

FAT File System, Cluster Size, and Large Hard Disks



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The FAT File System

- **DOS uses the FAT file system**

- ▶ **FAT - File Allocation Table**
- ▶ **The FAT keeps track of which sectors of the disk belong to which file and which are free or unusable**
- ▶ **Each FAT entry contains a pointer to a region on the disk**
 - **The FAT pointers are 16 bits in length**
 - **Some pointer values have special meanings so the maximum number of places a pointer can represent is 65520 (instead of $2^{16} = 65536$)**
- ▶ **If each FAT pointer was used to point to a single sector on the hard disk the largest disk could only be 33.5 MB (65520 * 512 bytes)**

Clusters

■ What is a cluster?

- ▶ To break the 33.5 MB limit DOS groups multiple disk sectors into units called clusters
- ▶ The cluster size is chosen to cover the entire partition, while remaining as small as possible
- ▶ $65520 * \text{cluster size} \geq \text{partition size}$
 - Cluster size must be a power of 2
 - Cluster size must be 2048 bytes or larger

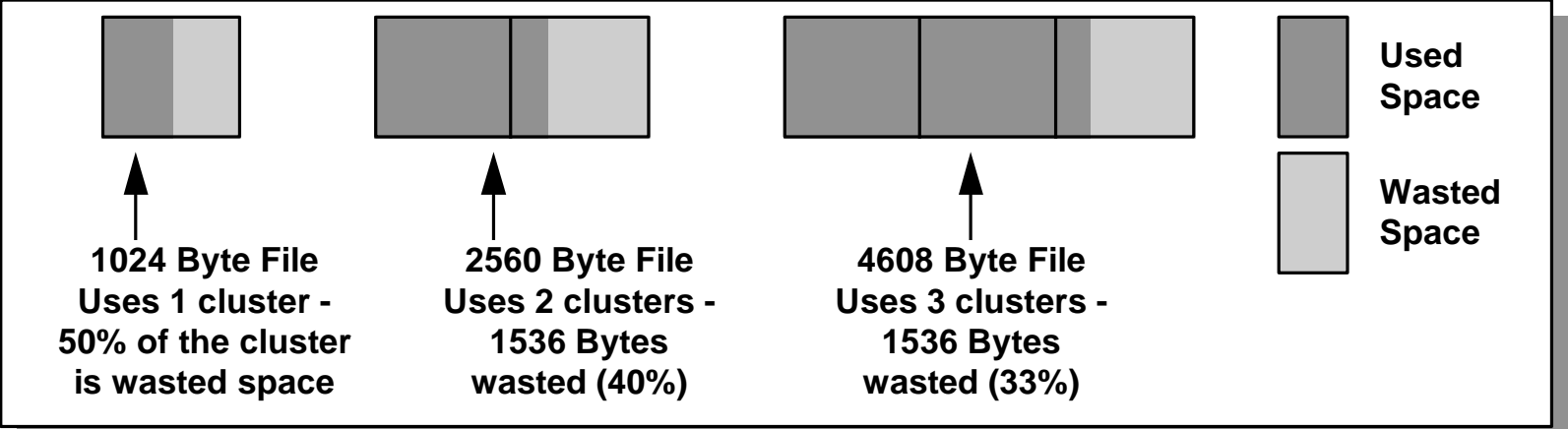
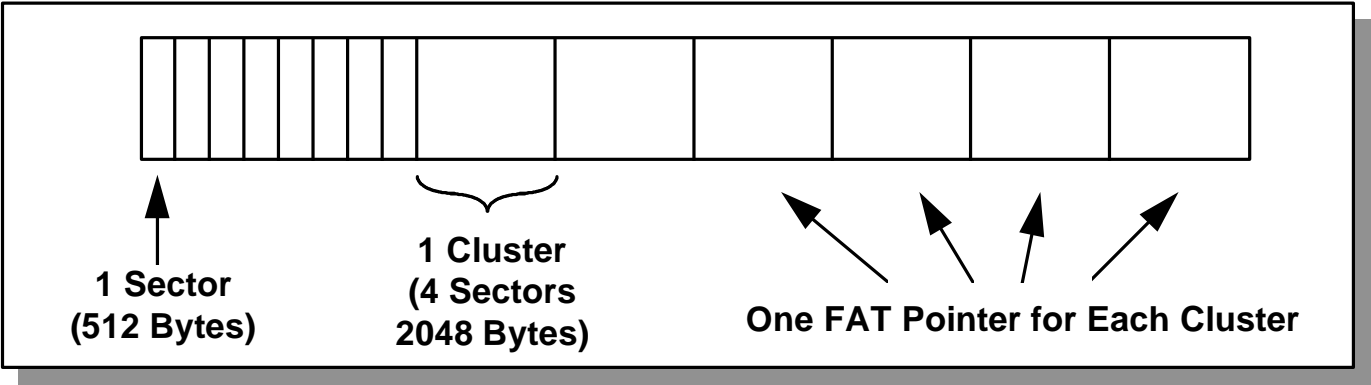
Partition Size (megabytes)	Sectors Per Cluster	Cluster Size (bytes)
1-134	4	2,048
135-268	8	4,096
269-536	16	8,192
537-1,073	32	16,384
1,074-2,145	64	32,768

Wasted Space

- A cluster is the smallest amount of space any file can occupy on a disk
 - ▶ If your cluster size is 2048 bytes and you save a file that is 1024 bytes, the file will take up the full 2048 bytes. That is a loss of 50%
 - ▶ The larger the cluster size, the more space is wasted



Wasted Space due to Clusters



Real Life Examples

- The following chart show the amount of space wasted when 202 MB of files are copied to different size partitions
 - ▶ This chart would change depending on the files stored on the hard drive - the smaller the files, the larger percentage of wasted space

Cluster Size (bytes)	Partition Size (MB*)	Total Wasted Space (MB*)	Total Space Used (MB*)	Space Wasted / Size of Files
2048	1-134	6.0	208	3.0%
4096	135-268	12.4	214.2	6.1%
8192	269-536	26.5	228.5	13.1%
16384	537-1073	57.4	259.4	28.5%
32768	1074-2145	125.6	327.6	62.2%

*MB = 1,000,000 bytes

AC2540 Example

- Using Disk Manager with the AC2540 can actually make the drive smaller than without DM!
 - ▶ Due to the amount of wasted space by cluster size differences

ACTION	SPACE AVAILABLE	
	OLD BIOS (no EIDE)	w/ DISK MANAGER
FDISK and FORMAT	528 MB	540 MB
Store 202 MB Files (as in previous example)	<i>528.0 Total Space</i> <i>-202.0 Files</i> <i>- 26.5 Wasted Space</i> 299.5 Remaining	<i>540.0 Total Space</i> <i>-202.0 Files</i> <i>- 57.4 Wasted Space</i> 280.6 Remaining

Solutions

- **Partition the hard drive into smaller logical drives**
 - ▶ **Use the FDISK utility**
 - ▶ **Unfortunately FDISK erases all data from the hard drive**
- **Use a different operating system and file system**
 - ▶ **Windows NT**
 - **NTFS**
 - ▶ **OS/2**
 - **HPFS**