Secondary Storage

Magnetic Hard Disks

- one or more disk platters mounted on a common spindle.
- A thin magnetic film is deposited on each platter, usually on both sides.
- The assembly is placed in a drive that causes it to rotate at a constant speed.
- The magnetized surfaces move in close proximity to read/write heads
- Data are stored on concentric tracks
- Read/write heads move radially to access different tracks

Read Write Head

- Each read/write head consists of a magnetic yoke and a magnetizing coil.
- Digital information can be stored on the magnetic film by applying current pulses of suitable polarity to the magnetizing coil.
- This causes the magnetization of the film in the area immediately underneath the head to switch to a direction parallel to the applied field.
- The same head can be used for reading the stored information.

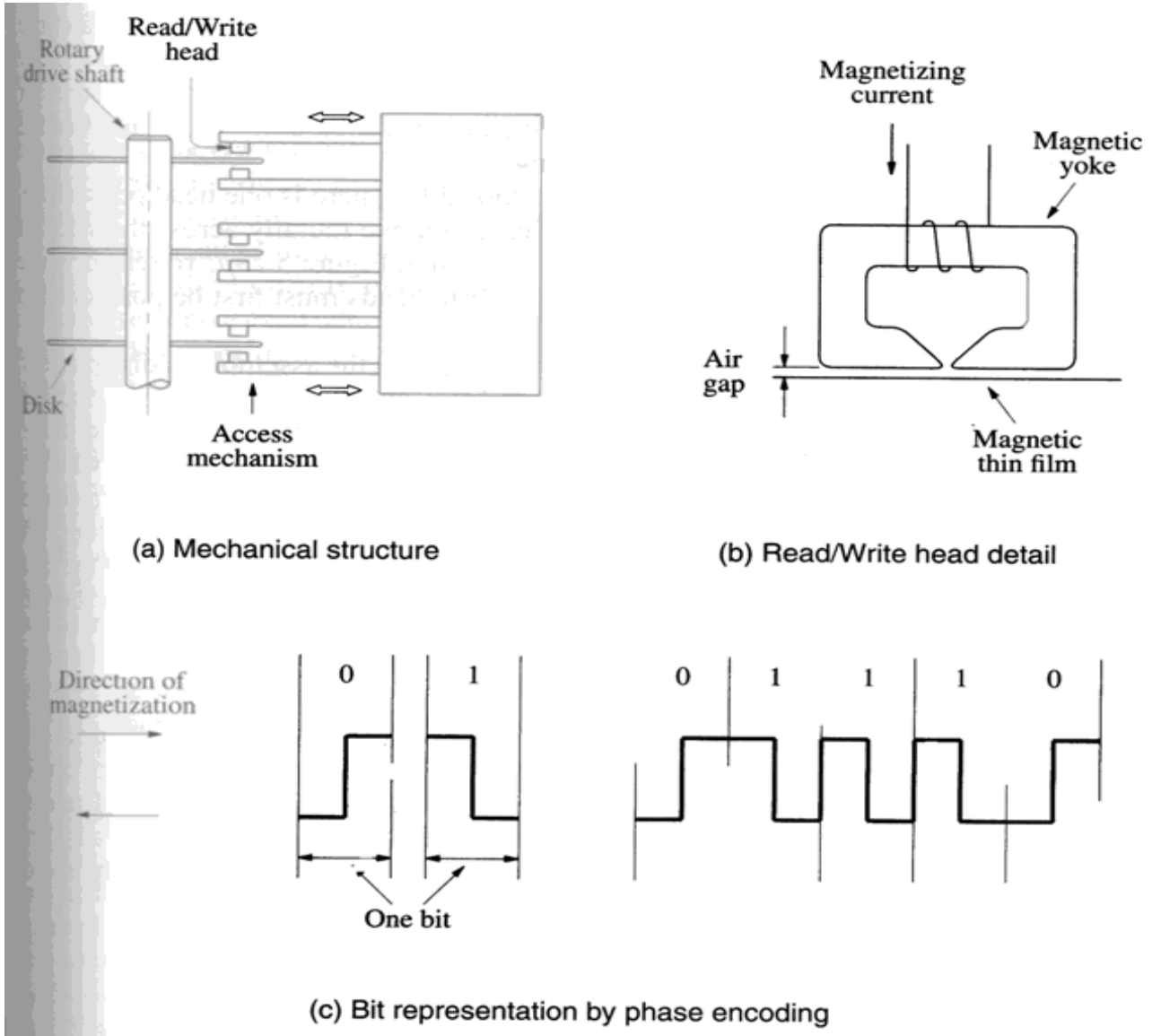
Read Write Head

- Changes in the magnetic field in the vicinity of the head caused by the movement of the film relative to the yoke induce a voltage in the coil, which now serves as a sense coil.
- The polarity of this voltage is monitored by the control circuitry to determine the state of magnetization of the film.
- if the binary states 0 and 1 are represented by two opposite states of magnetization, a voltage is induced in the head only at 0-to-1 and at 1-to-0 transitions in the bit stream.
- A long string of 0s or 1s causes an induced voltage only at the beginning and end of the string.

Phase encoding
or Manchester encoding

- changes in magnetization occur for each data bit
- Clocking information is provided by the change in magnetization at the midpoint of each bit period.
- The drawback of Manchester encoding is its poor bit-storage density

Magnetic Hard Disks



- disks and the read/write heads are placed in a sealed,air-filtered enclosure.
- known as *Winchester technology*

- The disk system consists of three key parts.
- the assembly of disk platters- usually referred to as the *disk*.
- The Electromechanical mechanism that spins the disk and moves the read/write heads -called the *disk drive*
- the *disk controller*, which is the electronic circuitry that controls the operation of the system - may be implemented as a separate module, or it may be incorporated into the enclosure that contains the entire disk system

Organization of Data on a Disk

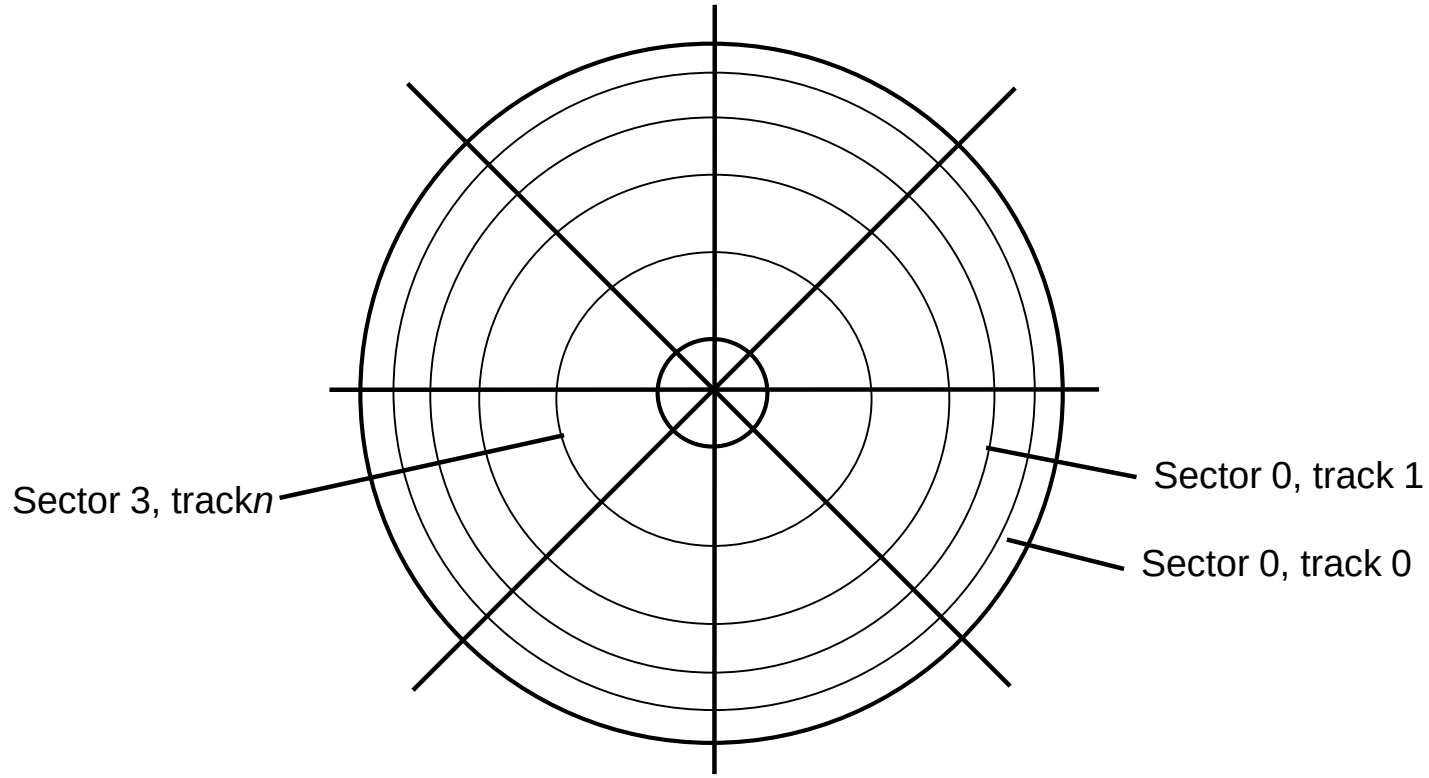


Figure 5.30. Organization of one surface of a disk.

Organization of Data on a Disk

- Each surface is divided into concentric *tracks*, and each track is divided into *sectors*.
- The set of corresponding tracks on all surfaces of a stack of disks forms a logical *cylinder*
- All tracks of a cylinder can be accessed without moving the read/write heads.
- Data are accessed by specifying the surface number, the track number, and the sector number.
- Read and Write operations always start at sector boundaries.

Access Data on a Disk

- Sector header-contains identification (addressing) information used to find the desired sector on the selected track
- Following the data, there is an error-correction code (ECC)-used to detect and correct errors that may have occurred in writing or reading the data bytes
- small *inter-sector gap* that enables the disk control circuitry to distinguish easily between two consecutive sectors.

- Formatting process writes markers that divide the disk into tracks and sectors. During this process, the disk controller may discover some sectors or even whole tracks that are defective. The disk controller keeps a record of such defects and excludes them from use.
- Difference between inner tracks and outer tracks-each track has the same number of sectors, which means that all tracks have the same storage capacity. the stored information is packed more densely on inner tracks than on outer tracks

- Access time
  - seek time -time required to move the read/write head to the proper track
  - rotational delay (latency)-time taken to reach the addressed sector after the read/write head is positioned over the correct track.
- Data buffer/cache -disk drive is connected to the rest of a computer system using some standard interconnection scheme, usually capable of transferring data at much higher rates than the rate at which data can be read from disk tracks.

- Include a *data buffer* in the disk unit.
- The buffer is a semiconductor memory, capable of storing a few megabytes of data. The requested data are transferred between the disk tracks and the buffer at a rate dependent on the rotational speed of the disk.
- Transfers between the data buffer and the main memory can then take place at the maximum rate allowed by the interconnect between them.

Disk Controller

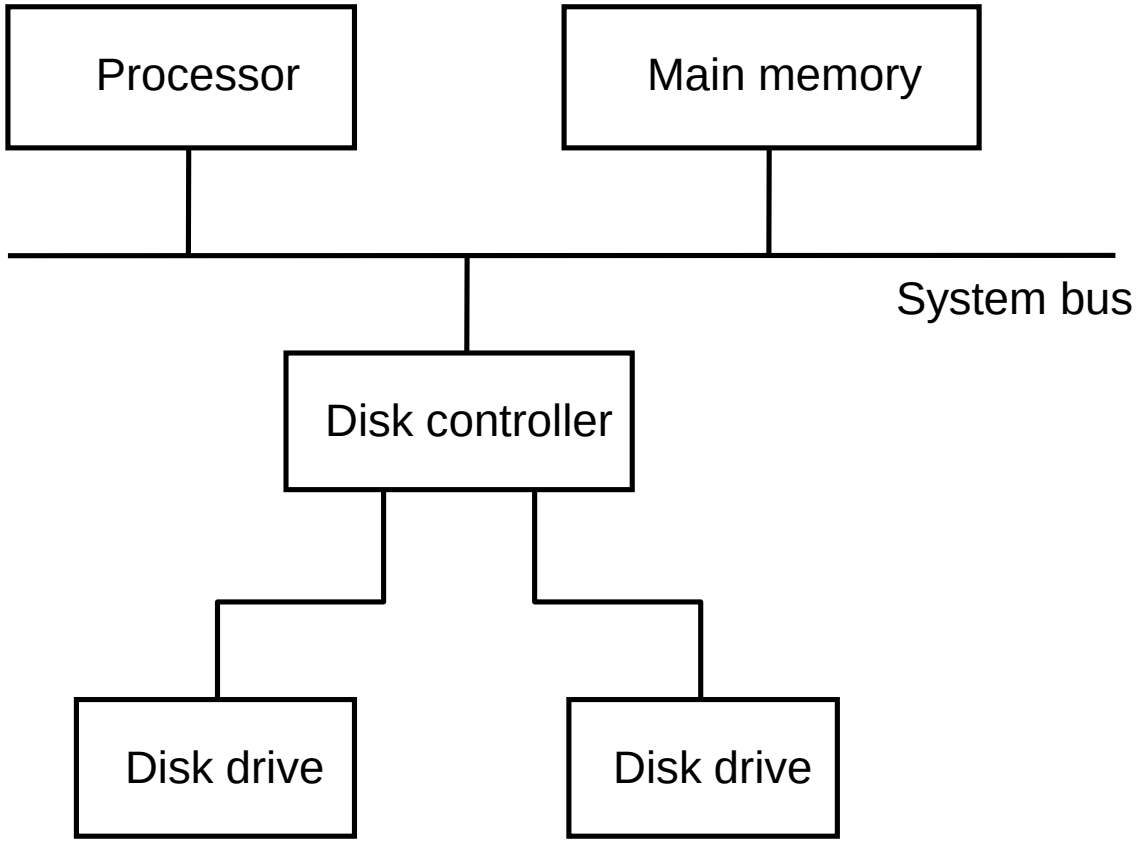


Figure 5.31. Disks connected to the system bus.

Disk Controller

- Operation of a disk drive is controlled by a *disk controller* circuit, which also provides an interface between the disk drive and the rest of the computer system.
- One disk controller may be used to control more than one drive.

Disc Controller Functions

- On the disk drive side, the controller's major functions are:
- Seek-Causes the disk drive to move the read/write head from its current position to the desired track.
- Read-Initiates a Read operation, starting at the address specified in the disk address register.
- Write-Transfers data to the disk
- Error checking-Computes the error correcting code (ECC) value for the data read from a given sector and compares it with the corresponding ECC value read from the disk

Reference

Carl Hamacher,Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, “Computer Organization and Embedded Systems”, Sixth Edition, McGraw Hill