Computer Storage Devices

Storage devices are used to store and retrieve digital data. They are classified into Primary Storage, Secondary Storage, and Tertiary Storage.

1. Primary Storage (Volatile Memory)

- Also known as main memory.
- Directly accessible by the CPU.
- Loses data when power is turned off.

a) Random Access Memory (RAM)

Stores data temporarily for quick access by the CPU.

Two types:

1. **Dynamic RAM (DRAM)** – Needs continuous refreshing; used in most computers.
2. **Static RAM (SRAM)** – Faster and expensive; used in CPU cache memory.

b) Cache Memory

- High-speed memory located close to the CPU.
- Stores frequently used data for quick retrieval.

Levels:

L1 Cache (Fastest, Smallest)

L2 Cache (Larger, Slower than L1)

L3 Cache (Largest, Slowest among caches)

c) Registers

- Smallest and fastest storage in the CPU.
- Stores data currently being processed.

2. Secondary Storage (Non-Volatile Memory)

- Permanent storage that retains data even after power loss.
- Used for long-term data storage.

a) Magnetic Storage Devices

1. Hard Disk Drive (HDD)

- ➤ Uses spinning magnetic platters.
- ➤ Stores large amounts of data (500GB – 16TB).
- ➤ Slower than SSDs but more affordable.
- ➤ **Components**: Platters, Read/Write Head, Actuator Arm, Spindle.

2. Magnetic Tape

- ➤ Used in large-scale backup systems.
- ➤ Slow access speed but cost-effective.

b) Solid-State Storage Devices (Flash Memory)

1. Solid-State Drive (SSD)

- ➤ Uses NAND flash memory.
- ➤ No moving parts, making it faster and more durable than HDDs.
- ➤ Types: SATA SSD, NVMe SSD, PCIe SSD.

2. USB Flash Drive (Pen Drive)

- ➤ Portable storage device.
- ➤ Uses flash memory (2GB – 2TB).

3. Memory Cards (SD Card, microSD, CompactFlash)

- ➤ Used in smartphones, cameras, and tablets.
- ➤ Available in SD, SDHC, and SDXC formats.

c) Optical Storage Devices

1. Compact Disc (CD)
   - ➤ Stores up to 700MB of data.
   - ➤ Used for music, software, and small file storage.
2. Digital Versatile Disc (DVD)
   - ➤ Stores 4.7GB (single-layer) or 8.5GB (dual-layer).
   - ➤ Used for movies, software installation, and gaming.
3. Blu-ray Disc (BD)
   - ➤ Stores 25GB (single-layer) or 50GB (dual-layer).
   - ➤ Used for high-definition video storage.

d) Cloud Storage

- ✔ Stores data on remote servers accessed via the internet.
- ✔ **Examples**: Google Drive, Dropbox, OneDrive, iCloud.
- ✔ **Advantages**: Accessible from anywhere, automatic backup.
- ✔ **Disadvantages**: Requires internet connection, data security concerns.

3. Tertiary Storage (Archival Storage)

- ✔ Used for long-term data retention.
- ✔ Includes magnetic tapes, optical discs, and cloud-based archival storage.
- ✔ Slow retrieval speed.

Comparison of Storage Devices

Storage Type	Speed	Capacity	Durability	Cost per GB	Examples
RAM	Fastest	4GB – 64GB	Low (Volatile)	High	DRAM, SRAM
HDD	Moderate	500GB – 16TB	Moderate	Low	Hard Disks
SSD	Fast	256GB – 8TB	High	High	SATA SSD, NVMe SSD
USB Drive	Moderate	4GB – 2TB	High	Moderate	Flash Drives
SD Card	Moderate	2GB – 1TB	High	Moderate	microSD, SDXC
Optical Disc	Slow	700MB – 50GB	Low	Low	CD, DVD, Blu-ray
Cloud Storage	Depends on Internet	Unlimited	High	Subscription-based	Google Drive, iCloud

Key Differences Between Storage Types

Feature	HDD	SSD	USB Drive	Cloud Storage
Speed	Slow	Fast	Moderate	Depends on internet
Durability	Mechanical parts (can fail)	No moving parts (durable)	Durable	Highly reliable
Capacity	500GB – 16TB	256GB – 8TB	4GB – 2TB	Unlimited
Cost	Cheaper	Expensive	Moderate	Subscription-based
Portability	Internal	Internal	Highly portable	Accessible anywhere