**Module II**
**Power Supply and Storage Devices**

## Purposes and characteristics of power supplies

- Power supply - The device in the computer that provides the power.
- A power supply converts 110V or 220V AC current into the DC voltages that a computer needs to operate.
- Watt is the unit of power.
- The primary characteristic of a power supply is its form factor, which specifies dimensions and mounting hole locations.
- Other two major characteristics are efficiency and performance over its specified temperature range, which may require cooling.
- Also, there are important characteristics that protect the power supply and its load from damage, such as overcurrent, overtemperature, and overvoltage, etc.

## Power Connectors

1.***Classic Power Connectors***

*(1) AT System Connector*

- The original power connectors used with old PC motherboards.
- These are two six-wire connectors, labeled P8 and P9.
- These are connected to an AT-style motherboard.
- The P8 and P9 connectors must be installed correctly otherwise the motherboard will get damaged. To do this, place the connectors side by side with their black wires together.

*(2) Standard Peripheral Power Connector*

- Also called as Molex connector.
- This is used to power different types of internal disk drives.
- This power connector uses the same wiring color code scheme as the floppy drive connector.
- Only difference is additional copper wires are used.

*(3) Floppy Drive Power Connectors*

- Also called as Berg connectors.
- Floppy drive power connectors are most commonly used to power floppy disk drives and other small form factor devices.
- This type of connector is smaller and flatter than any of the other types of power connectors.

2.***Modern Power Connectors***

(1) *ATX, ATX12V, and EPS12V Connectors*

ATX-It provides the required six voltages and it delivers them all through one connector, a single 20-pin connector.

ATX12V-It has two additional connectors, a single 6-pin auxiliary connector and a 4-pin square mini-version of the ATX connector(P4 connector).

EPS12V- It uses an 8-pin version, called the processor power connector, that doubles the P4's function with four +12V leads and four grounds.

(2) *Proprietary Power Connectors*

These type of connectors can be used instead of standard power connectors inorder to solve design issues.

(3) *SATA Power Connectors(Serial ATA )*

SATA storage devices can transmit data to and from the rest of the computer much faster than Parallel ATA.The fully pinned connector is made up of three +3.3V, three +5V, and three +12V leads interleaved with two sets of three ground leads.

## Replacing Power Supplies

- Whenever the power supply fails, it should be replaced. Never try to repair it.
- Steps to replace power supply:-

1Turn off your PC, unplug it, and remove your computer's case.

2Make sure the new power supply's cables will plug into the correct spots by putting a strip of masking tape on the end of each plug and writing down its destination.

3Unplug the power cables from the motherboard (the large, flat, circuitry-and-slot-filled board).

4Unplug the power cables from the hard drives and the CD/DVD burners (new on left, old on right), as well as any other places on the motherboard.

5Remove the four screws that hold the power supply to the computer's case.

6Lift out the power supply.

7Plug your new power supply into the wall before installing it, just to listen for the fan.

8Make sure that the power supply's voltage is set correctly, if necessary.

9Place the new power supply in the old one's place, and tighten the screws, then reconnect the cables to the motherboard, the drives, the fans, and the power switch.

10Reconnect the power cord and plug your computer back in.

11Turn on the power

**Purpose and characteristics of storage devices**

- Storage media hold the data being accessed, files the system needs to operate and data that needs to be saved.
- The many different types of storage differ in terms of their capacity (how much they can store), access time (how fast the computer can access the information), and the physical type of media used.

**Hard Disk Drive Systems**

- Hard disk drive (HDD) systems (hard disks or hard drives) are used for permanent storage and quick access.
- Hard disks are kept inside the computer, where they are mounted with no external access and can hold more information than other forms of storage.
- Hard drives use a magnetic storage medium and are known as conventional drives.

The hard disk drive system contains three critical components:

- *Controller* - This component controls the drive. The controller chip controls how the drive operates and how the data is encoded onto the platters. It controls how the data sends signals to the various motors in the drive and receives signals from the sensors inside the drive.

Nowadays, both the controller and drive are assembled into a single unit. Eg:- PATA and SATA.

- *Hard disk* - This is the physical storage medium. Hard disk drive systems store information on small discs also called as platters(from 1 inch to 5 inches in diameter), stacked together and placed in an enclosure.
- *Host bus adapter (HBA)* - This is the translator. It converts signals from the controller to signals the computer can understand.

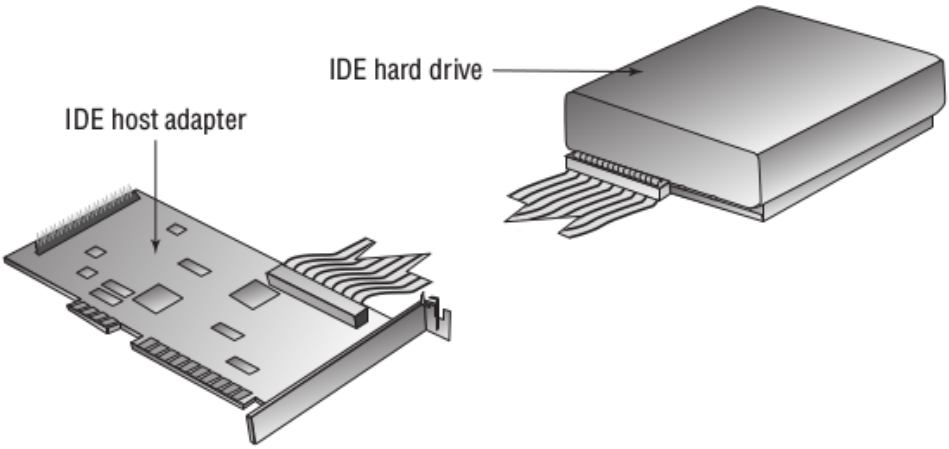
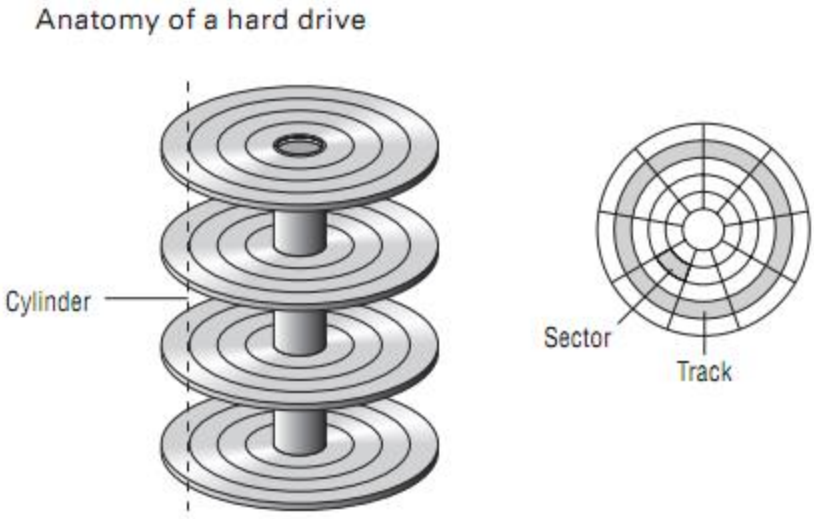



Figure shows hard disk drive system.

**Anatomy of a Hard Drive**
Following are the components of a hard drive:-

- Platters
- Read/write heads
- Tracks
- Sectors
- Cylinders
- Clusters (allocation units)




*Platters* - Platter is a circular, metal disk that is mounted inside a hard disk drive. Several platters are mounted on a fixed spindle motor to create more data storage surfaces in a smaller area.Platters are made out of aluminum, glass or ceramic and have a magnetic surface in order to permanently store data. These platters typically spin at 3,600 or 7,200 rpm when the disk is operating.
*Read/Write heads* - The heads are an interface between the magnetic media(where the data is stored) and electronic components in the hard disk. The heads convert the information, which is in the form of bits to magnetic pulses when it is to be stored on the platter and reverses the process while reading.
*Tracks* - A ring on a disk where data can be written is track. Each platter is divided into tracks. The tracks are numbered, starting from zero from outside of the platter to the innermost ring.

*Sectors* - Each track is further divided into smaller units called sectors. A single track typically can have thousands of sectors and each sector can hold more than 512 bytes of data. Also few additional bytes for control structures and error detection and correction.
*Cylinders* - A cylinder is any set of all tracks of equal diameter in a hard disk drive (HDD). It can be visualized as a single, imaginary, circle that cuts through all of the platters in the drive.
*Clusters* - Sectors are grouped together to form Clusters.
*How datas are stored in HDD?*
Hard disks are shiny, circular plate of magnetic material called a platter, divided into billions of tiny areas. Each one of those areas can be independently magnetized (to store a 1) or demagnetized (to store a 0). Magnetism is used in computer storage because it goes on storing information even when the power is switched off.

**Solid-State Drives**

- A solid-state drive (SSD) is a nonvolatile storage device that stores persistent data on solid-state flash memory.
- It has an array of semiconductor memory organized as a disk drive, using integrated circuits (ICs).
- An SSD does functionally everything a hard drive does.
- Data is stored on interconnected flash memory chips that retain the data even when there's no power.
- The chips can either be permanently installed on the system's motherboard or in a seperate box.
- SSDs are separated into two broad categories - volatile DRAM-based and non-volatile flash-based.
- Non-volatile flash-based SSDs made with NAND use considerably less power than HDDs.
- Volatile DRAM based use same power as HDDs.

*Advantages*:-

- consume less power
- produce less heat
- less susceptible to damage
- faster data access
- higher reliability

**Optical Storage Drives**

- It is a disk drive that uses laser light or electromagnetic waves to read or write data to and from optical discs.
- Compact discs, DVDs, and Blu-ray discs are common types of optical media which can be read and recorded by such drives.
- Each type of optical drive can support previous technologies.
- CD – Compact Disc Introduced in 1982. The average CD allows for up to 700 MB of data storage. Digital bits are stored as pits on the reflective material in the disc. A red wavelength laser detects these pits and converts them to a digital signal.
- DVD - Digital Versatile/Video Disc introduced in late 1990s. Allows 4.7 GB for a single-layer disc and up to 8.5 GB for a dual-layer disc. DVDs use a red wavelength laser like CDs.
- Blu-ray discs - It is a high-definition optical format developed by Sony during 1995. Blu-ray discs offer 25 GB per layer with up to two layers per disc.

***CD-ROM***

- Compact Disc Introduced in 1982.
- The average CD allows for up to 700 MB of data storage.
- Digital bits are stored as pits on the reflective material in the disc.

- A red wavelength laser detects these pits and converts them to a digital signal.
- The CD-ROM (read-only memory) was designed for long-term storage of data.
- CD-ROMs are read-only, meaning that information written in the factory can't be erased or changed.
- Commercial CD's are produced by stamping the pattern of pits and lands onto a moulded polycarbonate disc(known as a substrate)

***DVD-ROM***

- Digital Versatile/Video Disc introduced in late 1990s.
- Allows 4.7 GB for a single-layer disc and up to 8.5 GB for a dual-layer disc.
- DVDs use a red wavelength laser like Cds.
- The basic DVD-ROM disc is a single-sided disc that has a single layer of encoded information.

***BD-ROM***

- Blue-Ray Discs is a high-definition optical format developed by Sony during 1995.
- The equipment uses violet laser, in contrast to the red laser used with standard DVD and CD technologies.
- Blu-ray technology further increases the storage capacity of optical media without changing the form factor.
- Blu-ray discs offer 25 GB per layer with up to two layers per disc ie, 50 GB in total.

*Optical discs and their capacities*

| Disc Format | Capacity |
|---|---|
| CD SS (includes recordable versions) | 650MB, **700MB**, 800MB, 900MB |
| DVD-R/RW SS, SL | 4.71GB (**4.7GB**) |
| DVD+R/RW SS, SL | 4.70GB (**4.7GB**) |
| DVD-R, DVD+R DS, SL | **9.4GB** |
| DVD-R SS, DL | 8.54GB (**8.5GB**) |
| DVD+R SS, DL | 8.55GB (**8.5GB**) |
| DVD+R DS, DL | 17.1GB |
| BD-R/RE SS, SL | 25GB |
| BD-R/RE SS, DL | 50GB |
| BD-R/RE DS, DL | 100GB |

**Drive Interfaces and RAID**

- Drive interfacing means connecting the disk drive to the main computer system.
- Storage devices has different shapes and sizes.
- Following are the commonly used drive interface standards:-

- IDE/PATA
- SATA
- SCSI

***AT Attachment Drives***

ATA is a common interface used in many personal computers before the emergence of SATA. It is the least expensive of the interfaces.

***IDE/PATA Drives***

- Integrated Device Electronics - It is the most widely-used hard drive interface.
- Parallel ATA (Parallel Advanced Technology Attachment or PATA) is a standard for connecting hard drives into computer systems.
- PATA is the name given to the ATA/IDE standards before the arrival of SATA.
- After the introduction of Serial ATA in 2003, the original ATA was renamed as Parallel ATA.
- PATA uses the classic 40-pin connector for parallel data communications.

*Advantages*:-

- Low cost
- Large capacity

*Disadvantages*:-

- Older ATA adapters will limit transfer rates according to the slower attached device
- Only ONE device on the ATA cable is able to read/write at one time
- Limited standard for cable length (up to 18inches/46cm)

***SATA***

- Serial ATA (Serial Advanced Technology Attachment or SATA) is a standard for connecting and transferring data from hard disk drives (HDDs) to computer systems.
- SATA uses serial signaling technology.

*Advantages*:-

- Increased data transfer rate
- Easy cable management and cable length
- Increased airflow inside computer case
- Support for more drives

*Disadvantages*:-

- Sometimes require a special device driver to recognize the drive
- One drive per cable

***SCSI Drives***

- Small Computer System Interface (SCSI) is a computer interface used primarily for high-speed hard drives.
- SCSI devices can be either internal or external to the computer.
- 8 bit SCSI-1 and SCSI-2 internal devices use a SCSI A cable, a 50-pin ribbon cable similar to that of an IDE drive.
- 16 bit SCSI uses a SCSI P cable, with 68 wires and a 68-pin D- subminiature connector.
- External SCSI connectors depend on the type of standard in use.
- SCSI-1 uses a 50-pin connector. SCSI-2 uses a 25-, 50-, or 68-pin connector. SCSI-3 uses a 68- or 80-pin connector.

*Advantages*:-

- Its performance is much faster than IDE or SATA.
- Many devices (nearly 16) can be attached at the same time on a single controller.
- The interfacing for different types of devices is done through the same cable.

- The peripheral devices of the same type have common characteristics so it is easy to replace the old devices.

*Disadvantages*:-

- The SCSI drives and hardware are more expensive than IDE or SATA.
- It may be difficult to configure older models because each device needs a special ID number and correct termination.

**RAID**

- RAID stands for Redundant Array of Independent Disks.
- It's a way of combining the storage power of more than one hard disk for a special purpose, such as increased performance or fault tolerance.
- RAID was once more commonly done with SCSI drives, but it can be done with other drives. RAID can be implemented in software or in hardware, but hardware RAID is more efficient and offers higher performance at an increased cost.
- There are several types of RAID. The following are the most commonly used RAID levels:
- ***RAID 0***

➢ Also known as disk striping, where a striped set of equal space from at least two drives creates a larger volume.

➢ This is in contrast to unequal space on multiple disks being used to create a simple volume set, which is not RAID 0.

➢ RAID 0 is not RAID in every sense because it doesn't provide the fault tolerance implied by the redundant component of the name.

➢ Data is written across multiple drives, so one drive can be reading or writing while the next drive's read-write head is moving.

➢ This makes for faster data access. However, if any one of the drives fails, all content is lost.

➢ Some form of redundancy or fault tolerance should be used in concert with RAID 0.

- ***RAID 1***

➢ Also known as disk mirroring.

➢ RAID 1 is a method of producing fault tolerance by writing all data simultaneously to two separate drives.

➢ If one drive fails, the other contains all the data and will become the primary drive.

- However, disk mirroring doesn't help access speed, and the cost is double that of a single drive.
- If a separate host adapter is used for the second drive, the term duplexing is attributed to RAID 1.
- Only two drives can be used in a RAID 1 array.

- ***RAID 5***

- Combines the benefits of both RAID 0 and RAID 1, creating a redundant striped volume set.
- Unlike RAID 1, however, RAID 5 does not employ mirroring for redundancy.
- Each stripe places data on n–1 disks, and parity computed from the data is placed on the remaining disk.
- The parity is interleaved across all the drives in the array so that neighboring stripes have parity on different disks.
- If one drive fails, the parity information for the stripes that lost data can be used with the remaining data from the working drives to derive what was on the failed drive and rebuild the set once the drive is replaced.

**Removable Storage and Media**

There are many storage medias such as external hard drives and optical drives, also new storage media, such as USBs that can store many gigabytes (more all the time) on a single small plastic device.

- ***Tape Backup Devices***
  - An older form of removable storage is the tape backup.
  - Tape backup devices can be installed internally or externally and use either a digital or analog magnetic tape medium instead of disks for storage.
  - They hold much more data than any other medium but are also much slower.
  - Tape backup devices were once the most common choice in larger enterprises and networks because they were able to hold the most data and were the most reliable over the long term.

**TABLE 2.4** Sequential tape formats

| Format Name | Representative Capacity |
|---|---|
| Quarter-inch Cartridge (QIC) | 200KB to 525MB |
| Digital Linear Tape (DLT) | Up to 160GB |
| Eight Millimeter (Exabyte) | Up to 800GB |
| Digital Audio Tape (DAT)/Digital Data Storage (DDS) | Up to 300GB |
| Linear Tape-Open (LTO) | Up to 1.5TB (12.8TB planned) |

***Flash Memory***

- Flash memory is a non-volatile memory chip used for storage and for transfering data between a personal computer (PC) and digital devices. It has the ability to be electronically reprogrammed and erased. It is often found in USB flash drives, MP3 players, digital cameras and solid-state drives.
- Flash memory have offered low- to mid-capacity storage for devices.
- The name comes from the concept of easily being able to use electricity to instantly alter the contents of the memory.
- The original flash memory is still used in devices that require a nonvolatile means of storing critical data and code often used in booting the device, such as routers and switches.

***SD and Other Memory Cards***

- An SD Card (**S***ecure* **D***igital Card*) is an ultra small flash memory card designed to provide high-capacity memory in a small size.
- SD cards are used in many small portable devices such as digital video camcorders, digital cameras, handheld computers, audio players and mobile phones.
- A MultiMediaCard (MMC) is a tiny memory card that uses flash memory to make storage portable among various devices, such as car navigation systems, cellular phones, eBooks, PDAs, smartphones, and digital cameras, music players, and video camcorders, and personal computers.
- Both of these cards measure 32mm by 24mm, and slots that receive them are often marked for both.
- The SD card is slightly thicker than the MMC and has a write-protect notch (and often a switch to open and close the notch), unlike MMC.
- Other smaller devices include miniSD, which is slightly thinner than SD and measures 21.5mm by 20mm.
- The other, microSD, is thinner yet and only 15mm by 11mm. Both of these reduced formats have adapters allowing them to be used in standard SD slots.
- Many other devices exist for allowing access to memory cards.

**TABLE 2.5** Additional memory card formats

| Format | Dimensions | Details | Year Introduced |
|---|---|---|---|
| Subscriber Identity Module (SIM) | 25mm by 15mm | Used to store a subscriber's key on a telephone | 1991 |
| CompactFlash (CF) | 36mm by 43mm | Type I and Type II variants; Type II used by IBM for Microdrive | 1994 |
| SmartMedia (SM) | 45mm by 37mm | From Toshiba; intended to replace floppies | 1995 |
| Memory Stick (MS) | 50mm by 21.5mm | From Sony; standard, Pro, Duo, and Micro formats available | 1998 |
| xD-Picture Card | 20mm by 25mm | Used primarily in digital cameras | 2002 |

- USB Flash DrivesA USB flash drive -- also known as a USB stick, USB thumb drive or pen drive -- is a plug-and-play portable storage device that uses flash memory and is lightweight enough to attach to a keychain.
- A USB flash drive can be used in place of a compact disc.
- USB flash drives allows to store large quantities of information in a very small form factor.
- The larger their storage space, the faster they tend to operate.

**Externally Attached Drives**

- Before USB, an external drive used a SCSI or adapter and interface/cable combination or the standard RS-232 serial or parallel printer port often built in to the computer.
- Since USB, there has been a sense that there was no other way to attach drives externally.
- ***USB-Attached External Disk Drives***
  - USB attached devices are recognized as drives by the operating system upon connection, and if the external drive is to be used as a backup location, you simply install any additional software you want to use.
  - Windows Vista and Windows 7 have built-in backup utilities that are forms of drive imaging software and that work well with external drives.
  - Many external optical and hard disk drives today are manufactured into their own chassis and have detachable connectivity for USB
  - If the power requirement for the unit is high enough, there might also be a separate power connection for the device.
  - Otherwise, the USB or FireWire interface on the host provides all the power for the drive.
- ***eSATA-Attached External Disk Drives***
  - An external drive-attachment technology based on SATA, called eSATA or "external" SATA, promises to offer external attachment with no compromises.
  - eSATA doesn't provide power the way USB and FireWire do.
  - External power has to be supplied to the drive outside of the 2m or shorter data cable.
- ***Network Attached Storage***

- Network-attached storage (NAS) is a type of dedicated file storage device that provides local-area network (LAN) nodes with shared storage through a standard Ethernet connection.
- NAS devices are flexible and scale-out, meaning that as you need additional storage, you can add on to what you have.
- A NAS is like having a private cloud in an organisation.

***Hot swappable devices***

- Many of the removable storage devices are hot swappable or warm swappable.
- This means that we can insert and remove the device with the system powered on.
- Most USB-attached devices without a file system fall into this category.
- Non-hot-swappable devices, in contrast, either cannot have the system's power applied when they are inserted or removed or they have some sort of additional conditions for their insertion or removal.This can also be referred to as cold swappable.
- The system power must be off before we can insert or remove cold-swappable devices. An example of a cold-swappable device is anything connected to the PS/2-style mini-DIN connector, such as a keyboard or mouse. Insertion with the power on generally results in lack of recognition of the device.
- Warm-swappable devices include USB flash drives and external drives that have a file system. Warm-swappable devices include USB flash drives and external drives that have a file system.

**Installing, Removing and Configuring Storage Devices**

- The removal and installation of storage devices, such as hard drives, floppy drives, CD/DVD drives, and tape drives, is simply straightforward.

**Removing an Internal Storage Device**

1. With the power source removed from the system, ground yourself and the computer to the same source of ground.
2. Remove the cover from the system, exposing the internal components.
3. Unplug all connections from the storage device you wish to remove. These include data and power connections as well as any others, such as audio connections to the sound card or motherboard. The beveled Molex power connectors fit very tightly, so don't worry about how hard removing them seems to be. There is no clip to release. Do, however, be sure to grip the connector, not the wires.
4. Gather the appropriate antistatic packaging to plan ahead for all static-sensitive components that will be reused in the future, including any adapter cards that the storage device plugs into.
5. Remove any obstructions that might hinder device removal, such as component cables attached to adapter cards or adapter cards themselves, storing them to be reused in antistatic packaging.
6. Remove related adapter cards from the motherboard, storing them to be reused in antistatic packaging.
7. Remove the machine screws holding the storage device to the chassis. These could be on the side of the device or on the bottom.
8. Some devices, especially hard drives because they have no front access from the case, pull out of the chassis toward the rear of the case, while others, such as CD/DVD and floppy drives, generally pull out from the front. A gentle nudge from the rear of the device starts it on its way out the front. Go ahead and remove the device from the case. If you discover other components that obstruct the storage device's removal, repeat step 5.

### Installing an Internal Storage Device

1. With the power source removed from the system, ground yourself and the computer to the same source of ground.
2. Remove the cover from the system, exposing the internal components.
3. Locate an available bay for your component, paying attention to your device's need for front access. If you do not see one, look around; some cases provide fastening points near the power supply or other open areas of the case. If you still do not see one, investigate the possibility of sacrificing a rarely or never used device to make room.
4. Remove any obstructions that might hinder device installation, such as component cables attached to adapter cards or adapter cards themselves, storing them to be reused in antistatic packaging.
5. Find the proper screws for the storage device and set any jumpers on the drive while it is in-hand. Then insert the device into the bay. Keep in mind that some insert from the rear of the bay and some from the front.
6. Line up the screw holes in the device with the holes in the bay. Note that many devices rarely insert as far as they can before lining up with the chassis's holes. So don't be surprised when pushing the device all the way into the bay results in misalignment. Other devices that require front access stop themselves flush with the front of the case, and still others require you to secure them while holding them flush.
7. Use at least two screws on one side of the device. This keeps the device from sliding in the bay as well as from rotating, which happens when you use only one screw or one screw on each side. If the opposite side is accessible, go ahead and put at least one screw in the other side. Most devices allow for as many as four screws per side, but eight screws are not necessary in the vast majority of situations.