Hard drives and storage devices

KT0801 Hard drives and storage devices

What Does Hard Disk Drive (HDD) Mean?

A hard disk drive (HDD) is a non-volatile computer storage device containing magnetic disks or platters rotating at high speeds. It is a secondary storage device used to store data permanently, random access memory (RAM) being the primary memory device. Non-volatile means data is retained when the computer is turned off.A hard disk drive is also known as a hard drive.

Hard Disk Drive (HDD)

A hard drive fits inside a computer case and is firmly attached with the use of braces and screws to prevent it from being jarred as it spins. Typically, it spins at 5,400 to 15,000 RPM. The disk moves at an accelerated rate, allowing data to be accessed immediately. Most hard drives operate on high-speed interfaces using serial ATA (SATA) or serial attached technology. When the platters rotate, an arm with a read/write head extends across the platters. The arm writes new data to the platters and reads new data from them. Most hard drives use enhanced integrated drive electronics (EIDE) including cables and connectors to the motherboard. All data is stored magnetically, allowing information to be saved when power is shut off.

Hard drives need a read only memory (ROM) controller board to instruct the read/write heads how, when and where to move across the platters. Hard drives have disks stacked together and spin in unison. The read/write heads are controlled by an actuator, which magnetically reads from and writes to the platters. The read/write heads float on a film of air above the platters. Both sides of the platters are used to store data. Each side or surface of one disk is called a head, with each one divided into sectors and tracks. All tracks are the same distance from the centre of the disk. Collectively they comprise one cylinder. Data is written to a disk starting at the furthest track. The read/write heads move inward to the next cylinder once the first cylinder is filled.

A hard drive is divided into one of more partitions, which can be further divided into logical drives or volumes. Usually a master boot record (MBR) is found at the beginning of

the hard drive and contains a table of partition information. Each logical drive contains a boot record, a file allocation table (FAT) and a root directory for the FAT file system.

KT0802 Installing discs, formatting discs, partitioning discs, troubleshooting disks, as well as IDE, SCSI, and SATA

Preparing a Hard Disk for Use

Preparing a hard disk for use in your PC is the process by which you set up the drive so that it can hold your data (everything from Windows to programs and documents files). Usually you'll only need to go through this process when installing a new drive. Occasionally, however, you might decide it's time to give your PC a fresh start, by erasing everything on your drives, re-preparing them, and installing fresh copies of your software. (If you ever decide to do this, be very sure that you've backed up any essential data to another storage medium.)

If you have a PC made by one of the big PC producers, such as HP/Compaq, Dell, IBM, and so on, you probably received a restore CD or two (or sometimes instructions on how to make them using files stored in a hidden partition on your hard disk). A restore CD or restore partition can work in one of two ways:

Most restore CDs restore the computer's original software, wiping out your data and other personal information in the process.

Some restore CDs can also repair Windows and applications without wiping out your data.

If you have serious enough problems to justify using a restore CD, make sure you know how yours works or else watch your data vanish!

In most PCs, the system BIOS handles configuration duties for ATA/IDE hard disk drives (the standard type of hard drive found in most systems). Many recent systems also support SATA hard disk drives through the system BIOS.

Preparing either of these types of hard disks requires the use of your operating system's disk preparation utilities (Disk Management in Windows XP or Windows 2000; FDISK and FORMAT in Windows 9x/Me). These programs process the disk according to what the system or SCSI BIOS report. If the system BIOS is not configured properly, an ATA/IDE drive will not be recognized at its full capacity.

Most systems are set to auto-detect the capacity of ATA/IDE or SATA hard disks when you install them and turn on the computer; this type of hard disk configuration is the most

common type. You can determine if your version of Windows can view the entire capacity of the drive during the disk preparation process.

Preparing an Additional Hard Disk with Windows XP

The process of installing a hard disk varies according to whether the drive is being added to your computer or is being installed as a replacement. The process described in this section assumes that you are adding an additional hard disk to your existing computer.

What Does Disk Formatting Mean?

Disk formatting is the configuring process of a data storage media such as a hard disk drive, floppy disk or flash drive for initial usage. Any existing files on the drive would be erased with disk formatting. Disk formatting is usually done before initial installation or before installation of a new operating system. Disk formatting is also done if there is a requirement for additional storage in the computer.

Disk Formatting

Disk formatting can be performed on both magnetic platter hard drives and solid-state drives. The formatting comprises low-level formatting, partitioning and high-level formatting. Low-level formatting aids in preparing the physical structure on the storage media. The partitioning process involves the division of the hard drive into logical volumes for data storage. High-level formatting helps in creating the file system format within the logical volume or within the disk partition. Disk formatting is usually done with the help of a disk formatting utility.

While preparing the hard drive for initial use, disk formatting checks for errors in the drive. It can scan and repair bad sectors. Another benefit associated with disk formatting is its capability to erase bad applications and remove sophisticated viruses.

Disk formatting is an action which must be done with caution. As it deletes data and removes programs installed, backup of the necessary data or applications are required. Disk formatting takes time. Frequent disk formatting can gradually decrease the life of a hard drive.

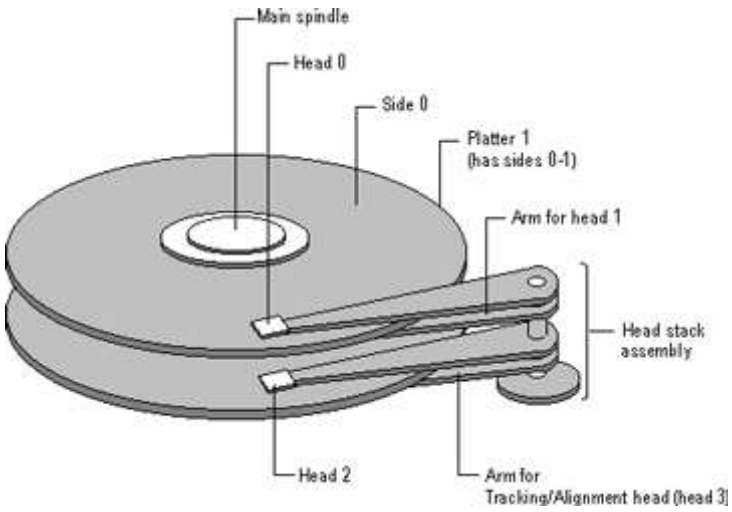
KT0803 Parts of a hard disk, such as platters, tracks, sectors, clusters, and cylinders

Hard Disk Drive Basics

A hard disk is a sealed unit containing a number of platters in a stack. Hard disks may be mounted in a horizontal or a vertical position. In this description, the hard drive is mounted horizontally. Electromagnetic read/write heads are positioned above and below each platter. As the platters spin, the drive heads move in toward the centre surface and out toward the edge. In this way, the drive heads can reach the entire surface of each platter.

Each disk consists of platters, rings on each side of each platter called tracks, and sections within each track called sectors. A sector is the smallest physical storage unit on a disk, almost always 512 bytes in size.

Figure below illustrates a hard disk with two platters. The remainder of this section describes the terms used on the figure.



Two plated hard disk

The cylinder/head/sector notation scheme described in this section is slowly being eliminated. All new disks use some kind of translation factor to make their actual hardware layout appear as something else, mostly to work with MS-DOS and Windows 95.

Tracks and Cylinders

On hard disks, the data are stored on the disk in thin, concentric bands called tracks. There can be more than a thousand tracks on a 3½ inch hard disk. Tracks are a logical rather than physical structure, and are established when the disk is low-level formatted. Track numbers start at 0, and track 0 is the outermost track of the disk. The highest numbered track is next to the spindle. If the disk geometry is being translated, the highest numbered track would typically be 1023. Next figure shows track 0, a track in the middle of the disk, and track 1023.

A cylinder consists of the set of tracks that are at the same head position on the disk. In a figure below, cylinder 0 is the four tracks at the outermost edge of the sides of the

platters. If the disk has 1024 cylinders (which would be numbered 0-1023), cylinder 1023 consists of all of the tracks at the innermost edge of each side.

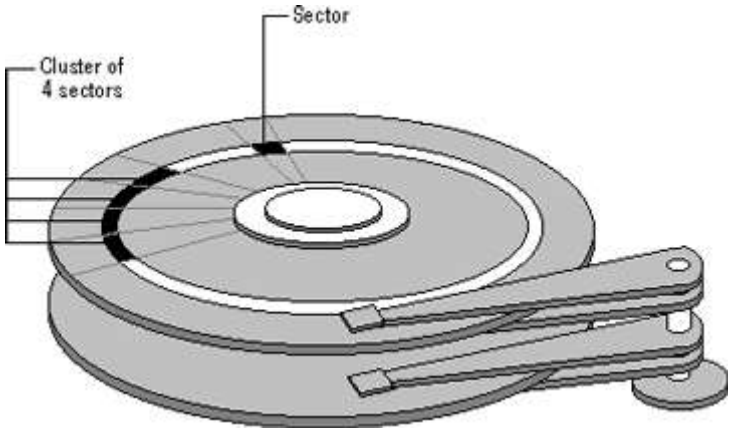
Most disks used in personal computers today rotate at a constant angular velocity. The tracks near the outside of the disk are less densely populated with data than the tracks near the center of the disk. Thus, a fixed amount of data can be read in a constant period of time, even though the speed of the disk surface is faster on the tracks located further away from the center of the disk.

Modern disks reserve one side of one platter for track positioning information, which is written to the disk at the factory during disk assembly. It is not available to the operating system. The disk controller uses this information to fine tune the head locations when the heads move to another location on the disk. When a side contains the track position information, that side cannot be used for data. Thus, a disk assembly containing two platters has three sides that are available for data.

Sectors and Clusters

Each track is divided into sections called sectors. A sector is the smallest physical storage unit on the disk. The data size of a sector is always a power of two, and is almost always 512 bytes.

Each track has the same number of sectors, which means that the sectors are packed much closer together on tracks near the center of the disk. Next figure shows sectors on a track. You can see that sectors closer to the spindle are closer together than those on the outside edge of the disk. The disk controller uses the sector identification information stored in the area immediately before the data in the sector to determine where the sector itself begins.



Clusters and sectors

As a file is written to the disk, the file system allocates the appropriate number of clusters to store the file's data. For example, if each cluster is 512 bytes and the file is

800 bytes, two clusters are allocated for the file. Later, if you update the file to, for example, twice its size (1600 bytes), another two clusters are allocated.

If contiguous clusters (clusters that are next to each other on the disk) are not available, the data are written elsewhere on the disk, and the file is considered to be fragmented. Fragmentation is a problem when the file system must search several different locations to find all the pieces of the file you want to read. The search causes a delay before the file is retrieved. A larger cluster size reduces the potential for fragmentation, but increases the likelihood that clusters will have unused space.

Using clusters larger than one sector reduces fragmentation, and reduces the amount of disk space needed to store the information about the used and unused areas on the disk.

The stack of platters rotates at a constant speed. The drive head, while positioned close to the centre of the disk reads from a surface that is passing by more slowly than the surface at the outer edges of the disk. To compensate for this physical difference, tracks near the outside of the disk are less-densely populated with data than the tracks near the centre of the disk. The result of the different data density is that the same amount of data can be read over the same period of time, from any drive head position.

The disk space is filled with data according to a standard plan. One side of one platter contains space reserved for hardware track-positioning information and is not available to the operating system. Thus, a disk assembly containing two platters has three sides available for data. Track-positioning data is written to the disk during assembly at the factory. The system disk controller reads this data to place the drive heads in the correct sector position.

KT0804 Installing IDE devices

How to Install IDE Hard Drive and Troubleshoot IDE Hard Drive Problems?

This guide is for installing an IDE drive. If you're opening up something an OEM machine you could be voiding your warranty, so check first.

When you try to install a really big hard drive into a lot of older systems, you'll find that the BIOS is only capable of seeing 137 GB. On even older mainboards you'll find a 32 GB limit. To get around this you'll want to use that install disk that came with the hard drive or if you're a relatively advanced user a BIOS update should be available. The install disk comes on a floppy so if you don't have one then you'd better be able to do a BIOS update.

Directly jump to the process you're most interested to get ready to install IDE hard drive: