

Logical Hard Drive Recovery and a brief explanation of NTFS and FAT File Systems.

The NTFS file system has a MFT or Master File Table instead of a FAT file system's file allocation table. The MFT maps all the files and directories stored on the hard drive. The MFT is divided into units or blocks known as records. Some of the MFT records contain metadata information that holds the directory or file's attributes including read-only, system, hidden or security. The MFT expands as more information is written to the hard drive.

MFT records hold small header information about the record, followed by one or more attributes that describe characteristics of the file and/or directory that corresponds to the record. The header information includes sequence numbers that NTFS uses for integrity verification. NTFS uses attributes to store directory and file information. NTFS on NT 4.0 has 14 attribute types.

Windows NTFS is far more efficient at storing files than FAT32. In other words, you'll use less space on the disk storing a given set of 1,000 typical files under NTFS than you will with FAT32. And the larger the hard drive, the greater the effect. No Windows file system stores data more efficiently than NTFS. Microsoft claims performance improvements on boot times And NTFS is faster than FAT32. Microsoft has worked to maximize the performance NTFS; and it is inherently faster than FAT32. However, another performance point is that the actual code size for NTFS is larger than for FAT32. So in a highly memory constrained environment, such as a handheld device or embedded situation, NTFS requires more space.

Also every file in NTFS has an ACL (Access Control List). Windows XP Pro has built-in file encryption. Encryption is even preserved in backups. NTFS is far more secure than FAT32.

Recommended Cluster Sizes

Partition Size

512 MB or Less -512 bytes -1 Sector Per Cluster

513 MB - 1,024 MB (1 GB) -1,024 bytes (1 KB) -2 Sectors Per Cluster

1,025 MB - 2,048 MB (2 GB) -2,048 bytes (2 KB) -4 Sectors Per Cluster

2,049 MB and larger 4,096 bytes (4 KB) -8 Sectors Per Cluster

However, when you format the partition manually, you can specify cluster size 512 bytes, 1 KB, 2 KB, 4 KB, 8 KB, 16 KB, 32 KB, 64 KB

Partitions formatted with FAT are broken into clusters. The FAT file system is prone to fragmentation. Fragmentation is when data is written to noncontiguous clusters, which can slow down the read/write process. FAT writes files to the first available cluster it can find, and then skips ahead past used clusters to complete writing the file. The FAT file system keeps track of it's file attributes for each file in sub-directory entry tables. It contains information such as the name of the file, the cluster of the starting sector, whether it is a system file, a read-only file, or an archive, and or the data and time.

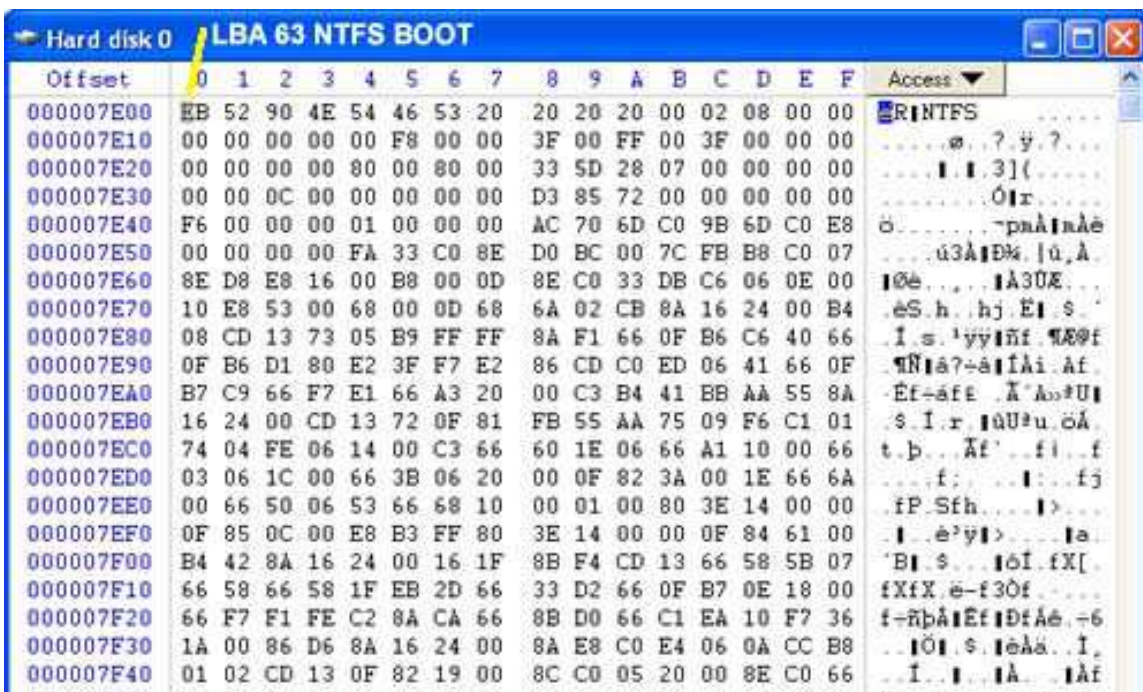
The NTFS and FAT32 file system supports filenames of up to 255 characters. (Files created from the command line can only have filenames up to 253 characters.)

NTFS has always been a more powerful file system than FAT 12, 16, and FAT32. Windows 2000 Server includes a new version of NTFS, with support for a variety of features including Active Directory, which is needed for domains, user accounts, and other important security features.

The Setup program makes it easy to convert your partition to the new version of NTFS, even if it used FAT or FAT32 before. This kind of conversion keeps your files intact (unlike formatting a partition). If you do not need to keep your files intact and you have a FAT or FAT32 partition, it is recommended that you *format* the partition with NTFS rather than *converting* from FAT or FAT32. Formatting a partition erases all data on the partition, but a partition that is formatted with NTFS rather than converted from FAT or FAT32 will have less fragmentation and better performance.

There is one situation in which you might want to choose FAT or FAT32 as your file system. If it is necessary to have a computer that will sometimes run an earlier operating system and sometimes run Windows 2000, you will need to have a FAT or FAT32 partition as the primary (or startup) partition on the hard drive. This is because earlier operating systems, with one exception, can't access a partition if it uses the latest version of NTFS. The one exception is Windows NT version 4.0 with Service Pack 4 or later, which has access to partitions with the latest version of NTFS, but with some limitations. Windows NT 4.0 cannot access files that have been stored using NTFS features that did not exist when Windows NT 4.0 was released.

Below is an example of an NTFS Boot Sector.



For data recovery issues each operating system has its strengths and weaknesses. The MFT table grows in proportion to the amount of data on the hard drive. Parts of the MFT could be in many places throughout the drive. In contrast, FAT 12 and 16 are static and are always located in the same area of the hard drive.

On a FAT16 the primary partition record is always at Head 0, Sector 1, Cylinder 0, or LBA sector 0. The primary boot record is always at Head 1, Sector 1, Cylinder 0, or LBA sector 63. The first FAT always immediately follows the boot record at Head 1, Sector 2, Cylinder 0. The size of each FAT can vary but is limited to 255 sectors per FAT. The second FAT immediately follows the first FAT. After the second FAT is the Root directory. The root directory is 32 sectors long.

Each sector can hold 16 file or directory entries which will allow up to 512 directories and/or files in the root directory.

FAT 32 is as dynamic as a FAT file system can get. It has to increase in proportion to the amount of data on the hard drive. However, it is located in a specific area of the hard drive.

On a FAT32 the primary partition record is always at Head 0, Sector 1, Cylinder 0, or LBA sector 0. The primary boot record is always at Head 1, Sector 1, Cylinder 0, or LBA sector 63. The boot record is 3 sectors in length. One of the advancements of FAT32 over FAT16 is a backup boot record. It begins at Head 1, Sector 7, Cylinder 0, or LBA sector 69. The first and second FAT follow after the boot, usually starting around LBA sector 97. The File Allocation Tables (FAT) are much larger on FAT32. For example a 30 GB partition will usually have around 16,000 sectors per FAT. The root directory normally follows the FAT's, but can be spread out on the drive if needed as data is stored on the drive.

When it comes to recovering data from a FAT16 or FAT32 it is very important that the beginning part of the drive be intact. If both FAT's are damaged it makes recovering fragmented files very difficult and often impossible to do. The FAT's are a map to the pieces of the file. The reason it is so hard to piece back together is because the second part of the file could literally be in millions of different locations.

With NTFS the MFT is often spread across the drive so even if the beginning part of the drive is completely damaged you can still recover data. Because of the way NTFS was designed each file has its mini-FAT type system known as the runlist.

However, it is often a matter of the extent of damage and the area affected which will determine the outcome of successful data recovery.

Of course, backing-up your data on a regular basis is the best way to avoid data loss. However, you can guarantee a higher rate of recovery from logical damage to a hard drive by defragmenting your hard drive on a regular basis. Ensuring your files are contiguous not only increases hard drive efficiency but also greatly increases the chances of recovering large files after deletion, format, or logical file system damage.