

# Hard Disk Drives

- **A sealed unit that a PC uses for nonvolatile data storage.**
- **Permanent storage - not like RAM, which is volatile**

# Changes in hard disk drives

- **Maximum storage capacities have increased from 10MB 5 1/4-inch full-height drives from 1982 to 20GB or more for small 3 1/2-inch half-height drives**
- **Data transfer rates from the media have increased from 85 to 102KB/sec in 1983 to 30MB/sec or more for some of the fastest drives today**

- **Average seek times have decreased from more than 85 ms (milliseconds), access time) for the 10 MB in 1983 to fewer than 8ms for some today**
- **Cost keeps decreasing**
- **1982, 10MB drive was more than \$1500.00 (\$150 per mb)**
- **3 cents per megabyte**

# Hard Disk Drive Operation

- **Track**
- **Sector**
- **Cylinder**
- **Rack**
- **Platters**

# Track

- **One of many concentric circles that holds data on a disk surface**
- **Consists of a single line of magnetic flux changes**
- **Is divided into some number of 512-byte pieces (sectors)**
- **Example (1 time around circle groove on record)**

# Sector

- **A section of one track defined with identification markings and an identification number**
- **Arc in a pie holding 512 bytes of data**
- **Important value is the number of sectors per track**
- **BIOS limitations set the number of sectors/track at 63**

# Cylinder

- **The set of tracks on a disk that are on each side of all the disk platters in a stack and are the same distance from the center of the disk**
- **Data is stored in circular paths on the surface of each head**
- **Each path is called a track**

- **There are hundreds of tracks on the surface of each head**
- **A set of tracks (all the same diameter) through each head is called a cylinder**
- **The number of cylinders is a measurement of drive geometry**
- **BIOS limitations set the maximum number of cylinders at 1024.**

# Platters

- **A disk contained in a hard disk drive**
- **Most hard drives have 2 - 4 platters, each with data recorded on both sides.**
- **Head reads both sides**
- **Number of platters determined by manufacturer. Western Digital has 3**

- **The number of heads equals the total number of sides of all the platters used to store data.**
- **If a hard drive has four platters it could have up to eight heads.**
- **The maximum number of heads is limited by BIOS to 16**

- **Hard drives that control the actuator arms using voice coil motors reserve a head or two for accuracy of the arm position**
- **Not uncommon for a hard drive to have an even or odd number of heads**

# Sector translation

- **This allows some hard drives to have more than two heads per platter**
- **It is possible for a drive to have up to 12 heads but only one platter**
- **Maximum number of heads is 16**

# Review

- **Physical Construction**
  - **Consists of spinning disks with heads that move over the disks and store data in tracks and sectors**
- **Heads read & write data in concentric rings called tracks**
- **Tracks are divided into segments called sectors, which store 512 bytes**

- **Hard disk drives usually have multiple platters that are stacked on top of each other & spin in unison**
- **Data is stored on both sides of the platter**
- **Identically positioned tracks on each side of every platter together make up a cylinder**
- **A hard disk normally has one head per platter side, with all heads mounted on a common carrier device or rack**

# Hard disk spin speed

- **Originally, 3600 RPMs was the top speed**
- **Now hard disks can spin up to 10,000 RPMs**

- **Heads in most hard drives do not touch the platters during normal operation**
- **When the heads are powered off, they land on the platters as they stop spinning**
- **While the drive is running, a very thin cushion of air keeps each head suspended a short distance above or below the platter**

# Head Crash

- **When the head comes in contact with a moving platter**
- **Result**
  - **Few bytes of lost data OR completely ruined drive**

# Sectors, more

- A disk track is too large to manage data effectively as a single storage unit
- Many disk tracks can store 50,000 or more bytes of data - efficient for storing small files
- For this reason, tracks are divided into several numbered divisions known as sectors

# Sectors, cont

- **Represent slices of the track**
- **Created by the standard formatting procedure on a PC system and have the capacity of 512 bytes**
- **Numbered starting with 1, unlike the heads or cylinders that are numbered starting with 0**

- **When the disk is formatted, the formatting program creates ID areas on the disk that the disk controller uses for sector numbering and for identifying the start & end of each sector**

- **Think of a sector as a page in a book**
  - **Each page contains text, but the entire page is not filled with text**
  - **Each page has margins**
  - **Imagine the text is the data that is stored in the sector**
  - **If it were full, the text would cover the entire page, no margins**
  - **Margins allow for identification data of the sector that is placed there during low-level formatting**

# Disk Formatting

- **Two formatting procedures required before you can write user data to a disk**
  - **Physical or low-level formatting**
  - **Logical or high-level formatting**

# Steps for storing data

- **1. Low-Level Formatting -  
Manufacturer**
- **2. Partitioning**
- **3. High-Level Formatting**

# Low-Level Formatting

- **This is the basic setup of the disk layout**
- **Dividing the disks tracks into a specific amount of sectors**
- **Creating header & trailer information**
- **Lays basic ground work of the formatting**

# Partitioning

- **Creating a partition on a hard drive enables it to support separate file systems, each in its own partition**
- **Each file system can then use its own method to allocate file space in logical units called clusters or allocation units**

# Common file systems used by OS today

- **FAT 16 (File Allocation table 16-bit)**
- **FAT 32 (File Allocation Table 32-bit)**
- **NTFS (NT File System)**
  - **SEE Chapter 19 of Upgrade & Repair)**

# High-Level Formatting

- **OS writes the structures necessary for managing files & data on the disk**
- **Creating of the “table of contents”**
- **Low-level formatting is the physical formatting of the drive**