

12-3 Auxiliary Memory

The most common auxiliary memory devices used in computer systems are magnetic disks and tapes. Other components used, but not as frequently, are magnetic drums, magnetic bubble memory, and optical disks. To understand fully the physical mechanism of auxiliary memory devices one must have a knowledge of magnetics, electronics, and electromechanical systems.

Although the physical properties of these storage devices can be quite complex, their logical properties can be characterized and compared by a few parameters. The important characteristics of any device are its access mode, access time, transfer rate, capacity, and cost.

The average time required to reach a storage location in memory and obtain its contents is called the access time. In electromechanical devices with moving parts such as disks and tapes, the access time consists of a *seek* time required to position the read-write head to a location and a *transfer* time required to transfer data to or from the device. Because the seek time is usually much longer than the transfer time, auxiliary storage is organized in records or blocks. A record is a specified number of characters or words. Reading or writing is always done on entire records. The transfer rate is the number of characters or words that the device can transfer per second, after it has been positioned at the beginning of the record.

Magnetic drums and disks are quite similar in operation. Both consist of high-speed rotating surfaces coated with a magnetic recording medium. The rotating surface of the drum is a cylinder and that of the disk, a round flat plate. The recording surface rotates at uniform speed and is not started or stopped during access operations. Bits are recorded as magnetic spots on the surface as it passes a stationary mechanism called a *write head*. Stored bits are detected by a change in magnetic field produced by a recorded spot on the surface as it passes through a *read head*. The amount of surface available for recording in a disk is greater than in a drum of equal physical size. Therefore, more information can be stored on a disk than on a drum of comparable size. For this reason, disks have replaced drums in more recent computers.

Magnetic Disks

A magnetic disk is a circular plate constructed of metal or plastic coated with magnetized material. Often both sides of the disk are used and several disks may be stacked on one spindle with read/write heads available on each surface. All disks rotate together at high speed and are not stopped or started for access purposes. Bits are stored in the magnetized surface in spots along concentric circles called tracks. The tracks are commonly divided into sections called sectors. In most systems, the minimum quantity of information which can be transferred is a sector. The subdivision of one disk surface into tracks and sectors is shown in Fig. 12-5.

Some units use a single read/write head for each disk surface. In this type of unit, the track address bits are used by a mechanical assembly to move the head into the specified track position before reading or writing. In other disk systems, separate read/write heads are provided for each track in each surface. The address bits can then select a particular track electronically through a decoder circuit. This type of unit is more expensive and is found only in very large computer systems.

Permanent timing tracks are used in disks to synchronize the bits and recognize the sectors. A disk system is addressed by address bits that specify the

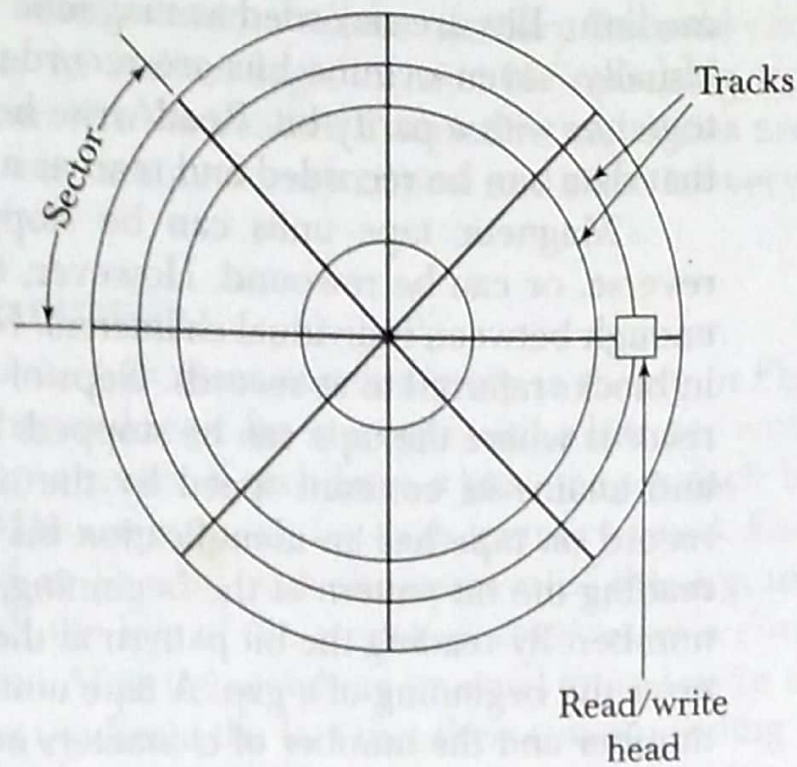


Figure 12-5 Magnetic disk.

disk number, the disk surface, the sector number and the track within the sector. After the read/write heads are positioned in the specified track, the system has to wait until the rotating disk reaches the specified sector under the read/write head. Information transfer is very fast once the beginning of a sector has been reached. Disks may have multiple heads and simultaneous transfer of bits from several tracks at the same time.

A track in a given sector near the circumference is longer than a track near the center of the disk. If bits are recorded with equal density, some tracks will contain more recorded bits than others. To make all the records in a sector of equal length, some disks use a variable recording density with higher density on tracks near the center than on tracks near the circumference. This equalizes the number of bits on all tracks of a given sector.

Disks that are permanently attached to the unit assembly and cannot be removed by the occasional user are called *hard disks*. A disk drive with removable disks is called a *floppy disk*. The disks used with a floppy disk drive are small removable disks made of plastic coated with magnetic recording material. There are two sizes commonly used, with diameters of 5.25 and 3.5 inches. The 3.5-inch disks are smaller and can store more data than can the 5.25-inch disks. Floppy disks are extensively used in personal computers as a medium for distributing software to computer users.