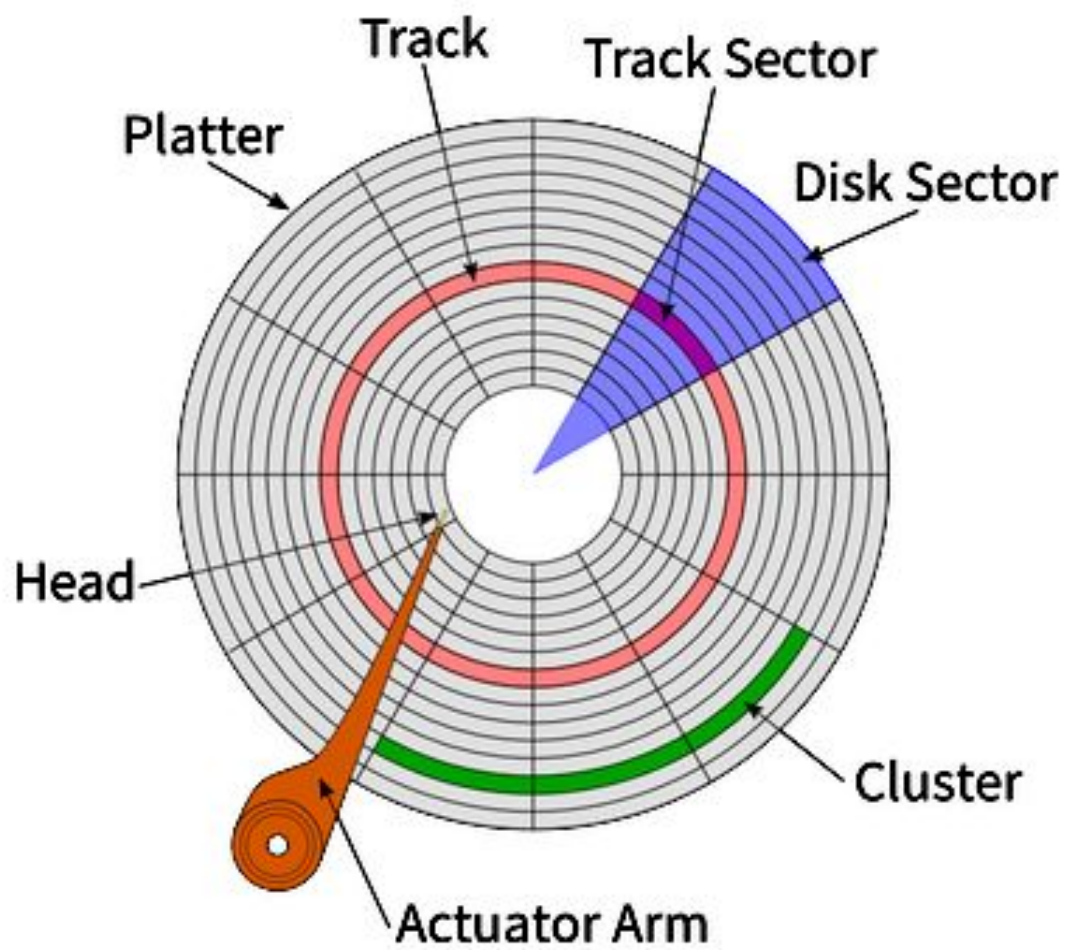


# Topic List

- Windows file systems
- UNIX /Linux file systems
- MAC file systems
- Mobile file systems
- Network file system



# Calculating Disk Capacity

Hard disk capacity can be determined based on the elements of the disk, including the number of tracks, sectors and surfaces on which various amounts of data can be accessed or written.

Capacity = (bytes/sector) \* (sectors/track) \* total tracks

# Calculating Disk Capacity

Example: To calculate the disk capacity of the drive, considering the following factors:

Bytes per sector **256**

Total tracks: **21,576**

Total cylinders: **7,192**

Sectors/track (avg): **213**

Number of heads: **3**

# Calculating Disk Capacity

To obtain the tracks/surface, the total tracks can be divided by the number of heads, that is, **(21,576/3)**.

*Thus, the formula can be written as:*

Capacity = (bytes/sector) \* (sectors/track) \* total tracks

Capacity = **256** bytes/sector \* **213** sectors/track \* **21,576** total tracks  
= **1176496128** or **1.1GB**

# Windows File System

Different ***Operating Systems*** use different file systems, while some OS support multiple file system. Few file systems which are commonly used by Microsoft OS include:

- FAT12
- FAT16
- VFAT
- FAT32
- NTFS

# FAT12

- **FAT (File Allocation Table)** file system was developed by the **DOS** operating systems.
- The first version of **FAT used a 12-digit binary number(12 bits)** for **cluster information**, hence it was called as **FAT12**.
- It was **useful for the smaller hard disks** that came with the original **IBM PC (less than 16MB in size)** and were also **used to format floppy diskettes**.

# FAT16

- **FAT16** was a standard file system for formatting hard disks for a long time, *it was developed for disks greater larger than 16MB.*
- Uses **16-bit allocation table entries** and is *supported by all Microsoft operating systems, from MS-DOS to Windows XP* along with some non-Microsoft operating systems, such as **OS/2 and Linux**. Thus, it was the most *universally compatible file system.*
- Some **drawbacks** of FAT16 included *its inability to scale well to large disks since the cluster size increases as disk partition increases*, lot of space was wasted when a large disk greater than 2GB was formatted with FAT16.
- It *doesn't support file-level security*, that is, individual level permissions to files and directories) and also *does not support file-level compression*, as the entire drive needs to be compressed.



# FAT16

## FAT-16 Directory Entry

*Each directory entry is 32 bytes:*

- File Name **(8 bytes)**
- Extension **(3 bytes)**
- **Attributes (1 byte)**
- Reserved **(10 bytes)**
- Time **(2 bytes)**
- Date **(2 bytes)**
- Block number of first file block **(2 bytes)**
- File size in bytes **(4 bytes)**

### ***Attributes (one-bit each):***

**R:** Read Only

**A:** Archive (set when file modified, cleared when backed up)

**S:** System File (file cannot be deleted by the del command)

**H:** Hidden File (file is not listed with dir command)

**D:** Directory

**V:** Volume Label

# VFAT

- **Virtual FAT** or VFAT, is a file system driver introduced in Windows for Workgroups 3.11 and was supported by Windows 95.
- It works in protected mode and ***allows usage of long filenames with FAT16.***
- ***VFAT is a program extension and not a file system,*** which handles filenames over the 8 character limitations imposed by the original FAT16.

# FAT32

- ***FAT32 uses a 32-bit allocation table*** and was first supported by the OSR 2 version of Windows 95 (95b).

## Advantages of FAT32 over FAT16 included:

- ***Efficient use of space with larger hard disks*** through small cluster sizes
- ***Support for larger partitions, up to 2TB*** in size, theoretically (Practically supports up to 32GB)
- ***Better reliability***, as includes backup copy of information in the boot record.

## Disadvantages of FAT32 was that it is incompatible with several

- Versions of Windows such as MS-DOS, Windows 3.x, Windows 95a, Windows NT, and some non-Microsoft operating systems (although FAT32 drivers were available from third-party vendors for Windows 95, NT, and even non-Microsoft operating systems such as Linux).
- Additionally, the ***overhead used by FAT32 can also slow performance slightly.***

# NTFS

- **NTFS (New Technology File System)** is the most secure file system for computers running **Microsoft Windows operating systems**.
- **NTFS was released in 1993** as a **replacement to FAT file system** on Windows NT OS, followed by successive releases in Windows 2000, 2003 Server, XP and Vista.
- **It was more robust and secure** as compared to other Microsoft file systems. **NTFS handles partitions, where partitions are logical sections of a hard disk which operate as a separate drive**. Example: A hard disk could be partitioned as C: , D: or E: drive on the computer.
- **NTFS supports very large partition sizes** (up to 16EB theoretically) and permits creation of volumes that can span two or more partitions.
- **It is more reliable since it supports hot fixing feature**, wherein the OS detects a bad sector on the disk and relocates the data from that sector to a good sector, and marks the bad sector so that the system does not use it. It happens in the background which does not require any user intervention.

# Metadata and the Master File Table (MFT)

- *Metadata is the information about a specific set of data*, which contains information such as author of the file, its size, and other technical information hidden from the common user, that is, it is data about data.
- *It describes a file, its format, its creation time*, and other details.
- NTFS stores additional files which are hidden in the system and contain information about *users, files and other details*.
- Whenever a disk is formatted to use NTFS, the files are created with their locations being stored in these files, known as *Master File Table (MFT) to keep track of each file on the volume*.
- FAT file system keeps track of files using a *File Allocation Table*,
- NTFS performs similar complex functions using a *Master File Table*.

# NTFS Attributes

- ***A record stored in the MFT works with NTFS attributes***, every file and directory are viewed as a set of file attributes containing information such as name, data, and security information by NTFS.
- The data which defines a file, and is used by the OS and other software's to decide how a file is accessed and used is called as attribute.
- Every attribute has a code and might contain information on attribute's name and description in MFT.

## Two different kinds of attributes can be used in NTFS:

- **Resident attributes:** *Can fit in an MFT record.* The name of the file and its timestamp are always included as resident attributes.
- **Non-resident attributes:** *Are allocated on the disk to one or more clusters elsewhere.* These attributes are useful when the information about any file is too large to fit in the MFT.

# NTFS Encrypting File Systems (EFS)

- **Encryption involves** the *process of file encoding to **make it unreadable for any unauthorized person** to open, copy, view, or rename the data, file, or folder*
- Encryption can be performed **on a disk as well as on a single file**.
- Disk or file encryption can be **built onto an OS or file system**.
- **EFS is integrated with the OS**, where the **encryption and decryption processes are invisible to the user**.