COMPUTER AND MOBILE HARDWARE FUNDAMENTALS

FORnSEC SOLUTIONS

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Chapter 1

Overview

Today's world has become an information-rich world and it has also become a necessity for everyone to know about computers and have a brief knowledge about its working and functioning.

Computer science is the study of information processes. Understanding the fundamentals of the technical components of information systems is an essential first step in understanding the strategic role of information systems in modern organizations.

An obvious technical component is the physical computing machinery, known as hardware. In this book, we will see that hardware is more than just the computer itself—it includes a variety of related technologies involved with getting data into and out of the computer. The information in this book will not only provide a foundation for understanding, but it also will help you make informed decisions about personal and professional computing technology.

Chapter 2

What is a Computer ?

In the simplest terms, a computer is a machine that accepts some kind of input, performs actions and calculations according to a set of instructions, and returns the result of its calculations. All computers, regardless of their size, purpose, or type, follow this definition.

A personal computer accepts input from a person via the keyboard, runs programs like word processors or games, and displays the results on the screen.

Computer design is separated into two categories: **Analog and Digital**.

You don't hear much about analog computers anymore, and that's because they've been largely replaced by digital computers. Analog computers, which have been around in one form or another since ancient times, are usually mechanical. For input, they rely on some kind of fixed starting point, like wires connecting electrical components together. Analog computers can be very complex and may employ thousands of parts to construct, but in spite of all that complexity, each analog computer will solve only one specific kind of problem.

On the other side, digital computers convert their input and operating instructions into numeric codes and perform calculations with those codes. The calculations are performed in strict, single steps; however, because they use numbers, digital computers can execute their instructions extremely fast. Unlike their analog counterparts, digital computers rely on electrical components rather than heavy gears. Digital computers are flexible.

2.1 Types of Digital Computers

While some computers are designed to work with many people at the same time, most computers are meant to be used by only one person at a time. Those computers are known as **Personal Computers (PCs).** It's common for personal computers have separate work spaces and storage for several different users, but only one user can work with the machine at a time. Personal computers are also called microcomputers because they are among the smallest computers created to use.

Although, personal computers are used by individuals, they can be connected together to create networks, allowing users to share information from computer to computer. In fact, networking—the process of connecting to and sharing data between devices and locations—has become one of the most important jobs of personal computers, and even tiny handheld computers can now be connected to networks. Some computers, while still following the same fundamental design of all digital computers, are specially created to handle the needs of many users at the same time. These powerful systems are most often used by businesses or schools. Each user interacts with the computer through his or her own input and output hardware, freeing people from having to wait their turn at a single keyboard and monitor. The largest organizational computers support thousands of individual users at the same time, from thousands of miles away. While some of these large-scale systems are devoted to a special purpose, enabling users to perform only a few specific tasks. Many organizational computers are general-purpose systems that support a wide variety of tasks.

Six primary types of computers are designed to be used by one person at a time -

1. Desktop computers
2. Workstations
3. Notebook (or laptop) computers
4. Tablet computers
5. Handheld computers
6. Smart phones

1. Desktop Computers

The most common type of personal computer is the desktop computer—a PC that is designed to keep on a desk or table. Today's desktop computers are powerful and versatile, and they are used for an amazing number of tasks. Not only do these machines enable people to do their jobs with greater ease and efficiency, but they can be used to communicate, produce music, edit photographs and videos, play sophisticated games, and much more. PC's has been used by everyone and still using, desktop computers are indispensable for learning, work, and play. As its name implies, a desktop computer is a full-size computer that is too big to be easily carried around. The main component of a desktop PC is the system unit, which is the case that houses the computer's critical parts, such as its processing and storage devices.

2. Workstations

A workstation is a specialized, single-user computer that typically has more power and features than a standard desktop PC. These machines are popular among scientists, engineers, and animators who need a system with greater than average speed and the power to perform sophisticated tasks. Workstations often have large, high-resolution monitors and accelerated graphics-handling capabilities, making them suitable for advanced architectural or engineering design, animation, and video editing.

3. Notebook Computers

Notebook computers, as their name implies, approximate the shape of a writing notebook and easily fit inside a briefcase. Because people frequently set these devices in their lap, they are also called laptops. Notebooks have raised to reveal a thin monitor and a keyboard. When not in use, the device folds up for easy storage. Notebooks are fully functional microcomputers; the people who use them need the power of a full-size desktop computer wherever they go. Along with the monitor and keyboard, notebooks also typically contain a mouse, DVD player, and wireless networking capability. Notebook computers come in a variety of sizes, with different sets of features and hardware to accommodate a wide range of user preferences. Notebook computers can operate on either an AC adapter or special batteries. They generally weigh less than eight pounds, and some even weigh less than three pounds. Recent arrivals to the notebook scene are small and inexpensive computers referred to as net books. Netbooks

are small, compact computers with reduced processing power and often without extra devices such as DVD drives. They are designed both for notebook shoppers with a very low budget and for users who only need a computer for casual use. Because of their portability, notebook PCs fall into a category of devices called mobile computers— systems small enough to be carried by their user.

4. Tablet PCs

The tablet PC is the newest development in portable, full-featured computers. Tablet PCs offer all the functionality of a notebook PC, but they are lighter and can accept input directly from a special pen called a stylus or a digital pen or even the user's palm. Some of the newer models can display an image of a keyboard on the screen and allow the user to type. Many tablet PCs also have a built-in microphone and special software that accepts input from the user's voice. A few models even have a foldout keyboard, so they can be transformed into a standard notebook PC. Tablet PCs run specialized versions of standard programs and can be connected to a network. The popularity of tablet PCs has exploded in recent years, both for business and personal use. The combination of portable size and friendly interface makes them ideal in a wide range of circumstances for note-taking, document sharing, and online communication.

5. Handheld PCs

Handheld personal computers are computing devices small enough to fit in your hand. Though they can be indispensable tools for many types of users, their small size and limited processing power put them in a different category from notebook and tablet computers.

Handheld PCs are typically used for applications that help connect mobile users to online resources; provide portable entertainment in the form of games, music and video; and assist with mobile computing tasks such as taking notes and managing address books or task lists. Many users rely heavily on their handheld PC to stay current all day long with the latest news from the world and their friends. As handheld PCs became widely popular, they were commonly known as personal digital assistants (PDAs). Early PDAs had a limited set of software programs that they could run, many of which were targeted toward note-taking, small spreadsheets, and appointment management. Input to the PDA was commonly accomplished via tapping and drawing on a touch sensitive screen

with a stylus. Now, handheld PCs often have intuitive and shortcut user interfaces with colourful displays, and touch screens that can accept various kinds of fingertip taps and swipes for input. The concept of the PDA is alive and well, even though the PDA term itself is rapidly becoming a thing of the past. Manufacturers of handheld PCs have made rapid advances in their products as a result of this widespread acceptance and demand for mobile computing devices.

Chapter 3

Computer Hardware

Electronic parts and subsystems in a computer are generally installed on a circuit board, which is commonly a thin, rigid piece of plastic or other material that provides a convenient way to mount, organize, and connect parts together. Circuit boards are usually rectangular, come in a wide variety of sizes, and have at least one kind of connector so they can be conveniently linked to other parts of the computer. Circuit boards that are used to provide a specific ability like sound or video capability in the computer are also commonly called cards.

The main processor for the computer is known as the **Central Processing Unit (CPU).** The CPU consists of the following features:

1. The CPU performs all types of data processing operations.
2. It stores data, intermediate results and instructions (program).
3. It controls the operation of all parts of the computer.

The CPU itself is following three components. :

1. Control Unit
2. ALU (Arithmetic Logic Unit)

1. Control Unit -

This unit controls the operations of all parts of computer, but does not carry out any actual data processing operations. Functions of this unit are: it is responsible for controlling the transfer of data and instructions among other units of a computer.

I. It manages and coordinates all the units of the computer.

II. It obtains the instructions from the memory, interprets them, and directs the operation of the computer.

III. It communicates with Input/output devices for transfer of data or results from storage.

IV. It does not process or store data.

2. ALU (Arithmetic Logic Unit)

This unit consists of two subsections namely Arithmetic section :

I. Logic Section

Function of logic section is to perform logic operations such as comparing, selecting, matching and merging of data.

II. Arithmetic Section

Function of arithmetic section is to perform arithmetic operations like addition, subtraction, multiplication and division. All complex operations are done by making repetitive use of the above operations.

Chapter 4

Working of Harddisk

A hard drive has only a few basic parts. There are one or more shiny silver platters where information is stored magnetically, there's an arm mechanism that moves a tiny magnet called a read-write head back and forth over the platters to record or store information, and there's an electronic circuit to control everything and act as a link between the hard drive and the rest of your computer.

They are -

1. Actuator that moves the read-write arm. In older hard drives, the actuators were stepper motors. In most modern hard drives, voice coils are used instead. As their name suggests, these are simple electromagnets, working rather like the moving coils that make sounds in loudspeakers. They position the read-write arm more quickly, precisely, and reliably than stepper motors and are less sensitive to problems such as temperature variations.

2. Read-write arm swings read-write head back and forth across platter.

3. Central spindle allows platter to rotate at high speed.

4. Magnetic platter stores information in binary form.

5. Plug connections link hard drive to circuit board in personal computer.

6. Read-write head is a tiny magnet on the end of the read-write arm.

7. Circuit board on underside controls the flow of data to and from the platter.

8. Flexible connector carries data from circuit board to read-write head and platter.

9. Small spindle allows read-write arm to swing across platter.

The platters are the most important parts of a hard drive. As the name suggests, they are disks made from a hard material such as glass or aluminum, which is coated with a thin layer of metal that can be magnetized or demagnetized. A small hard drive typically has only one platter, but each side of it has a magnetic coating. Bigger drives have a series of platters stacked on a central spindle, with a small gap in between them. The platters rotate at up to 10,000 revolutions per minute (rpm) so the read-write heads can access any part of them.

There are two read-write heads for each platter, one to read the top surface and one to read the bottom, so a hard drive that has five platters (say) would need ten separate read-write heads. The read-write heads are mounted on an electrically controlled arm that moves from the center of the drive to the outer edge and back again. To reduce wear and tear, they don't actually touch the platter: there's a layer of fluid or air between the head and the platter surface.

4.1 - Structure of Harddisk

As with floppy disks, each platter is divided into thin concentric bands known as **tracks**. There can be more than a thousand tracks on a 3.5 inch hard disk. The tracks are further subdivided into **sectors**. These are the smallest physical storage unit on a disk and they are almost always 512 bytes long.

A group of tracks which have the same track number, but are on different platters, is sometimes referred to as a **cylinder**, but this term is no longer widely used.

Tracks are created when the disk is initially formatted. There are normally 1024 tracks on a hard disk, numbered from 0 (at the edge of the disk) to 1023 (near the centre).

One obvious problem with this structure is that the tracks near the centre are shorter than those near the edge of the disk. To compensate for this, they are more densely populated with data, meaning that the same amount of data can be written or read over the same period of time, irrespective of the drive head position.

One side of the first platter has space reserved for hardware-based track-positioning information which is not available to the operating system. This data is written to the disk during assembly and is used by the **disk controller** to position the drive heads correctly.

We have already noted that a sector is the smallest physical storage unit on the disk and is usually 512 bytes long. Files should ideally be stored in a single contiguous area of disk space. Since most files are longer than 512 bytes, the file system must allocate the number of sectors required to store the file, eg: a 640 byte file would require two sectors. If additional data is appended to the file later, further sectors can be allocated.

4.2 - Reading and writing data

The most important thing about memory is not being able to store information but being able to find it later. Imagine storing a magnetized iron nail in a pile of 1.6 million million identical nails and you'll have some idea how much trouble your computer would get into if it didn't use a very methodical way of filing its information.

When your computer stores data on its hard drive, it doesn't just throw magnetized nails into a box, all jumbled up together. The data is stored in a very orderly pattern on each platter. Bits of data are arranged in concentric, circular paths called tracks. Each track is broken up into smaller areas called sectors. Part of the hard drive stores a map of sectors that have already been used up and others that are still free. (In Windows, this map is called the File Allocation Table or FAT.) When the computer wants to store new information, it takes a look at the map to find some free sectors. Then it instructs the read-write head to move across the platter to exactly the right location and store the data there. To read information, the same process runs in reverse.

With so much information stored in such a tiny amount of space, a hard drive is a remarkable piece of engineering. That brings benefits (such as being able to store 500 CDs on your iPod)—but drawbacks too. One of them is that hard drives can go wrong if they get dirt or dust inside them. A tiny piece of dust can make the read-write head bounce up and down, crashing into the platter and damaging its magnetic material. This is known as a disk crash (or head crash) and it can (though it doesn't always) cause the loss of all the information on a hard drive. A disk crash usually occurs out of the blue, without any warning. That's why you should always keep backup copies of your important documents and files, either on another hard drive, on a compact disc (CD) or DVD, or on a flash memory stick.

Chapter 5

Opertaing System and File System

5.1 -What is file system?

Any computer file is stored on some kind of storage with a given capacity. Actually, each storage is a linear space to read or both read and write digital information. Each byte of information on the storage has its own offset from the storage start (address) and is referenced by this address. A storage can be presented as a grid with a set of numbered cells(each cell – single byte). Any file saved to the storage takes a number of these cells.

5.2 -Windows file systems

Microsoft Windows OS use two major file systems: **FAT**, inherited from old DOS with its later extension **FAT32**, and widely-used **NTFS** file systems. Recently released **ReFS** file system was developed by Microsoft as a new generation file system for Windows 8 Servers.

FAT (File Allocation Table):

FAT file system is one of the most simple types of file systems. It consists of file systemdescriptor sector (boot sector or superblock), file system block allocation table (referenced as File Allocation Table) and plain storage space to store files and folders. Files on FAT are stored in directories. Each directory is an array of 32-byte records, each defines file or file extended attributes (e.g. long file name). File record references the first block of file. Any next block can be found through block allocation table by using it as linked-list.

Block allocation table contains an array of block descriptors. Zero value indicates that the block is not used and non-zero – reference to the next block of the file or special value for file end.

FAT or FAT32 is a file system, used on Windows-compatible external storages or disk partitions with size below 2GB (for FAT) or 32GB (for FAT32).

Windows can not create FAT32 file system over 32GB (however Linux supports FAT32 up to 2TB).

NTFS (New Technology File System):

NTFS was introduced in Windows NT and at present is major file system for Windows. This is a default file system for disk partitions and the only file system that is supported for disk partitions over 32GB. The file system is quite extensible and supports many file properties, including access control, encryption etc. Each file on NTFS is stored as file descriptor inMaster File Table and file content. **Master file table** contains all information about the file: size, allocation, name etc. The first and the last sectors of the file system contain file system settings (boot record or **superblock**). This file system uses 48 and 64 bit values to reference files, thus supporting quite large disk storages.

5.3 - MacOS file systems

Apple Mac OS operating system applies HFS+ file system, an extension to their own HFS file system that was used on old Macintosh computers. HFS+ file system is applied to Apple desktop products, including Mac computers, **iPhone**,**iPod**, as well as Apple X Server products. Advanced server products also use Apple Xsan file system, clustered file system derived from StorNext or CentraVision file systems.

This file system except files and folders also stores Finder information about directories view, window positions etc.

5.4 - Linux file systems

Open-source Linux OS always aimed to implement, test and use different concepts of file systems. Among huge amount of various file system types the most popular Linux file systems nowadays are:

- **Ext2, Ext3, Ext4** - 'native' Linux file system. This file system falls under active developments and improvements. **Ext3** file system is just an extension to **Ext2** that uses transactional file write operations with journal. **Ext4** is a further development of Ext3, extended with support of optimized file allocation information (extents) and extended file attributes. This file system is frequently used as 'root' file system for most Linux installations.

Chapter 6

Motherboard

A computer has several hardware subsystems that perform its required tasks. While it's common to refer to the CPU as the central part of a computer system, there is a less mentioned hardware component that truly serves to connect everything else together: **The Motherboard**. A motherboard is the largest circuit board in a personal computer. It contains connectors and ports for hooking up all the other parts of a computer, from the CPU to the webcam on top of the monitor. It also contains its own set of electronic components to help regulate power to different subsystems and manage the flow of data from one hardware subsystem to another.

In some cases, the motherboard contains its own electronic subsystems that years ago were only stored on separate circuit boards, handling tasks such as video and sound output and network communication. To be fully functional, a computer requires a set of hardware components that are connected to the motherboard.

These hardware devices fall into one of four basic categories:

1. Processors
2. Memory
3. Input and output
4. Storage

6.1 – Processors

The procedure that transforms raw data into useful information is called processing. Logically, the computer components responsible for this procedure are called processors. Processors are complex electronic circuits engraved into slivers of silicon. The main processor for the computer is known as the **Central Processing Unit (CPU).**

The CPU is like the brain of the computer; it organizes and carries out instructions that come from either the user or the software. In a personal

computer, the CPU consists of a specialized chip, called a microprocessor, which integrates several different processing functions into a single chip. The CPU is plugged into a special socket on the computer's motherboard. CPUs come in a wide variety of designs and processing power. By designing the CPU as an installable unit, manufacturers allow users more flexibility; computer makers can select different combinations of motherboards and CPUs, which would not be possible if CPUs were preinstalled on each motherboard. Modern CPUs generate a great deal of heat when they operate. Without cooling, the heat would quickly damage a CPU and cause it to stop functioning. CPUs are therefore installed with cooling units that consist of large blocks of heat-conducting metal pressed tightly against the CPU and cooling fans to whisk the heat from the metal. Between the cooling unit and the mounting circuit board with dozens of tiny copper pins, the CPU looks like a very large unit, yet the chip itself is just a thin wafer a fraction of an inch across.

6.2 –Memory

Memory in a computer is one or more sets of chips that store data and program instructions, either temporarily or permanently. Memory is a critical processing component in any computer.

Personal computers use several different types of memory, but the two most important are called **Random Access Memory (RAM)** and **Read-Only Memory (ROM).**

- Random Access Memory

These two types of memory work in very different ways and perform distinct functions. The most noticeable type of memory for a PC user is called **Random Access Memory (RAM)**.

As a result, the term memory is typically used to mean RAM. Like many computer components, RAM consists of a set of chips mounted on a small circuit board. Those circuit boards are plugged into sockets on the motherboard so that various subsystems can access the memory. RAM is like an electronic scratch pad inside the computer, allowing the computer to store and retrieve data and instructions very quickly. Accessing RAM is far faster than reading and writing from storage media like hard drives or DVDs. When a program is launched, it is loaded into and run from RAM. As the program needs data, it is loaded into memory for fast access. RAM is volatile, meaning it loses its

contents when the computer is shut off or if there is a power failure. Because RAM needs a constant supply of power to hold its data, it is not considered to be a form of permanent storage. RAM has a tremendous impact on the computer's operating efficiency.

Generally, the more RAM a computer has, the more it can do and the faster it can perform certain tasks. If the computer needs data, but doesn't have enough RAM to hold what it needs, it must store some of what is in RAM already onto its hard drive in order to make more room. Storing and retrieving chunks of data on disks are very time consuming, and if the computer has followed this process frequently, programs run slowly. Adding RAM to a computer system to improve its performance is one of the more common system upgrades people perform.

The most common measurement unit for describing a Computer there is memory byte —the amount of memory it takes to store a single character, such as a letter of the alphabet or a numeral. When referring to a computer's memory, the numbers are often so large that it is helpful to use terms such as Kilobyte (KB), Megabyte (MB), Gigabyte (GB), and Terabyte (TB) to describe the values.

Today's personal computers commonly require at least one gigabyte of memory to comfortably function for light-duty use. Many users choose to add more (four to eight gigabytes) for better performance. RAM cards are not all created equal. Different models of RAM may have different speeds at which they store and retrieve data, different methods for data storage and retrieval, and even different physical layouts. Each PC motherboard requires a specific type and speed range of RAM. Many other styles of RAM cannot even be physically installed on newer motherboards because their connectors are a different size and shape. But even if a RAM card can be plugged in, an incompatible data transfer speed or method can result in terrible performance or more likely a completely non-functional computer.

Whether building a computer from scratch or upgrading an existing system's RAM, it is critically important to match the RAM card's specifications to the requirements provided by the motherboard manufacturer. When adding extra RAM to a system, it's also important to make sure the existing and new RAM modules match in speed in order to avoid poor performance.

There are different types of RAM. Those are -

1. Static Ram

2. Dynamic Ram

I. Static RAM

SRAM chips use a matrix of 6-transistors and no capacitors. Transistors do not require power to prevent leakage, so SRAM need not have to be refreshed on a regular basis. Because of the extra space in the matrix, SRAM uses more chips than DRAM for the same amount of storage space, thus making the manufacturing costs higher. So SRAM is used as cache memory and has very fast access.

Characteristic of the Static RAM

- It has long life
- There is no need to refresh
- Faster
- Used as cache memory
- Large size
- Expensive
- High power consumption

II. Dynamic RAM (DRAM) - DRAM, unlike SRAM, must be continually refreshed in order to maintain the data. This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second. DRAM is used for more system memory because it is cheap and small. All drums are made up of memory cells which are composed of one capacitor and one transistor.

Characteristics of the Dynamic RAM

- It has short data lifetime
- Need to be refreshed continuous
- Slower as compared to SRAM
- Used as RAM
- Lesser in size
- Less expensive
- Less power consumption

Read-only memory (ROM)

ROM permanently stores its data, even when the computer is shut off. It is used not for programs and user data, but rather, to store computer instructions and hardware information that rarely changes. Though the ROM's contents can be changed, the process is much slower than for altering RAM, and that makes ROM unsuitable for storing temporary or rapidly changing information. The ROM is called non-volatile memory because it never loses its contents.

I. PROM (Programmable Read only Memory)

PROM is read-only memory that can be modified only once by a user. The user buys a blank PROM and enters the desired contents using a PROM program. Inside the PROM chip there are small fuses which are burnt open during programming. It can be programmed only once and is not erasable.

II. EPROM (Erasable and Programmable Read Only Memory)

The EPROM can be erased by exposing it to ultra-violet light. Usually, an EPROM eraser achieves this function. During programming, an electrical charge is trapped in an insulated gate region. The charge is retained for more than ten years because the charge has no leakage path. For erasing this charge,

ultra-violet light passes through a quartz crystal window. This exposure to ultra-violet light dissipates the charge. During normal use the quartz lid is sealed with a sticker.

III. EEPROM (Electrically Erasable and Programmable Read Only Memory)

The EEPROM is programmed and erased electrically. It can be erased and reprogrammed about ten thousand times. Both erasing and programming take about 4 to 10 ms (Milli second). In EEPROM, any location can be selectively erased and programmed. EEPROMs can be erased one byte at a time, rather than erasing the entire chip. Hence, the process of re-programming is flexible but slow.

6.3-Input and Output

A personal computer would be useless if you could not interact with it, because the machine could not receive instructions or deliver the results of its work. Input devices accept data and instructions from the user or from another computer system. Examples include keyboards, mice, and digital cameras.

Output devices, including the monitor, printer, and speakers, return processed data to the user or to another computer system. The computer sends output to the monitor (the display screen) when the user needs only to see the output. It sends output to the printer when the user requests a paper copy also called a hard copy of a document.

Some types of hardware can act as both input and output devices. For users, a touch screen displays output in the form of text or icons you can touch, and it accepts input via special sensors on the screen to detect the touch of a finger. Between two computers, the most common types of devices that can perform both input and output are communications devices. These devices connect one computer to another—a process known as networking. For example - You can take a print out from a wireless printer.

6.4 -Storage Devices

A computer can function with only processing, memory, input, and output devices. To be really useful, however, a personal computer also needs a place to keep program files and related data when they are not in use. The purpose of storage is to hold data permanently, even when the computer is turned off.

The main types of computer storage are magnetic, optical, and flash memory.

The most common type is the magnetic disk. A disk is a round, flat object that spins around its center. (Magnetic disks are almost always housed in a case of some kind, so you can't see the disk itself unless you open the case.) Read/ write heads, which work in much the same way as the heads of a tape recorder or VCR, read data from the disk or write data onto the disk. The complete device that holds a disk is called a disk drive.

In addition to magnetic storage, nearly every computer sold today includes at least one form of optical storage—devices that use lasers to read data from or write data to the reflective surface of an optical disc. For a time, the CD-ROM drive was the most common type of optical storage device, but it has lately been surpassed by the use of DVD drives, which in turn are rapidly losing ground to the new Blu-ray optical storage format. Compact discs (CDs) are a type of optical storage, identical to audio CDs. Data CDs can hold varying amounts of data up to nearly 900 MB. CD-Recordable (CD-R) disks allow you to create your own CDs, but CD-R disks cannot be erased and reused. A CD-Rewritable (CD-RW) disk allows you to write and erase data multiple times on the same disk.

The digital video disc (DVD), using sophisticated compression technologies, the typical single-sided DVDs can hold anywhere from 4.7 GB to 8.5 GB of data. Though this capacity is still far less than the capacity of a hard disk, DVDs are popular for permanent, removable storage. Modern DVD drives for computers are combination units, capable of reading from and writing to both DVDs and CDs.

The latest advance in optical storage technology is called the Blu-ray disc, named after the blue- spectrum laser that the drive uses. Though the disc's diameter is the same as for CD and DVD drives, switching to a blue light laser and improving the design of the disc itself have resulted in a storage format that can store 25 to 50 GB of data depending on whether one or two storage layers are in use. The newest Blu-ray storage formats allow for more than 100 GB to be written to a single disc. Blu-ray drives are rapidly becoming the new standard for both home entertainment media and permanent data storage and are included in many home theater, game console, and computer systems. Most Blu-ray devices can also read CD and DVD disks. The future of data storage may well be the solid state drive (SSD), a memory subsystem that relies on

special kinds of ROM to permanently store data. Since SSDs use memory chips for storage, they have no moving parts like hard disks; consequently, they have no risk of losing data due to mechanical failures, and they generally use less power in their operation. Their lack of mechanical parts also results in a smaller size, which along with reduced power requirements makes them an ideal match for mobile computing devices like notebook computers. Though most PCs still use a hard drive, you may very well have recently been using an SSD without using the term.

Flash drives, commonly found as the little storage sticks that plug into a USB port, are a regular staple of many computer users. Once used to transfer occasional files between computers. Flash drives are now produced with enough storage to rival hard drives, with recent models providing 256 GB of storage. This allows users to store entire music and video libraries in one small package, or back up their PC's hard drive to a device that can be easily secured in a different location. Also included in the SSD category are the small, thin memory cards used to store data in portable devices such as digital cameras and phones.

The two major formats currently in use for these devices are CompactFlash (CF) and Secure Digital (SD), and manufacturers for each of those formats produce a range of cards in different sizes and storage capacities. It's common to find SSD cards that provide anywhere from 2 to 32 GB of storage, but both CF and SD formats are expanding to support storage amounts into the terabytes and beyond. CF and SD cards require little power to run, which makes them ideal choices for storage in devices that rely on limited battery capacity to operate. They can be easily removed from their home device and transferred to a special reader on a PC, to allow the quick transfer of images or video from the mobile device to the PC. Though SSD technology has been commercially available since the 1970s, it is rapidly evolving. Costs are falling even as design improvements are increasing the efficiency of the devices. It may not be long before hard drives cease to be a common component of desktop PCs and notebooks.

Chapter 7

Ports

Port is a physical docking point using which an external device can be connected to the computer. It can also be the programmatic docking point through which information flows from a program to compute or over the internet.

Following are few important types of ports

1. Serial Port

I. Used for external modems and older computer mouse

II. Two versions: 9 pin, 25 pin models

III. Data travels at 115 kilobits per second

2. Parallel Port

I. Used for scanners and printers

II. Also called printer port

III. 25 pin models

IV. Also known as IEEE 1284-compliant Centronics port

3. PS/2 Port

I. Used for old computer keyboard and mouse

II. Also called the mouse port

III. Most of the old computers provide two PS/2 port, each for mouse and keyboard

IV. Also known as IEEE 1284-compliant Centronics port

4. Universal Serial Bus (or USB) Port

I. It can connect all kinds of external USB devices such as external hard disk, printer, scanner, mouse, keyboard, etc.

II. Most of the computers provide two USB ports as a minimum.

III. Data travels at 12 megabits per seconds

IV. USB compliant devices can get power from a USB port

5. VGA Port

I. Monitor connects to a computer's video card.

II. Has 15 holes.

III. Similar to serial port connector, but serial port connector has pins, it has holes.

6. Power Connector

I. Three-pronged plug

II. Connects to the computer's power cable that plugs into a power bar or wall socket

7. Firewire Port

I. Transfers large amount of data at very fast speed.

II. Connects camcorders and video equipments to the computer

III. Data travels at 400 to 800 megabits per seconds

IV. Three variants: 4-Pin FireWire 400 connector, 6-Pin FireWire 400 connector and 9-Pin FireWire 800 connector

8. Modem Port

I. Connects a PC's modem to the telephone network.

9. 70 Ethernet Ports

I. Connects to a network and high speed Internet.

II. Connect network cable to a computer.

III. This port resides on an Ethernet Card.

IV. Data travels at 10 megabits to 1000 megabits per seconds depending upon the network bandwidth.

10. Game Port

I. Connect a joystick to a PC

II. Now replaced by USB.

11. Digital Video Interface, DVI port

I. Connects Flat panel LCD monitor to the computer's high end video graphic cards.

II. Very popular among video card manufacturers.

12. Sockets

I. Connect microphone, speakers sound card of the computer

Chapter 8

Computer Networks

A computer network is a system in which multiple computers are connected to each other to share information and resources. In computer networks, networked computing devices exchange data with each other using a data link. The connections between nodes are established using either cable media or wireless media. The best-known computer network is the internet.

Network computer devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as personal, phones, servers as well as networking hardware. Two such devices can be said to be networked together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other.

Computer networks differ in the transmission medium used to carry their signals, the communications protocols to organize network traffic, the network's size,topology and organizational intent.

Computer networks support an enormous number of applications such as access to the world wide web, video, digital audio, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications as well as many others. In most cases, application-specific communications protocols are layered over other more general communications protocols.

8.1 Characteristics of a computer network

I. Share Resources from one computer to another

II. Create files and store them in one computer, access those files from the other computers connected over the network

III. Connect a printer, scanner, or a fax machine to one computer within the network and let other computers on the network use the machines available over the network.

Following is the list of hardwares required to set up a computer network :

1. Network Cables

2. Distributors Routers

3. Network Cards

1. Network Cables

Network cables are used to connect computers. The most commonly used cable is Category 5 cable RJ-45.

2. Distributors Router

A computer can be connected to another one via a serial port, but if we need to connect many computers to produce a network, this serial connection will not work. The solution is to use a central body to which other computers, printers, scanners, etc. can be connected and then this body will manage or distribute network traffic.

A router is a type of device which acts as the central point among computers and other devices that are part of a network. A router is equipped with holes called ports and computers and other devices are connected to a router using network cables. Now-a-days router comes in wireless modes using which computers can be connected without any physical cable.

3. Network Card

The network card is a necessary component of a computer without which a computer cannot be connected over a network. It is also known as a network adapter or Network Interface Card (NIC). Most branded computers have network card pre-installed. Network cards are of two types: Internal and External Network Cards.

I. Internal Network Cards

The motherboard has a slot for an internal network card where it is to be inserted. Internal network cards are of two types in which first type uses Peripheral Component Interconnect (PCI) connection while the second type uses Industry Standard Architecture (ISA). Network cables are required to provide network access.

II. External Network Cards

External network cards come in two flavors: Wireless and USB based. Wireless network card need to be inserted into the motherboard but no network cable is required to connect to the network.

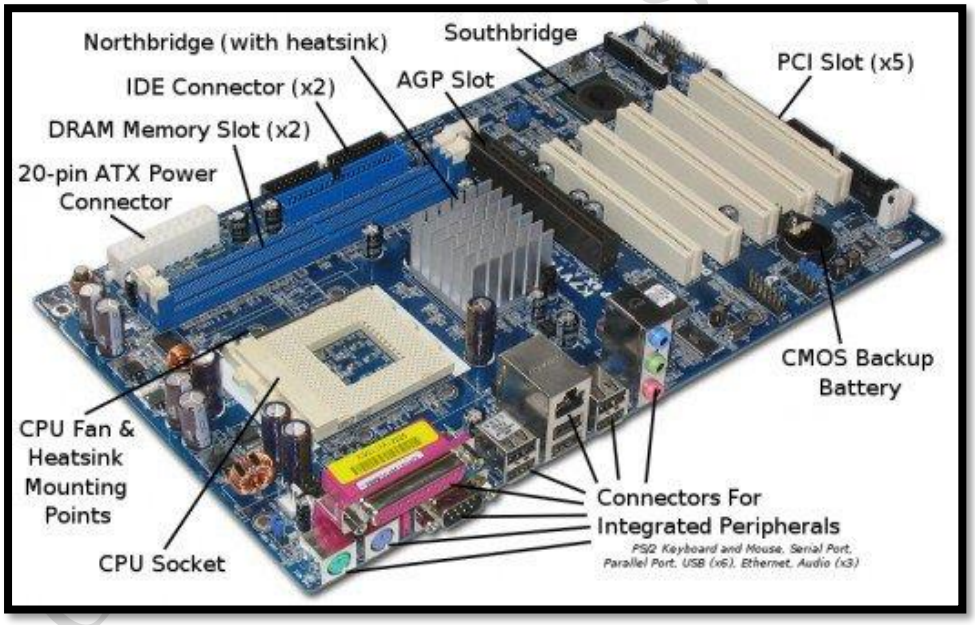
Chapter 9

The Mainboard

It is a printed circuit board, on which multiple chips, ports (plug ins), and other electronic components are mounted. In the PC, data are exchanged continuously between these components. Therefore, it is important to understand each component, its connections and characteristics. All data exchange is done on the system board, which thus is the most important component in the PC. So, now we will start with a more technical evaluation of the system board.

The Mainboard Components-

The PC is built around the main, system or motherboard. This board is so essential for the PC, because it holds the CPU and all its connections. Let us see, what you can find on it:



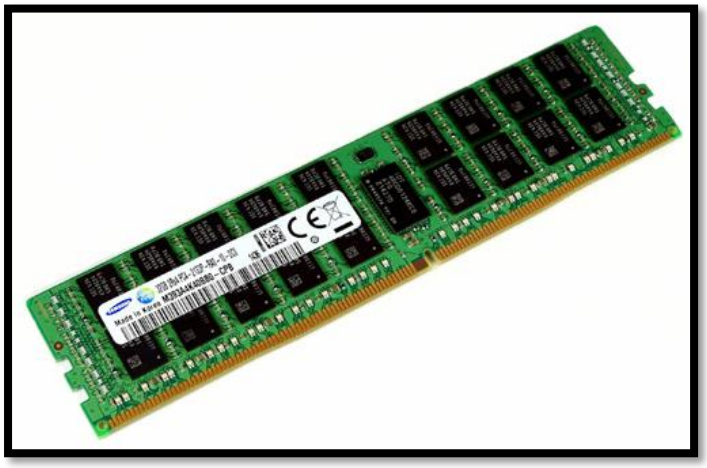
Central Processing Unit

Also known as the microprocessor or the processor, the CPU is the computer's brain. It is responsible for fetching, decoding, and executing program instructions as well as performing mathematical and logical calculations.

The processor chip is identified by the processor type and the manufacturer. This information is usually inscribed on the chip itself. For example, Intel 386, Advanced Micro Devices (AMD) 386, Cyrix 486, Pentium MMX, Intel Core 2Duo, or iCore7.

If the processor chip is not on the motherboard, you can identify the processor socket as socket 1 to Socket 8, LGA 775 among others. This can help you identify the processor that fits in the socket. For example, a 486DX processor fits into Socket 3.

Random Access Memory



Random Access Memory, or RAM, usually refers to computer chips that temporarily store dynamic data to enhance computer performance while you are working.

In other words, it is the working place of your computer, where active programs and data are loaded so that any time time the processor requires them, it doesn't have to fetch them from the hard disk.

Random access memory is volatile, meaning it loses its contents once power is turned off. This is different from non-volatile memory, such as hard disks and flash memory, which do not require a power source to retain data.

When a computer shuts down properly, all data located in RAM is returned back to permanent storage on the hard drive or flash drive. At the next boot-up, RAM begins to fill with programs automatically loaded at startup, a process called booting. Later on, the user opens other files and programs that are still loaded in the memory.

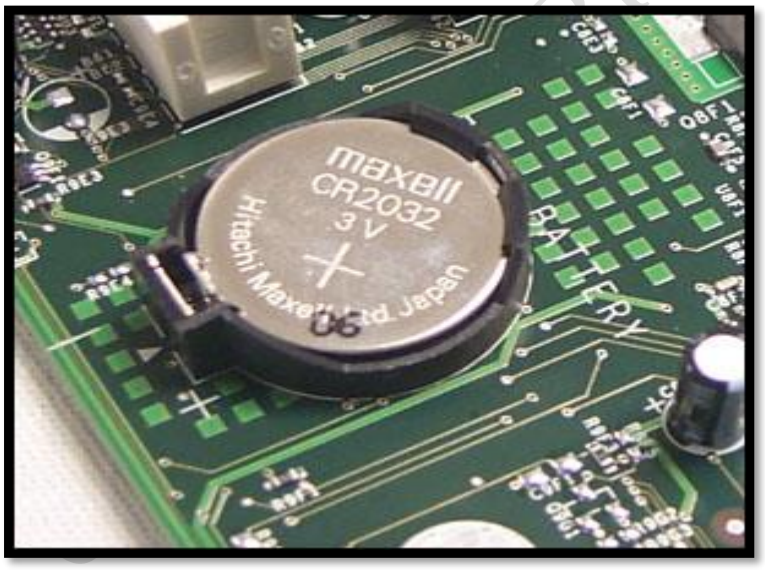
Basic Input/Output System (BIOS)

BIOS stands for Basic Input/Output System. BIOS is a "read only" memory, which consists of low-level software that controls the system hardware and acts as an interface between the operating system and the hardware. Most people know the term BIOS by another name—device drivers, or just drivers. BIOS is essentially the link between the computer hardware and software in a system.

All motherboards include a small block of Read Only Memory (ROM) which is separate from the main system memory used for loading and running software. On PCs, the BIOS contains all the code required to control the keyboard, display screen, disk drives, serial communications, and a number of miscellaneous functions.

The system BIOS is a ROM chip on the motherboard used during the startup routine (boot process) to check out the system and prepare to run the hardware. The BIOS is stored on a ROM chip because ROM retains information even when no power is being supplied to the computer.

Complimentary Metal Oxide Semiconductor Random Access Memory (CMOS RAM)



Motherboards also include a small separate block of memory made from CMOS RAM chips which is kept alive by a battery (known as a CMOS battery) even when the PC's power is off. This prevents reconfiguration when the PC is powered on.

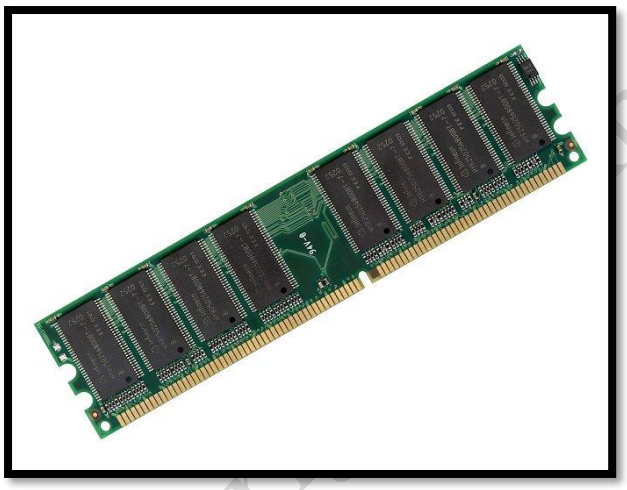
CMOS devices require very little power to operate.

The CMOS RAM is used to store basic Information about the PC's configuration for instance:-

- Floppy disk and hard disk drive types
- Information about CPU
- RAM size
- Date and time
- Serial and parallel port information
- Plug and Play information
- Power Saving settings

Other Important data kept in CMOS memory is the time and date, which is updated by a Real Time Clock (RTC).

Cache Memory

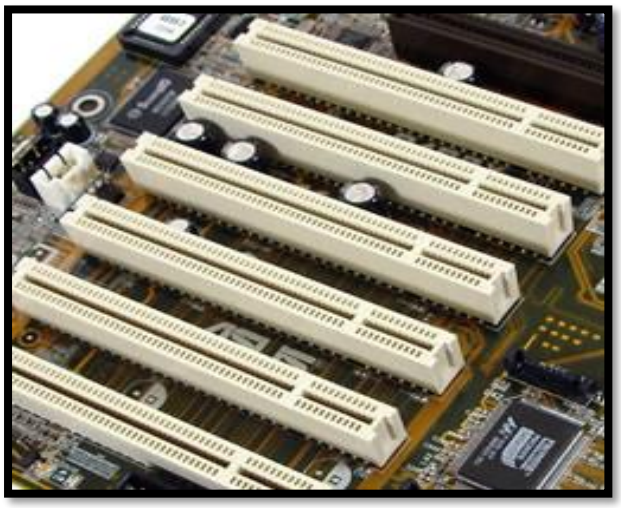


Cache memory is a small block of high-speed memory (RAM) that enhances PC performance by pre-loading information from the (relatively slow) main memory and passing it to the processor on demand.

Most CPUs have an internal cache memory (built into the processor) which is referred to as Level 1 or primary cache memory. This can be supplemented by external cache memory fitted on the motherboard. This is the Level 2 or secondary cache.

In modern computers, Levels 1 and 2 cache memory are built into the processor die. If a third cache is implemented outside the die, it is referred to as the Level 3 (L3) cache.

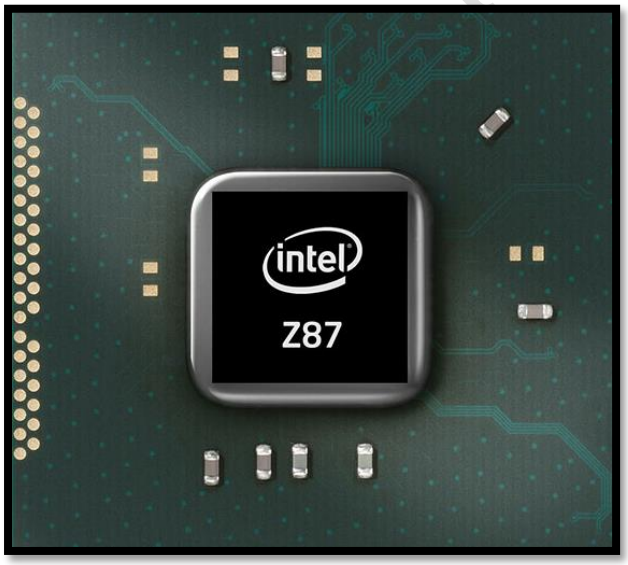
Expansion Bus



An expansion bus is an input/output pathway from the CPU to peripheral devices and it is typically made up of a series of slots on the motherboard. Expansion boards (cards) plug into the bus. PCI is the most common expansion bus in a PC and other hardware platforms. Buses carry signals such as data, memory addresses, power, and control signals from component to component. Other types of buses include ISA and EISA.

Expansion buses enhance the PCs capabilities by allowing users to add missing features in their computers by slotting adapter cards into expansion slots.

Chipset



A chipset is a group of small circuits that coordinate the flow of data to and from a PC's key components. These key components include the CPU itself, the main memory, the secondary cache, and any devices situated on the buses. A

chipset also controls data flow to and from hard disks and other devices connected to the IDE channels.

A computer has got two main chipsets:

- The NorthBridge (also called the memory controller) is in charge of controlling transfers between the processor and the RAM, which is why it is located physically near the processor. It is sometimes called the GMCH, for Graphic and Memory Controller Hub.
- The SouthBridge (also called the input/output controller or expansion controller) handles communications between slower peripheral devices. It is also called the ICH (I/O Controller Hub). The term "bridge" is generally used to designate a component which connects two buses.

Chipset manufacturers include SIS, VIA, ALI, and OPTI.

CPU Clock

The CPU clock synchronizes the operation of all parts of the PC and provides the basic timing signal for the CPU. Using a quartz crystal, the CPU clock breathes life into the microprocessor by feeding it a constant flow of pulses.

For example, a 200 MHz CPU receives 200 million pulses per second from the clock. A 2 GHz CPU gets two billion pulses per second. Similarly, in any communications device a clock may be used to synchronize the data pulses between sender and receiver.

A "real-time clock," also called the "system clock," keeps track of the time of day and makes this data available to the software. A "time-sharing clock" interrupts the CPU at regular intervals and allows the operating system to divide its time between active users and/or application.

Chapter 10

Peripherals

There are devices that provide data storage, like disks and tapes, and there are devices that connect the computer system to the external world (keyboards, printers, displays, sensors). The storage devices record data using the same bit pattern encodings as used in the memory and CPU. These devices work with blocks of thousands of bytes. Storage space is allocated in these large units. Data transfers are in units of "blocks".

The other i/o devices transfer only one, or sometimes two, bytes of data at a time. Their controllers have two parts. There is a part that attaches to the bus and has some temporary storage registers where data are represented as bit patterns. A second part of the controller has to convert between the internal bit representation of data and its external representation. External representations vary – sensors and effectors (used to monitor and control machinery in factories) use voltage levels, devices like simple keyboards and printers may work with timed pulses of current, some devices use flashes of light.

INPUT devices are -

Keyboard

A keyboard is the most common input device. Several kinds of keyboards are available, but they resemble each other with minor variations. The keyboard in most common use is the QWERTY board. Generally standard keyboard has 104 keys. In these keyboards, the cursor control keys are duplicated to allow easier use of the numeric pad.

Mouse

A mouse is an electro-mechanical, hand-held device. It is used as a pointer. It can perform functions like selecting menu commands, moving icons, resizing windows, starting programs, and choosing options. The most common mouse uses an internal, magnetically coated ball, to detect the movement of the mouse across a flat surface, usually a desktop. Nowadays, optical or laser mouse is used to detect the movement. All windows based applications today are designed to work with a mouse. A mouse is used to replace hard -to-remember key combinations with easier "Point and Click"
actions. However, it cannot substitute all keyboard operations. It can be alternative for commands based operations.

Light pen

An input device that utilizes a light-sensitive detector to select objects on a display screen. A light pen is similar to a mouse except that with a light pen you can move the pointer and select objects on the display screen by directly pointing to the objects with the pen.

Optical Scanner

These devices are used for automatic data collection. The devices of this category completely eliminate manual input of data. For example, the bar-code reader is actually just a special type of image scanner. An image scanner translates printed images into an electronic format that can be stored in a computer's memory, and with the right kind of software, one can alter a stored image. Another example of scanner is optical character recognition (OCR) device, used by banks to convert the scanned image of a typed or printed page into text that can be edited on the computer.

Touch Screen

Touch panel displays and pads are now being offered as alternatives to keyboard. Here the input can be given through the computer screen, that accepts the input through monitor; users touch electronic buttons displayed on the screen or they may use light pen.

Microphone

Microphone is an input device, which takes voice as input. The voice communication is more error-prone than information through keyboard. There are two types of microphones available -

1. Desktop Microphone
2. Hand held Microphone

Track Ball

Trackball, a pointing device, is a mouse lying on its back. To move the pointer, you rotate the ball with your thumb, your fingers, or the palm of your hand. There are usually one to three buttons next to the ball, which you use just like mouse buttons. The advantage of trackballs over mouse is that the trackball is stationary so it does not require much space to use it. In addition, you can place a trackball on any type of surface, including your lap. For both these reasons, trackballs are popular pointing devices for portable computers.

OUTPUT DEVICES -

Output devices return processed data that is information, back to the user. Some of the commonly used output devices are:

1. Monitor (Visual Display Unit)
2. Printers
3. Plotter
4. Speakers

1. Monitor

Out of all the output devices, monitor is perhaps the most important output device because people interact with this device most intensively than others. Computer information is displayed, visually with a video adapter card and monitor. Information processed within the CPU, that needs to be visually displayed, is sent to video adapter. The video adapter converts information from the format used, in the same manner as a television displays information sent to it by a cable service.

Two basic types of monitors are used with microcomputers,
which are as follows:
1. CRT
2. LCD

Cathode Ray Tube (CRT):

CRT or Cathode Ray Tube Monitor is the typical monitor that you see on a desktop computer. It looks a lot like a television screen, and works the same way. This type uses a large vacuum tube, called cathode ray tube (CRT).

Liquid Crystal Displays (LCD):

This type of monitors are also known as flat panel monitor. Most of these employ liquid crystal displays (LCDs) to render images. These days LCD monitor are very popular. When people talk about the capabilities of various monitors, one critical statistic is the resolution of the monitor. Most monitors have a resolution of at least 800 x 600 pixels. High-end monitors can have resolutions of 1024 x 768 pixels or even 1280 x 1024 pixels. Thus monitors are available either in low resolution or in high resolution.

2. Printer

After a document is created on the computer, it can be sent to a printer for a hard copy (printout). Some printers offer special features such as colored and large page formats. Some of the most commonly used printers are:

1. Laser Printer
2. Ink Jet Printer
3. Dot Matrix Printer
4. Line Printer

Laser Printer:

A laser printer produces high quality print that one normally finds in publishing. It is extremely fast and quiet. Moreover, the operation of a laser printer is easy with automatic paper loading and no smudging or messing up of ink ribbons. The fastest laser printer can print up to 200 pages per minute in monochrome (black and white) and up to 100 pages per minute in colour.

Ink-Jet Printer:
An ink-jet printer creates an image directly on paper by spraying ink through as many as 64 tiny nozzles. Although the image it produces is not generally quite as sharp as the output of a laser printer, the quality of ink-jet images is still high. In general, ink-jet printer offers an excellent middle ground between dot matrix and laser printer. Like laser printer, an ink-jet printer is quiet and convenient, but not particularly fast. Typically, an ink-jet printer is more expensive than a dot-matrix printer, but costs only half as much as a laser printer.

Dot Matrix Printer:
The dot matrix printer was very popular at one point of time. It is a very versatile and inexpensive output device. In dot matrix printer the print head physically "hits" the paper through the ribbon and produces text (or images) by combinations of dots; hence the name dot matrix printer. Its speed is measured in characters per second (CPS). Although it is less expensive, it is louder, slower and produces lower print quality.

Line Printer:
A line printer is generally used with large computer systems to produce text based data processing reports. Line printers are high-speed printers with speeds ranging anywhere from 100 to about 3800 lines per minute. In the past, print quality on line printers was not high. Developments in technology are improving the print quality on line printers. These are in the cost range of lacs of Rupees.

3. Plotter:

A plotter is a special kind of output device that, like a printer, produces images on paper, but does so in a different way. Plotters are designed to produce large drawings or images, such as construction plans for buildings or blueprints for mechanical objects. A plotter can be connected to the port normally used by a printer.

An array of different colored pens in a clip rack and a robotic arm is part of plotter. The instructions that a plotter receives from a computer consist of a colour, and beginning and ending coordinates for a line. With that information, the plotter picks up the appropriate pen through its arm, positions it at the beginning coordinates drops the pen down to the surface of the paper and draws to the ending coordinates. Plotters draw curves by creating a sequence of very short straight lines.

Plotters usually come in two designs:

1. Flat Bed: Plotters of small size to be kept on table with restriction of paper size.

2. Drum: These plotters are of big size using rolls of paper of unlimited length.

4. Speaker

Speakers are another type of output device, which allow you to listen to voice like music, and conversation with people.

MOBILE FUNDAMENTALS

Chapter 11

Introduction

A **mobile phone** (also known as a **wireless phone**, **cell phone**, or **cellular telephone**) is a very small portable radio telephone.

The mobile phone can be used to communicate over long distances without wires. It works by communicating with a nearby base station which connects it to the main phone network. As the mobile phone moves around, if the mobile phone gets too far away from the cell it is connected to, that cell sends a message to another cell to tell the new cell to take over the call and the call continues with the new cell the phone is connected to. The hand-off is done so well and carefully that the user will usually never even know that the call was transferred to another cell.

In recent days, more and more mobile phones are considered as "**smartphones**". A majority of new mobile phones from the 21st century are smartphones. These phones can be used for email, browsing the internet, playing music and games,and many other functions that computers can perform. This is because mobile phones basically are small computers. Older phones also used computer technology, but lacked many of the parts of a computer that were too big to fit into a phone. Modern phone makers have been able to use smaller parts. Most smartphones are also GPS receivers and digital cameras. Therefore, it is essential to know about their working and functions to understand the concepts of mobile fundamentals.

Chapter 12

Mobile Computing Devices

Mobile computing is an interaction between human and computer by which a computer is expected to be motivating during normal usage. Mobile computing involves software, hardware and mobile communication. Respectively, mobile software deals with the requirements of mobile applications. Also, hardware includes the components and devices which are needed for mobility. Communication issues include ad-hoc and infrastructure networks, protocols, communication properties, data encryption and concrete technologies. Mobile computing means being able to use a computing device while changing location properties. Portability is one aspect of mobile computing. Also, it is referred as the ability to use computing capability without a pre-defined location and/or connection to a network to for engaging data and information.

12.1 Personal Digital Assistant (PDA)

A personal digital assistant (PDA), also known as a palmtop computer, or personal data assistant, is a mobile device that functions as a personal information manager. PDAs are largely considered obsolete with the widespread adoption of smart phones. Commonly current PDAs are able to connect to the Internet. A PDA has all requirements of connecting to the Internet such as : an electronic visual display, enabling it to include a web browser, audio capabilities enabling use as a portable media player. Most PDAs can access the Internet, intranets or extranets via wireless methods like Wi-Fi or Wireless Wide Area Networks. Most PDAs use touch screen technology. The term PDA was first used on January 7, 1992 by Apple Computer CEO John Sculley at the Consumer Electronics Show in Las Vegas, Nevada, referring to the Apple Newton.

12.2 Smartphone

A smartphone is a mobile phone built on a mobile operating system, with more advanced computing capability and connectivity than a feature phone. The first smartphones was a combination of a personal digital assistant (PDA) and a mobile phone functionally. Some functions were added in later models like portable media players, low-end compact digital cameras, pocket video cameras, and GPS navigation units to form one multi-use device, high-resolution touchscreens and web browsers for displaying standard web sites and

mobile-optimized pages. Also, Wi-Fi provided high-speed data access and mobile broadband. The most usual mobile operating systems (OS) used by modern smartphones include Google's Android, Apple's iOS, Nokia's Symbian, RIM's BlackBerry OS, Samsung's Bada, and Microsoft's Windows Phone. Such operating systems are able to adjust with many different phone models. Also, typically each device can have multiple OS installed over its lifetime.

12.3 Tablet Computer

Tablet computers are larger than a mobile phone or personal digital assistant. They are a type of mobile devices integrated into a flat touch screen and primarily operated by touching the screen. No physical keyboard is placed in them. It often uses an onscreen virtual keyboard, a passive stylus pen, or a digital pen.

Normally, tablet does not have an integrated keyboard but they can be connected to a wireless or a USB keyboard, while notebook computers have an integrated keyboard that can be hidden by a slide joint. In hybrid models, a detachable keyboard is included so that the touch screen can be used as a stand-alone tablet. Booklets include dual-touchscreens. One of them is used as a virtual keyboard. Apple released the iPad with operating system and touchscreen technology in 2010 and became the first successful mobile computer tablet to achieve worldwide commercial purposes.

Typical functions of tablet computers are:

1. Wireless mobile browser functions (using 2G,3G,4G or WiFi)
2. E-mail and social media devices
3. Potential cell phone functions (Messaging, video calling, etc.)
4.GPS satellite navigation
5. Stills and video camera functions, photo and video viewing and editing
6. E-book reading (including electronic versions of periodicals)
7. Downloadable apps (games, education, utilities)
8.Portable media player function

12.4 - Wearable computers

Wearable computers, also known as body-borne computers are miniature electronic devices that are worn by the bearer under, with or on top of clothing. This class of wearable technology has been developed for general or special purpose information technologies and media development. Wearable computers

are especially useful for applications that require more complex computational support than just hardware coded logics. One of the main features of a wearable computer is consistency. There is a constant interaction between the computer and user, i.e. there is no need to turn the device on or off.

Another feature is the ability to multi-task. It is not necessary to stop what you are doing to use the device; it is augmented into all other actions. These devices can be incorporated by the user to act continously. It can therefore be an extension of the user's mind and/or body. One of the latest and the most efficient gadget of the time.

Chapter 13

Mobile Operating System

Mobile operating systems are talked in this section. This issue involves the most popular operating systems such as: Symbian, Windows, BlackBerry, iOS, Android.

13.1 Symbian

Symbian is a mobile operating system designed for smartphones originally developed by Symbian Ltd. but currently maintained by Accenture. The Symbian platform is the successor to Symbian OS and Nokia Series. The latest version, Symbian version 3, was officially released in 2010 and first used in the Nokia N8. The first Symbian phone the touchscreen Ericsson R380 Smartphone was released in 2000and was the first device to be marketed as a 'smartphone'. It combined a PDA with a mobile phone. Later in 2000, the Nokia 9210 communicator was released, also with Symbian. The later 9500 was Nokia's first camera phone and first Wi-Fi phone. The 9300 was smaller, and the E90 Communicator included GPS. In 2007, Nokia launched the Nokia N95 which integrated various multimedia features: GPS, a 5 megapixel camera with autofocus and LED flash, 3G and Wi-Fi connectivity and TV-out. The Nokia 6110 Navigator was a Symbian based dedicated GPS phone introduced in June 2007. In 2010, Nokia released the Nokia N8 smartphone with a stylus-free capacitive touchscreen, the first device to use the new Symbian OS. It was a megapixel camera able to record HD video in 720p. Some estimates indicate that the number of mobile devices shipped with the Symbian OS up to the end of Q2 2010 is 385 million. Symbian was the number one smartphone platform by market share from 1996 until 2011 when it dropped to second place behind Google's Android OS. In February 2011, Nokia announced that it would replace Symbian with Windows Phone as the operating system on all of its future smartphones. This transition was completed in October 2011, when Nokia announced its first line of Windows Phone 7.5 smartphones, Nokia Lumia 710 and Nokia Lumia 800. Nokia committed to support its Symbian based smartphones until 2016, by releasing further OS improvements, like Nokia Belle and Nokia Belle FP1, and new devices, like the Nokia 808 PureView.

13.2 Windows

Microsoft Windows CE (now officially known as Windows Compact Embedded) is an operating system developed by Microsoft for embedded systems. Windows CE is a distinct operating system and kernel, rather than a trimmed-down version of desktop Windows. It is not to be confused with Windows Embedded Standard which is an NT-based componentized version of desktop Microsoft Windows. Microsoft licenses Windows CE to OEMs and device makers. The OEMs and device makers can modify and create their own user interfaces and experiences, with Windows CE providing the technical foundation to do so. The current version of Windows Embedded Compact supports Intel x86 and compatibles.

13.3 BlackBerry

BlackBerry is a line of phone devices developed and designed by Research In Motion (RIM). The first BlackBerry smartphone was released in 1999. BlackBerry devices are smartphones, which are designed to function as personal digital assistants, portable media players, internet browsers, gaming devices, cameras and much more. They are primarily known for their ability to send and receive push email and instant messages while maintaining a high level of security through on-device message encryption. BlackBerry devices support a large variety of instant messaging features, with the most popular being the proprietary BlackBerry Messenger service. BlackBerry accounts for 3% of mobile device sales worldwide in 2011, making its manufacturer RIM the sixth most popular device maker (25% of mobile device sales are smartphones). The consumer BlackBerry Internet Service is available in 91 countries worldwide on over 500 mobile service operators using various mobile technologies. As of October 2011, there were seventy million subscribers worldwide to BlackBerry. In 2011 the Caribbean and Latin America, had the highest penetrations of BlackBerry smartphones worldwide – with up to about 45 per cent in the region having a RIM device. Modern GSM-based BlackBerry handhelds incorporate an ARM 7, 9 or ARM 11 processor, while older BlackBerry 950 and 957 handhelds used Intel 80386 processors. The latest BlackBerry models called "Torch" (Torch 9850/9860, Torch 9810, and Bold 9900/9930) have a 1.2 GHz MSM8255 Snapdragon processor, 768 MB system memory, and 8 GB of on-board storage. All BlackBerry smartphones after OS 5 support up to 32 GB microSD cards.

13.4 Ios

iOS (previously iPhone OS) is a mobile operating system developed and distributed by Apple Inc. Originally released in 2007 for the iPhone and iPod Touch, it has been extended to support other Apple devices such as the iPad and Apple TV. Unlike Microsoft's Windows CE (Windows Phone) and Google's Android, Apple does not license iOS for installation on non-Apple hardware. The user interface of iOS is based on the concept of direct manipulation, using multi-touch gestures. Interface control elements consist of sliders, switches, and buttons. The response to user input is immediate and provides a fluid interface. Interaction with the OS includes gestures such as swipe, tap, pinch, and reverse pinch, all of which have specific definitions within the context of the iOS operating system and its multi-touch interface. Internal accelerometers are used by some applications to respond to shaking the device or rotating it in three dimensions (one common result is switching from portrait to landscape mode). iOS is Apple's mobile version of the OS X operating system used on Apple computers. In iOS, there are four abstraction layers: the Core OS layer, the Core Services layer, the Media layer, and the Cocoa Touch layer. The current version of the operating system (iOS 5.1.1) dedicates 1-1.5 GB of the device's flash memory for the system partition, using roughly 800 MB of that partition (varying by model) for iOS itself.

13.5 Android

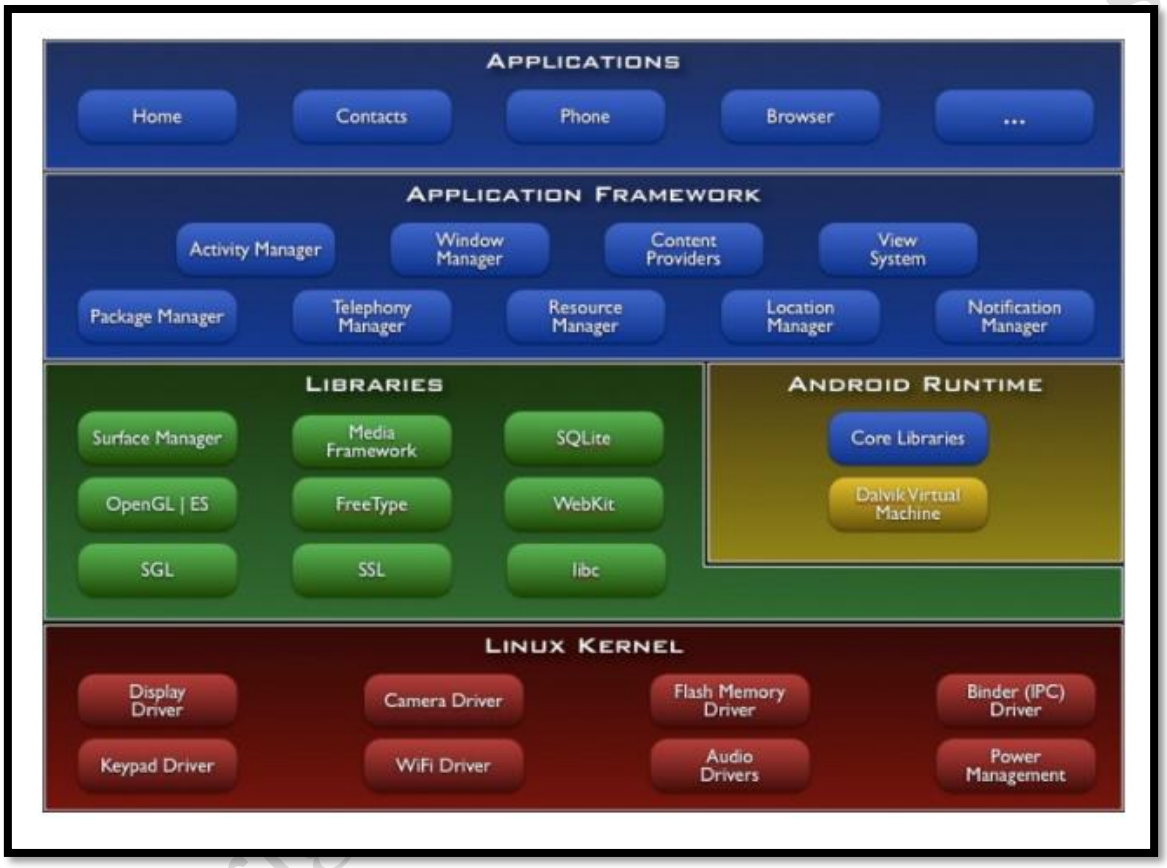
Android is a Linux-based operating system designed primarily for touchscreen mobile devices such as smartphones and tablet computers, developed by Google in conjunction with the Open Handset Alliance. Initially developed by Android Inc, whom Google financially backed and later purchased in 2005, Android was unveiled in 2007 along with the founding of the Open Handset Alliance, a consortium of 86 hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. Google released the Android code as open-source, under the Apache License. The Android Open Source Project (AOSP), lead by Google, is tasked with the maintenance and further development of Android. Additionally, Android has a large community of developers writing applications that extend the functionality of devices. Developers write primarily in a customized version of Java and apps can be downloaded from online stores such as Google Play (formerly Android Market), the app store run by Google, or third-party sites. In June 2012, there were more than 600,000 apps available for Android, and the estimated number of applications downloaded from Google Play was 20 billion. The first Android-

powered phone was sold in October 2008 and by the end of 2010 Android had become the world's leading smartphone platform. It had a worldwide smartphone market share of 59% at the beginning of 2012.

Chapter 14

Structural Overview of Android

The Android software stack as shown in figure 1.1 can be subdivided into five layers: The kernel and low level tools, native libraries, the Android Runtime, the framework layer and on top of all the applications.



The kernel in use is a Linux 2.6 series kernel, modified for special needs in power management, memory management and the runtime environment. Right above the kernel run some Linux typical daemons like bluez for Bluetooth support and wpa supplicant for WiFi encryption.

As Android is supposed to run on devices with little main memory and low powered CPUs, the libraries for CPU and GPU intensive tasks are compiled to device optimized native code. Basic libraries like the libc or libm were developed especially for low memory consumption and because of licensing issues on Android. In this layer the surface manager handles screen access for the window manager from the framework layer. Opposing to other frameworks,

the media framework resides in this layer, as it includes audio and video codecs that have to be heavily optimized.

The Android Runtime consists of the Dalvik virtual machine and the Java core libraries. The Dalvik virtual machine is an interpreter for byte code that has been transformed from Java byte code to Dalvik byte code. Dalvik itself is compiled to native code whereas the the core libraries are written in Java, thus interpreted by Dalvik.
Frameworks in the Application Framework layer are written in Java and provide abstractions of the underlying native libraries and Dalvik capabilities to applications. Android applications run in their own sandboxed Dalvik VM and can consist of multiple components: Activities, services, broadcast receivers and content providers. Components can interact with other components of the same or a different application via intents.

Chapter 15

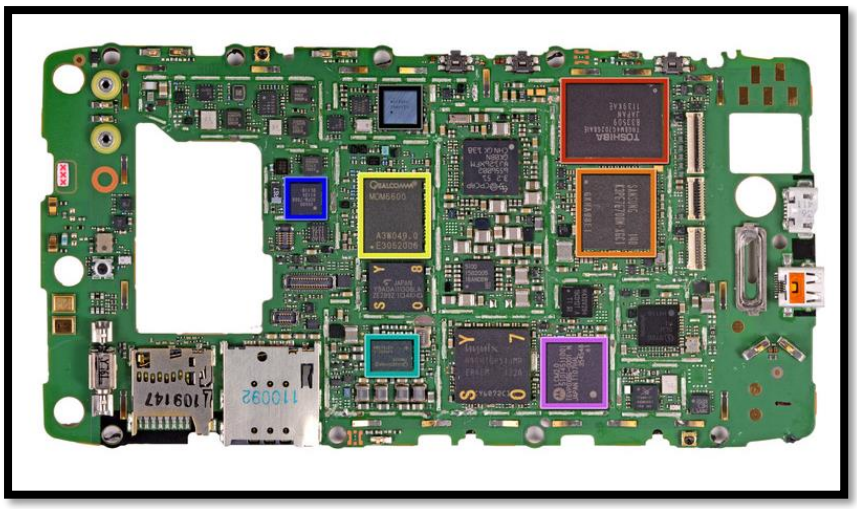
Android Memory and Storage

Like RAM, internal storage is critical to a smartphone's operation; without any place to store the operating system and critical files there would be nothing for the phone to do. Even if a phone has no storage accessible to the user, there will also be some form of internal storage that stores the operating system.

Depending on the operating system loaded on the device, and the device itself, there are multiple storage chips inside the device. These chips may then be partitioned into several areas for different purposes, such as application storage, cache and system files. Normally the chip that stores the system files is called the ROM for read-only memory; however this is a bit of a misnomer as the memory here can actually be modified through system updates, just not by the end user.

Some devices, such as the Samsung Galaxy S, have a multi-ROM set-up. One memory chip is smaller around 512 MB, but faster, and stores the main system files, cache and application data in separate partitions. The second chip is larger, and is usually a 1-2 GB partition of the user storage that is slower but allows for storage of applications.

In these systems having a full 2 GB of fast access memory may be too expensive to include, so lowering the size to just accommodate the operating system and using the cheaper user storage for the remaining non-user-accessible data is a better option. It creates a good balance between performance and cost for the manufacturer.



The internals of the Motorola Droid Razr; 16 GB storage highlighted in red (and 1 GB RAM in orange)

Other devices such as the Apple iPhone 4S and Motorola Droid Razr prefer to include just one storage chip that sits, in terms of performance, between the two chips used in a multi-chip set-up. The phone may be stated to include 16 GB of internal storage, but after a 1-2 GB system partition and (in the case of the Razr) a 4 GB application partition the user accessible storage may end up as low as 8 GB.

Performance of internal storage chips are, generally speaking, better than you would achieve with external microSD cards. As the chips are directly soldered to the smartphone's mainboard and can be made to specially interface with the SoC used, the read/write speeds attained are usually quite good: in my testing I usually achieve above 6 MB/s write.

Sometimes companies cheat and don't solder user-accessible internal storage to the mainboard, instead putting a microSD card in a hidden slot that can't be normally accessed by the user. This was particularly prevalent on early generation Windows Phones such as the HTC Trophy and HTC HD7 and has few benefits.

Chapter 16

Android File System Structure

Most of the Android user are using their Android phone just for calls, SMS, browsing and basic apps, But form the development prospective, we should know about Android internal structure. Android uses several partitions (like boot, system, recovery,data etc) to organize files and folders on the device just like Windows OS. Each of these partitions has it's own functionality, But most of us don't know the significance of each partition and its contents. In this article, we will take you on a tour of Android partitions. So lets start the android file system tutorial.

There are mainly 6 partitions in Android phones, tablets and other Android devices. Below is the list of partition for Android File System. Note that there might be some other partitions available, it differs from Model to Model. But logically below 6 partitions can be found in any Android devices.

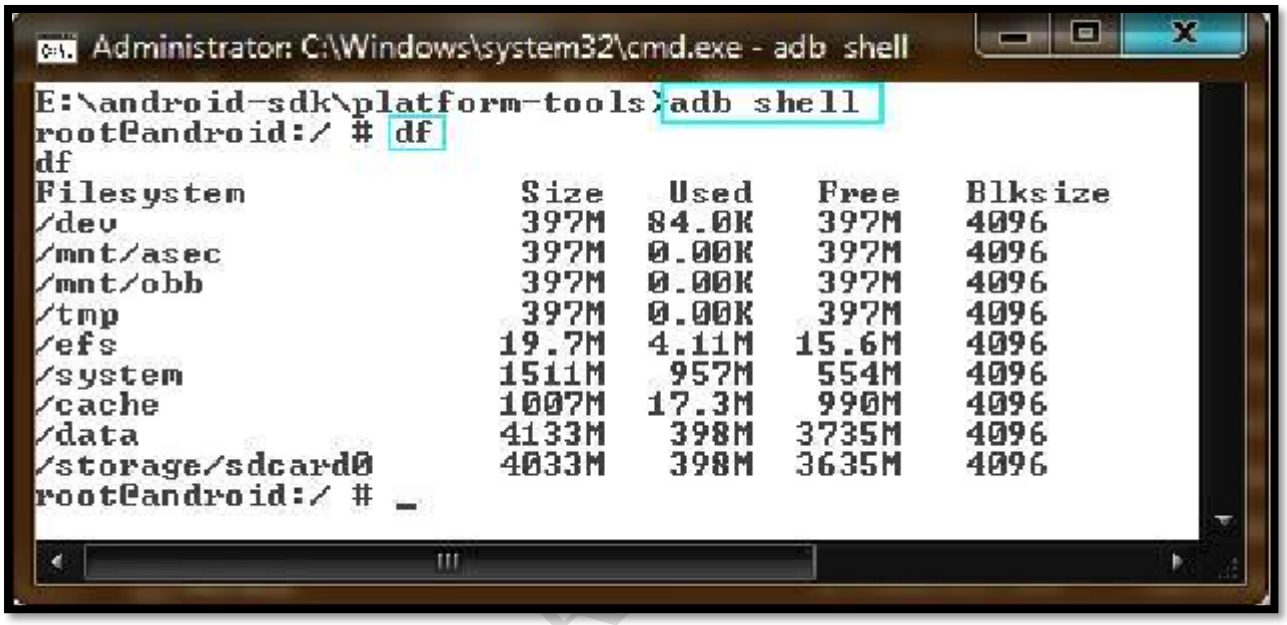
/boot
/system
/recovery
/data
/cache
/misc

Also Below are the for SD Card Fie System Partitions.

/sdcard
/sd-ext

Know Your Android Device Partition Size using adb Command -

You can know which partitions are available along with the partition size for all partition in your android device. Go through the below image and run the adb command as shown in that image. For more adb commands, you can read my atricle **Useful adb Commands for Android Development.** Also for more details for android architecture, you can read my article **Android Architecture**



/boot

This is the boot partition of your Android device, as the name suggests. It includes the android kernel and the ramdisk. The device will not boot without this partition. Wiping this partition from recovery should only be done if absolutely required and once done, the device must NOT be rebooted before installing a new one, which can be done by installing a ROM that includes a /boot partition.

/system

As the name suggests, this partition contains the entire Android OS, other than the kernel and the ramdisk. This includes the Android GUI and all the system applications that come pre-installed on the device. Wiping this partition will remove Android from the device without rendering it unbootable, and you will still be able to put the phone into recovery or bootloader mode to install a new ROM.

/recovery

This is specially designed for backup. The recovery partition can be considered as an alternative boot partition, that lets the device boot into a recovery console for performing advanced recovery and maintenance operations on it.

/data

Again as the name suggest, it is called userdata partition. This partition contains the user's data like your contacts, sms, settings and all android applications that you have installed. While you perform factory reset on your device, this partition will be wiped out, Then your device will be in the state, when you used for the first time or the way it was after the last official or custom ROM installation.

/cache

I hope you have some idea about cache, as you are expert on internet browsing. This is the partition where Android stores frequently accessed data and app components. Wiping the cache doesn't effect your personal data but simply gets rid of the existing data there, which gets automatically rebuilt as you continue using the device.

/misc

This partition contains miscellaneous system settings in form of on/off switches. These settings may include CID (Carrier or Region ID), USB configuration and certain hardware settings etc. This is an important partition and if it is corrupt or missing, several of the device's features will will not function normally.

/sdcard

This is not a partition on the internal memory of the device but rather the SD card. In terms of usage, this is your storage space to use as you see fit, to store your media, documents, ROMs etc. on it. Wiping it is perfectly safe as long as you backup all the data you require from it, to your computer first. Though several user-installed apps save their data and settings on the SD card and wiping this partition will make you lose all that data.

On devices with both an internal and an external SD card – devices like the Samsung Galaxy S and several tablets – the /sdcard partition is always used to refer to the internal SD card. For the external SD card – if present – an alternative partition is used, which differs from device to device. In case of Samsung Galaxy S series devices, it is /sdcard/sd while in many other devices, it is /sdcard2. Unlike /sdcard, no system or app data whatsoever is stored automatically on this external SD card and everything present on it has been

added there by the user. You can safely wipe it after backing up any data from it that you need to save.

/sd-ext

This is not a standard Android partition, but has become popular in the custom ROM scene. It is basically an additional partition on your SD card that acts as the /data partition when used with certain ROMs that have special features called APP2SD+ or data2ext enabled. It is especially useful on devices with little internal memory allotted to the /data partition. Thus, users who want to install more programs than the internal memory allows can make this partition and use it with a custom ROM that supports this feature, to get additional storage for installing their apps. Wiping this partition is essentially the same as wiping the /data partition – you lose your contacts, SMS, market apps and settings.