File System in Win

In a computer, a <u>file system (sometimes written filesystem) FS is the way in which files are named and where they are placed logically for storage and retrieval, FS allows users and programs to organize and sorts files on a computer, often through the use of directories (or "folders")</u>. Access to data stored on disks is a central feature of all operating systems. Computers store data on disks using files, which are structured in specific ways in order to allow for faster access, higher reliability, and to make better use out of the drive's available space. <u>The specific way in which files are stored on a disk is called a *file system*, it enables files to have names and attributes. It also allows them to be stored in a hierarchy of directories or folders arranged in a directory tree</u>.

We can summarize the basic features of File System (FS) as:

➢ A <u>**file system** is an abstraction to store, retrieve and update a set of files</u>. The term also identifies the data structures specified by some of those abstractions, which are designed to organize multiple files as a single stream of bytes. <u>responsible for organizing files and directories, and keeping track of which areas of the media belong to which file and which are not being used.</u>

➢ The file system manages access to the data of the files, and manages the available space of the device(s) which contain it.

➢ **File system** is a system for organizing data in an efficient manner, directories and files, generally in terms of how it is implemented in the disk operating system, collection of files and directories stored on a given drive (floppy drive, hard drive, RAM drive, etc.).

➢ File systems allocate space, multiple physical units on the device.

➢ A file system can be thought of as an index or database containing the physical location of every piece of data on a hard drive. A file system is setup on a drive during a format.

➢ <u>FS is the method for storing and retrieving files on a disk. It is system software that takes commands from the operating system to read and write the disk clusters (groups of sectors).</u>

➢ FS is a data processing application that manages individual files. It opens, closes, reads and writes the file as a single entity.

➢ As such, the file system is highly operating-system-dependent. In most cases you don't generally have a "choice" between different file system types. However, in

some operating systems you do, and there can be a performance impact from the choice. Windows NT and 2000 typically give you your choice of file system; Windows 2000 supports FAT16, FAT32 and NTFS.

➢ Some file systems store files in packages as small as 512 bytes, while others store files in larger chunks called *allocation units* **or** *clusters*. Some are very simple file systems with few features and little overhead (such as the FAT file system used in DOS and Windows 9x), and others have many features but comparatively higher overhead (NTFS used in NT).

There are numerous file systems in use; for example, FAT32 and NTFS are Windows file systems, and HFS is used on Macs. Linux uses ext2, ext3 and FAT32. Unix systems use UFS, ext2, ext3 and ZFS.

For most users, the file system is the most visible aspect of an operating system. It provides the mechanism for on-line storage of and access to both data and programs of the operating system and all the users of the computer system. For example, DOS, Windows, and Macintosh all have file systems in which files are placed somewhere in a hierarchical (tree) structure. A file is placed in a directory (folder in Windows) or subdirectory at the desired place in the tree structure.
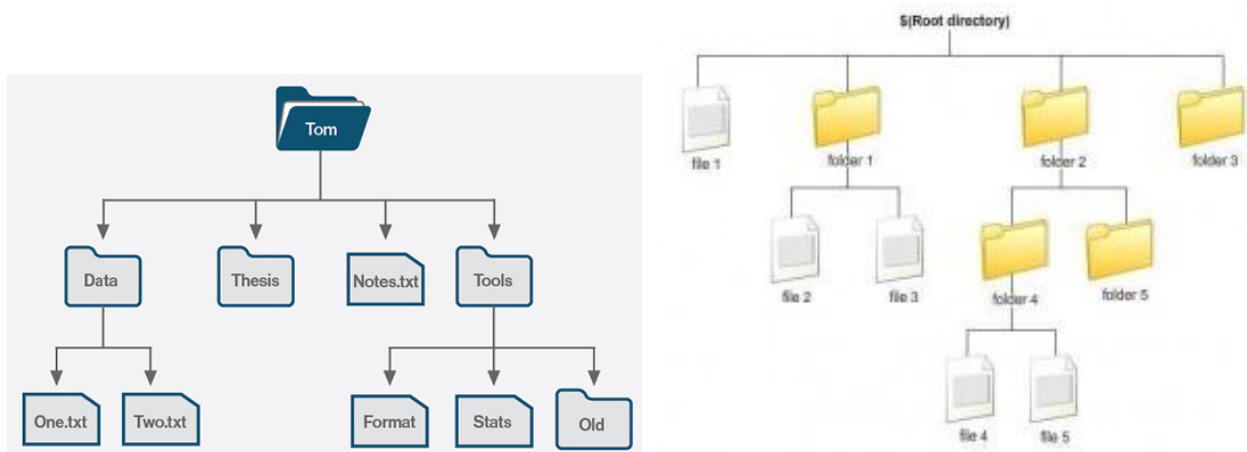
Examples of a file tree diagram

The file system consists of two distinct parts: a collection of *files*, each storing related data, and a *directory structure*, which organizes and provides information about all the files in the system.

* Each file has a **file name**, it is used to identify a storage location in the file system. Most file systems have restrictions on the length of filenames. In some file systems, filenames are case-insensitive (i.e., filenames such as FOO and foo refer to the same file); in others, filenames are case-sensitive (i.e., the names FOO and foo refer to two separate files).

Most modern file systems allow filenames to contain a wide range of characters from the Unicode character set. Most file system interface utilities, however, have restrictions on the use of certain special characters, disallowing them within filenames (the file system may use these special characters to indicate a device, device type, or file type).

* File systems typically have **directories** (also called **folders**) which allow the user to group files into separate collections. This may be implemented by associating the file name with an index in a table of contents. Directory structures may be flat (i.e. linear), or allow hierarchies where directories may contain subdirectories.

File systems specify conventions for naming files, including the maximum number of characters in a name, which characters can be used and, in some systems, how long the file name suffix can be. A file system also includes a format for specifying the path to a file through the structure of directories.

File systems use metadata to store and retrieve files. Some examples of metadata tags include:

- Date created
- Date modified
- File size and others

File System Formulas (Types)

Below some types of file system:

Hierarchical File System (HFS)

HFS is a file system type developed by Apple Inc. for use on computers running Mac OS. Two main variants of HFS exist: Mac OS Standard ("HFS Standard" or "HFS") and Mac OS extended ("HFS extended" or "HFS+"). If you are running Mac OS X, your bootable drive is almost certainly using HFS+, not standard HFS. HFS+ allows for larger files with longer file names to be stored on the disk.

File Allocation Table (FAT)

FAT is a brief for File Allocation Table, which dates back to the beginnings of DOS programming. The File Allocation Table (FAT) file system was the primary file system in Microsoft's older operating systems, it is a file system that was created by Microsoft in 1977. FAT was the primary file system used in all of Microsoft's consumer operating systems from MS-DOS through Windows ME.

Over the years, the file system has been expanded from FAT12 to FAT16 and FAT32. Various features have been added to the file system including subdirectories, extended attributes, and long filenames. Below is more information on the versions of the FAT file system:

- **FAT12** - The initial version of the FAT file system, FAT12 was introduced in 1977, and was the primary file system for Microsoft operating systems up to MS-DOS 4.0. FAT12 supports drive sizes up to 32MB.

- **FAT16** - The second implementation of FAT was FAT16, introduced in 1988. FAT16 was the primary file system for MS-DOS 4.0 up to Windows 95. FAT16 supports drive sizes up to 2GB. It uses 16 bits addresses to determine files positions.

The O.S. saves the new file by searching in the first empty cluster in the hard, and registers this cluster in the FAT file system.

The FAT12 and FAT16 file systems had a limit on the number of entries in the root directory of the file system and had restrictions on the maximum size of FAT-formatted disks or partitions.

- **FAT32** - FAT32 is the latest version of the FAT file system. It was introduced in 1996 for Windows 95. FAT32 addresses the limitations in FAT12 and FAT16, except for the file size limit of close to 4GB. It depends smaller clusters and larger storage units than those of FAT16, thus this produces more effective allocation of areas in storage units.

Notes:

* FAT 32 is compatible with Windows 98 SE, Me, 2000, XP, NT, Mac OS 9.x and Mac OS 10.x.

* FAT12, FAT16 and FAT32 also have a limit of eight characters for the file name, and three characters for the extension (such as .exe). This is commonly referred to as the 8.3 filename limit. VFAT, an optional extension to FAT12, FAT16 and FAT32, introduced in Windows 95 and Windows NT 3.5, allowed long file names (LFN).

* FAT32 has better, more and interactive recovery utilities (scandisk).

* Scandisk is very quick.

* Faster on drives less than 10GB.

* Cluster size is 32KB.

New Technology File System (NTFS)

NTFS is a file system type that is commonly used for Microsoft Windows. It is the standard file system for Windows NT, Windows 2000, Windows XP, Windows Vista and Windows 7. It provides numerous improvements over the FAT file system, including better security and better disk utilization. **NTFS** is a proprietary file system developed by Microsoft Corporation for its Windows line of operating systems, beginning with Windows NT 3.1 and Windows 2000, including Windows XP, Windows Server 2003, and all their successors to date.

NTFS offers several features that are not available with FAT 32: file compression, encryption, permissions, and mirroring drives. NTFS supersedes the FAT file system as the preferred file system for Microsoft's Windows operating systems. NTFS has several technical improvements over FAT and HPFS (High Performance File System), such as the use of advanced data structures to improve performance, reliability, and disk space utilization, plus additional extensions, such as security access control lists (ACL).

Notes:

- Use NTFS if You want to encrypt files, assign permissions to files.

- You will be formatting partitions larger than 32GB.
- You need to store individual files that are larger than 4GB.

- Provides better security and increased it on personal files with file encryption.
- Allows extended file names, foreign characters.
- Smaller file clusters, 4KB.

- The minimum supported volume size for NTFS is 10MB with a maximum of 2TB with no limit to file size.

If you don't have a need for FAT32 and find a drive that is not NTFS you should perform the following steps to convert your drive(s) to NTFS:

- Click Start ---> Click All Programs ---> Click Accessories --->Click Command Prompt
- In the command prompt window type "convert c: /fs:ntfs" (substitute the appropriate drive letter if you are not converting the "C" drive)

NOTE: This is a one-way ticket. The convert utility from Microsoft will only convert from FAT or FAT32 to NTFS- not the other way around, it causes data losing . If you need to convert an NTFS drive to FAT or FAT32 you will need program as partition magic.

File System Fragmentation

File system fragmentation occurs when unused space or single files are not contiguous. As a file system is used, files are created, modified and deleted. When a file is created and there is not an area of contiguous space available for its initial allocation the space must be assigned in fragments. When a file is modified such that it becomes larger it may exceed the space initially allocated to it, another allocation must be assigned elsewhere and the file becomes fragmented.

The O.S. starts with the first empty cluster, if it is not enough to contain entire file, O.S. exceeds some clusters (filled) until it reaches another empty cluster to finish file writing in the hard.

The file that is divided among separated clusters in the hard called fragmented file, this makes the head of the hard jump here and here to read the fragmented file, this causes slowly system performance.

The solution of that state is doing defragmentation.