small amounts, such as 5 V

Functions/importance

Power supply acts as a transformer and rectifier

– Rectifier: converts AC to DC

– Transformer: changes ratio of current to voltage. Steps down voltage from 110 V or 220 V to 3.5, 5, and 12 V to provide the required voltages and currents that are needed to operate the components of the computer

-Regulates (for some PSU), the voltage to eliminate spikes and surges common in most electrical systems

Power Supplies Types/Form Factors

• **MicroATX form factor**

– Reduces total cost of a system

• **FlexATX**

– Variation of MicroATX with maximum flexibility

• **BTX (Balanced Technology Extended) form factor**

– Reduces heat with better airflow

• **NLX form factor**

– Developed to improve older and similar LPX form factor

Types of Computer Cases

• **Desktop cases** – Motherboard on bottom; power supply to the rear

• **Tower cases** – Up to 2 feet high; can contain several drives

• **Notebook cases** – Used for all portables; includes desktop components

Power supply features(factors to consider)

- Form factor determines power supply size
- Wattage ratings - Maximum amount of power watts required by the computer
- AC power voltage - AC power-line voltages and frequencies vary according to country (kenya 240v)
- Type and number of power cables, and connectors
- Warranty and overall quality

Types of power connectors

- **Motherboard Connector:** The power supply in your computer has one 20-pin connector that supplies power to the motherboard.
- **Large 4-pin DC connector (Molex):** These large, roundpin type connectors with 4-pins are used for some drives like HDD. The connector is polarized so it can only be installed in one direction
- **Medium DC connector (Berg):** these medium, square-pin type Connectors with 4-pins are used on some drives like FDD. The connector is polarized so it can only be installed in one direction
- **Small DC connector**: this small, connector with 2 or 3 pins is sometimes used for the CPU cooler or other devices. Never plug this connector directly into the motherboard
- **Auxiliary 12V connector**: this is 4-pin square type connector used to provide the motherboard with 12V power

Common Power Problems and solutions

- The light or fan on the power supply does not work.
- Nothing in the computer works.(plug something into the USB power to see if there is power going to it)
- No lights / fans or beeps come from the computer.
- System shuts off almost immediately or emits a continuous beep or repeating short beeps
- System reboots or shuts down while in use

  Possible faults:

  • New adapter card is overloading the power supply

  • Defective adapter card or motherboard

  • Defective power supply

  Troubleshooting procedures:

  • Remove all adapter cards and check power-supply status after power-up

  • If power supply shuts down with only the motherboard connected, substitute good power supply

  • Add adapter cards one at a time while checking power supply status (remember to turn off power when removing or inserting cards)

Power Disturbances

1. **Complete power failure(blackout):** – Power-line voltage drops to zero for extended periods of time Consequences: data loss

2. **Transients**: – It is an over voltage condition caused by lighting or electric motors resulting in possible permanent system damage

– Classified as: • Spikes (nanosecond) • Surges (millisecond)

3. **Sags** – It is an under voltage condition where voltage dips below voltage required by power supply resulting in data loss.

– Classified as: • Voltage sag (milliseconds) • Brown out (longer seconds)

Power Supply Protection Devices

The following types of power-protection devices are explained in the sections that follow:

• Surge suppressors- Power-distribution box that suppresses voltage spikes using a Metal Oxide Varistor (MOV)

• Phone-line surge protectors

• Line conditioners

• Standby power supplies (SPS/UPS) -Batteries charged while current level is monitored – If power fails, batteries switch on automatically

• Uninterruptible power supplies (UPS)- Batteries always used to provide power to system – Input power used to charge batteries while in use

Protect Yourself Against Electrical Shock and Burns

– Disconnect power • Pull plug at AC outlet

– Protect power cord • Do not pull on cord itself

– Remove jewelry

Protect the Equipment Against Static Electricity or ESD

– Touching device causes discharge, damaging device – Particularly severe in dry and cold climates

Protecting system from ESD

– Use ground bracelet, static mat, static shielding bags, ESD gloves

– Touch computer case before touching components

– Touch person when passing components

– Remove jewelry, work on hard floors

– Unplugged power cord before working inside case

CHAPTER 9: COMPPUTER ASSEMBLY & DISASSEMBLY

What is Computer Hardware Inventory?

Computer hardware inventory involves cataloging and tracking the physical components of computers and related devices within an organization. This includes desktops, laptops, servers, printers, networking equipment, and peripheral devices such as keyboards and mice. The goal is to maintain an accurate and up-to-date record of all hardware assets.

Importance of Computer Hardware Inventory

- **Asset Management**: Helps in keeping track of all hardware assets, ensuring that nothing is lost or misplaced.
- **Cost Management:** Facilitates budgeting and financial planning by providing clear insights into hardware expenses.
- **Maintenance and Support**: Enables timely maintenance and support, reducing downtime and extending the lifespan of hardware.
- **Security**: Helps in identifying and addressing potential security vulnerabilities associated with hardware components.
- **Compliance**: Ensures compliance with legal and regulatory requirements by maintaining proper records.

Key Components of Computer Hardware Inventory

- **Asset Details**: Information about each hardware item, including make, model, serial number, purchase date, warranty details, and current status.
- **Location Tracking**: Physical location of each hardware item, which can include office locations, departments, or even individual desks.
- **Ownership Information:** Details about the individual or department responsible for the hardware.
- **Configuration Details**: Specifications and configurations of hardware components, such as processor type, RAM, storage capacity, and installed software.
- **Lifecycle Management:** Tracking the lifecycle stages of hardware from acquisition to disposal, including maintenance schedules and depreciation.

Circumstances that would lead to updating computer hardware inventory

1. Acquisition of New Hardware - New Purchases: When new computers, servers, or other hardware devices are purchased, they must be added to the inventory with details such as the make, model, serial number, purchase date, and cost. Gifts and Donations: Any hardware received as gifts or donations should also be recorded in the inventory.

2. Disposal of Hardware Decommissioning: When hardware reaches the end of its lifecycle and is decommissioned, it should be removed from the inventory. Disposal or Recycling: If hardware is disposed of or sent for recycling, this change must be reflected in the inventory to ensure accurate tracking and compliance with environmental regulations.

3. Relocation of Hardware Office Moves: When hardware is relocated to a different office, department, or desk, the inventory should be updated to reflect its new location. Remote Work Assignments: If hardware is assigned to employees for remote work, the inventory should record these changes to track the hardware's physical location.

4. Changes in Ownership or Responsibility Employee Changes: When hardware is reassigned to different employees due to staff changes, promotions, or role shifts, the inventory should be updated to reflect the new ownership. Departmental Changes: When hardware is transferred between departments, the inventory should be adjusted accordingly.

5. Hardware Upgrades and Modifications Component Upgrades: Upgrades to hardware components, such as adding more RAM, replacing hard drives, or updating graphics cards, should be documented in the inventory. Repairs and Maintenance: Any significant repairs or maintenance work that changes the configuration or status of hardware should be recorded.

6. Software Installations and Changes New Software Installations: Installation of new software that affects hardware configuration should be noted in the inventory. Software Removal: Removal of software, particularly if it changes the hardware's functionality, should also be reflected.

7. Inventory Audits and Reconciliations Regular Audits: Periodic audits of the hardware inventory can reveal discrepancies that need to be updated. Reconciliation: Any reconciliation process between physical hardware and inventory records may identify updates required to ensure accuracy.

8. Security Incidents Theft or Loss: If hardware is stolen or lost, it should be immediately updated in the inventory and flagged for security and insurance purposes. Damage: Any hardware that is damaged beyond repair should be removed from the active inventory and recorded as disposed of.

9. Changes in Warranty or Support Status Warranty Expirations: When the warranty status of hardware changes, such as expiration or renewal, this information should be updated. Support Contracts: Updates related to the support or maintenance contracts associated with hardware should also be reflected in the inventory.

10. Policy or Compliance Requirements Compliance Updates: Changes in compliance requirements or organizational policies may necessitate updates to the inventory to ensure adherence to new standards.

Audit Findings: Findings from external or internal audits may require inventory adjustments to address discrepancies or meet regulatory requirements.

Hardware upgrading

A hardware upgrade is any new hardware better than that which it replaced or additional hardware that improves performance. A good example of a common hardware upgrade is a RAM upgrade, where the user increases the computer's total memory. Another good example is a video card upgrade, which is the act of removing an old video card and replacing it with a newer, better one.

Benefits of a hardware upgrade

- Performance increase, which make the overall computer run faster and more smoothly.
- Capacity increase. For example, adding a new hard drive allows the computer to store more information, and more memory increases the computers ability to run more.
- It may be necessary to upgrade the computer to meet a program or games system requirements.

Disassembling and Assembling the computer system

Disassemble is the process of breaking down a device into separate parts. A device may be disassembled to help determine a problem, to replace a part, or to take the parts and use them in another device or to sell them individually. For example, if a computer has a bad processor a user may need to disassemble the computer to get to the bad processor and replace it with a good processor.

Assemble is to fit or join together (the parts of something, such as a computer). The assembling of the computer system is exactly the opposite of disassembling operation.

Steps on how to disassemble a computer

1. The first thing you do, is unplug every cable that’s plugged in to your computer.
2. Now that your computer is fully unplugged, move your PC to a clean work space, preferably a carpet. The carpet is better than tile, because screws and other small parts will roll around.
3. Remove outer Shell/Casing
4. Now that the case is off, begin to remove the internal components which is system fan. Remove the CPU fan.
5. Unscrew the power supply.
6. Unscrew or disassemble DVD or CD Drive.
7. Remove or unscrew the Card reader (Available in new computer)
8. Remove the hard Disk Drive.
9. Remove the Expansion Card slots.

10. Remove the Connectivity Center Cables
11. Remove RAM (Random Access Memory)
12. Remove Power Button & Power LED + HDD LED
13. Remove the Connectivity Center
14. Remove Motherboard.

CHAPTER 10
COMPUTER DISPLAY

A computer monitor computer display or a is an electronic visual display for computers. A display device is an output device for presentation of information in visual or tactile form (the latter used for example in tactile electronic displays for blind people). When the input information is supplied has an electrical signal, the display is called an electronic display.
display adapter
A plug-in card in a desktop computer that performs graphics processing. Also commonly called a "graphics card" or "video card," modern display adapters use the PCI Express interface, while earlier cards used PCI and AGP. The display adapter determines the maximum resolution, refresh rate and number of colors that can be displayed, which the monitor must also be able to support. On many PC motherboards, the graphics circuits are built into the chipset, and a separate plug-in card is not required.

Types of computer monitors

CRT (cathode ray tube) monitors

These monitors employ CRT technology, which was used most commonly in the manufacturing of television screens. With these monitors, a stream of intense high energy electrons is used to form images on a fluorescent screen. A cathode ray tube is basically a vacuum tube containing an electron gun at one end and a fluorescent screen at another end.

LCD (liquid crystal display) monitors

The LCD monitor incorporates one of the most advanced technologies available today. Typically, it consists of a layer of color or monochrome pixels arranged schematically between a couple of transparent electrodes and two polarizing filters. Optical effect is made possible by polarizing the light in varied amounts and making it pass through the liquid crystal layer.

LED (light-emitting diodes) monitors

LED monitors are the latest types of monitors on the market today. These are flat panel, or slightly curved displays which make use of light-emitting diodes for back-lighting, instead of cold cathode fluorescent (CCFL) back-lighting used in LCDs. LED monitors are said to use much lesser power than CRT and LCD and are considered far more environmentally friendly.

Factors That Affect The Quality Of A Display Device

(Monitor performance measurement)

Resolution

The number of pixels displayed on the screen, typically measured in width x height (e.g., 1920x1080).
Impact: Higher resolution provides sharper images and text, enhancing clarity and detail.

Pixel Density (PPI - Pixels Per Inch)

The number of pixels per inch of the display. Higher pixel density results in finer detail and smoother image quality, especially noticeable in small screens.

Contrast Ratio

The ratio between the luminance of the brightest white and the darkest black the display can produce. Higher contrast ratios offer deeper blacks and more vivid whites, enhancing overall image depth and quality.

Brightness (Luminance)

The amount of light emitted from the screen, measured in nits or candelas per square meter (cd/m^2). Higher brightness improves visibility in bright environments and enhances the dynamic range of the display.

Refresh Rate

The number of times the display updates its image per second, measured in Hertz (Hz). Typical rates include 60Hz, 120Hz, and 144Hz. Higher refresh rates result in smoother motion and reduce blurring, beneficial for gaming and video playback.

Response Time

The time it takes for a pixel to change from one color to another, typically measured in milliseconds (ms). Includes gray-to-gray (GtG) and black-to-white transitions. Lower response times reduce motion blur and ghosting, improving performance in fast-paced visuals.

Backlighting (For LCDs)

- **Types:**
    - **Edge-Lit:** LEDs around the edges of the screen.
    - **Direct-Lit:** LEDs behind the entire screen.
    - **Full-Array Local Dimming (FALD):** Allows for selective dimming of specific screen areas.

Affects brightness, contrast, and uniformity of the display. Local dimming can enhance contrast.

Connectivity Options

HDMI, DisplayPort, USB-C, Thunderbolt, VGA. Determines compatibility with various input sources and the ease of connecting multiple devices.

Aspect Ratio

The ratio of the display's width to its height (e.g., 16:9, 21:9). Influences the viewing experience for different types of content and applications.

Troubleshooting Process

Step 1 Identify the problem
Step 2 Establish a theory of probable causes
Step 3 Determine an exact cause
Step 4 Implement a solution
Step 5 Verify solution and full system functionality
Step 6 Document findings

Troubleshooting Process

Step 1 - Identify the Problem

Laptop information

•Manufacturer, model, OS, network environment, connection type

Open-ended questions

• What problems are you experiencing with the laptop?
• What software has been installed recently?
• What were you doing when the problem was first identified?
• What error messages have you received?

Closed-ended questions (Can be answered with a 'yes' or no')

• Is the laptop under warranty?
• Is the laptop currently using the battery?
• Can the laptop operate using the AC adapter?
• Can the laptop boot and show the operating system desktop?

Step 2 - Establish a Theory of Probable Causes

▪The problem may be simpler than the customer thinks.
▪Create a list of the most common reasons why the error would occur.
•Battery does not have a charge
•Battery will not charge
•Loose cable connections
•Keyboard does not work
•Num Lock key is on
•Loose RAM

Step 3 - Determine the Exact Cause

▪ Test your theories of probable causes one at a time, starting with the quickest and easiest.
• Use AC adapter with laptop
• Replace the battery
• Reboot the laptop
• Check BIOS settings
• Disconnect and reconnect the cables
• Disconnect peripherals

• Toggle Num Lock key
• Remove and reinstall RAM
• If Caps lock key is on, turn it off
• Non-bootable media in a boot device
• Password has changed
▪ If the exact cause of the problem has not been determined after you have tested all your theories, establish a new theory of probable causes and test it.

Step 4 - Implement a Solution

▪ If a quick procedure does not correct the problem, you might need to research the problem further to establish the exact cause.
▪ Divide larger problems into smaller problems that can be analyzed and solved individually.
▪ Create a list of possible solutions and implement them one at a time. If you implement a possible solution and it does not work, reverse the solution and try another.

Step 5 - Verify Solution and System Functionality

▪ Verifying full system functionality and implementing any preventive measures if needed. This ensures that you have not created another problem while repairing the computer.
• Reboot the laptop
• Attach all peripherals
• Operate laptop using only battery
• Print a document from an application
• Type sample document to test keyboard
• Check Event Viewer for warnings or errors
▪ Have the customer verify the solution and system functionality.

Step 6 - Document Findings

▪ Discuss the solution with the customer
▪ Have the customer confirm that the problem has been solved
▪ Give the customer all appropriate paperwork
▪ Document the process in the work order and in your technician's journal:

- ✓ •Problem description
- ✓ •Solution
- ✓ •Components used
- ✓ •Amount of time spent in solving the problem

Factors to consider when replacing a component:

- ➢ Data Driven Decisions,
- ➢ Analyze the Costs,
- ➢ Consider the Age of Equipment,
- ➢ Consider the Cost of Repairs,
- ➢ Consider Downtime,
- ➢ Consider Safety,
- ➢ Consider Efficiency