

## On Partitioning (Draft) (120KB)

For: [Windows 95](#) | [Windows 98](#) | [Windows ME](#) | [Windows 2000 Professional](#) | [Windows XP](#)

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### I. Introduction

A hard disk is comprised of one or more double-sided platters onto which data is written, stored, and retrieved from. In order for a hard disk to accept data it must undergo three preparatory steps, in order.

1. Low-Level Formatting
  - Creates a hard disk's tracks, cylinders, and sectors.
  - Performed by the hard disk manufacturer, not by a user.
2. Partitioning
  - Creates drives.
  - Can be performed by a user.
  - **The subject of this page.**
3. High-Level Formatting
  - Also known as formatting.
  - Applies a file system to a drive.
  - Can be performed by a user.

**Note:** For additional information on formatting see [On Formatting \(Draft\)](#) (Steve's Tech Resource).

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### II. Partitioning Defined

A partition is a group of adjacent hard disk cylinders which has been designated as a compartment. The process through which a group of adjacent cylinders is designated as such a compartment, or partition, is known as partitioning.

**Note:** For additional information on hard disk cylinders see [On Formatting \(Draft\)](#) (Steve's Tech Resource).

No matter the operating system one plans to use, a hard disk must be partitioned. A hard disk must be partitioned because it was determined a long time ago, and with good reason, that a hard disk, itself, should not represent the top-most level of an operating system's data organization tree.

Operating systems provide tools through which partitions recognized by that operating system may be created. The Windows provided partitioning tools, as described below, allow one to create Windows partitions.

The drive represents the top-most level of the Windows data organization tree. A drive is a partition which has been assigned a drive letter designation. C: is an example of a drive.

Although not every Windows partition is assigned a drive letter designation, the ultimate purpose of partitioning a hard disk for Windows is the creation of drives. As such, partitioning can be thought of as the process through which drives are created.

**Note:** In order for a hard disk's partitions to accept data, the partitions must be formatted. For additional information see [On Formatting \(Draft\)](#) (Steve's Tech Resource).

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### III. Windows Partitions

There are three types of Windows partitions.

1. The Primary DOS Partition.
  - The C: drive.
2. The Extended DOS Partition.
  - Not assigned a drive letter designation.
  - The only compartment which can contain one or more subcompartments.
  - The subcompartment(s) created within the extended DOS partition are logical DOS drives.
3. The Logical DOS Drive.
  - The subcompartment(s) created within the extended DOS partition.
  - Assigned drive letter designations, such as D:, E:, F:, etc..

**Note:** Although a logical DOS drive is not formally given the name of "partition," a logical DOS drive is, by definition, a partition. As such, a logical DOS drive is also known as a logical DOS partition, or simply as a logical partition.

Logical DOS drive is an unfortunate and oft confusing term coined by Microsoft. But as logical DOS drive is the term used by the Windows 95, Windows 98, and Windows ME (Windows 9x/ME) provided partitioning tools, logical DOS drive will be used throughout this page. However, if it helps one's understanding, then by all means feel free to substitute logical DOS partition or logical partition for logical DOS drive.

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### IV. On New Hard Disks

Hard disks on the store shelves are not partitioned. Unpartitioned hard disk space is known as unallocated hard disk space. As an operating system is able to organize data on a hard disk only with reference to the partitions a hard disk has, when one buys a new hard disk it is up to the user to partition it. If one is planning to use a hard disk with Windows, Windows partitions are required.

**Note:** In order for a hard disk's partitions to accept data the partitions must be formatted. For additional information see [On Formatting \(Draft\)](#).

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### V. On The Hard Disks Of Pre-Built Computers

The first computer most people buy usually comes with an operating system already installed. The hard disks of pre-built Windows-based systems are almost always partitioned such that the primary DOS partition, the C: drive, spans the entire hard disk. When C: spans the entire hard disk, Windows recognizes the hard disk as a single drive and the terms, disk, drive, hard disk, hard drive, disk drive, hard disk drive, C:, and C: drive are frequently used interchangeably.

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## VI. On Virtual Drives

There are two ways in which hard disk associated C: and D: drives can be made available. The first is to install two hard disks and to create a primary DOS partition on each. Here, Windows assigns the primary DOS partition of one hard disk as the C: drive and the primary DOS partition of the other hard disk as the D: drive. When this is the case it is said that C: and D: are drives located on distinct physical hard disks.

**Note:** If one has multiple hard disks only one partition may be designated as the active partition.

If acquiring a second hard disk is not an option, one can have a C: and D: drive available by creating multiple partitions on a single physical hard disk. As alluded to above and depicted below, the primary DOS partition is the first partition created. The primary DOS partition becomes the C: drive. Then an extended DOS partition is created and one or more logical DOS drives are created within the extended DOS partition. Here, the first logical DOS drive created within the extended DOS partition becomes the D: drive, the second logical DOS drive created within the extended DOS partition becomes the E: drive, the third logical DOS drive created within the extended DOS partition becomes the F: drive, etc..

When a hard disk has been partitioned into multiple drives it is said that the single physical hard disk has multiple virtual drives. A virtual drive is a drive which is not associated with a distinct physical hard disk, but which has the characteristic of being associated with a distinct physical hard disk. The principle characteristic that virtual drives have in common with drives located on distinct physical hard disks is that the drives operate, for the most part, independent of any other drives present.

**Note:** There is one circumstance in which having two drives each located on a distinct physical hard disk is preferred to having a single hard disk with multiple (virtual) drives: Hard disk failure. Here, when a hard disk reports bad sectors, the entire hard disk is in jeopardy of becoming unreadable/unusable, not just the particular drive(s) in which the bad sectors are being reported.

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## VII. On The Benefits Of Partitioning A Hard Disk Into Multiple (Virtual) Drives

There are a number of benefits in having two or more hard disk associated drives available. If acquiring a second physical hard disk is not an option, one can enjoy the benefits of having multiple hard disk associated drives available by partitioning one's single physical into multiple (virtual) drives.

### Disaster Recovery

Any file not required for the functioning of one's operating system or applications can be considered a data file. Office documents, favorites/bookmarks, saved E-mails, downloads, and the like can all be considered data files.

It is strongly recommended that one keeps their data files on a drive separate from one's operating system. The reason is for this is quite simple. Say one kept their data files on C:, along with the operating system, and the operating system became unbootable. Here, if in order to get the computer working again one decided to reformat C: and reinstall Windows, the data files located on C: would be lost.

**Note:** For additional information on data recovery and reformatting see [On Formatting \(Draft\)](#) (Steve's Tech Resource).

If, however, one kept their data files on D:, one could reformat C: and reinstall Windows and the data files on D: would be entirely unaffected.

### Multiple-Booting

A computer from which one can boot multiple operating systems is known as a multiple-boot computer. For example, a computer set up to boot two different operating systems is known as a dual-boot computer.

When setting up a multiple-boot computer it is strongly recommended that each operating system be installed to its own drive. The reason for this is to avoid boot sector problems and file path/version conflicts.

**Note:** Further discussion of boot sectors and on setting up a multiple-boot computer is beyond the scope of this page. Time permitting a new page on boot sectors and on setting up a multiple-boot computer will be put

together.

## Norton Ghost

Norton Ghost is a utility through which one can image (a.k.a., backup) and restore the contents of an individual drive or the contents of an entire hard disk. With good reason, Norton Ghost cannot be used to image an individual drive, or an entire hard disk, to itself. In other words, the source drive/hard disk and the destination drive/hard disk cannot be the same drive/hard disk. Therefore, in order to image C:, either a second physical hard disk drive, a CD-R/RW drive, or a virtual drive D: must be available.

**Note:** For additional information on using Norton Ghost see [Using Norton Ghost 2002](#) (Steve's Tech Resource).

## CD Burning

To help prevent buffer underruns, the drive containing the files to be burned should be defragmented prior to burning. If one has a single hard disk with a C: drive which spans the entire hard disk, one's operating system and applications are located on the same drive as the files to be burned. As a result, when one defragments prior to burning, not only are the files to be burned defragmented, but one's operating system, applications, in short, everything must be defragmented at the same time. Defragmenting the entire contents of one's hard disk each and every time one wants to burn a CD is unnecessary, and a tremendous waste of time. Rather, it is suggested that one creates a D: drive for the purpose of burning CDs. Here, keep the files to be burned on D:, and when one is ready to burn a CD, simply defragment D: as opposed to defragmenting the entire contents of the hard disk.

## VIII. On Partitioning A Hard Disk Into One Or More Drives

The first Windows partition created is, and must be, a primary DOS partition. Windows recognizes the primary DOS partition and assigns it a drive letter designation. The ubiquitous C: drive is the primary DOS partition.

If additional Windows drives are to be created, the second partition created is, and must be, an extended DOS partition. The extended DOS partition is a unique Windows partition in that it is not assigned a drive letter designation. The extended DOS partition is not assigned a drive letter designation because the extended DOS partition does not serve as an end, but as a means to an end. Here, the extended DOS partition functions solely as a compartment within which one or more subcompartments may be created. The subcompartments created within the extended DOS partition are logical DOS drives, and it is the logical DOS drives which are assigned drive letter designations. Here, the first logical DOS drive created within the extended DOS partition is the D: drive, the second logical DOS drive created within the extended DOS partition is the E: drive, the third Logical DOS Drive created within the extended DOS partition is the F: drive, etc..

### Partitioning Hard Disk Into C: Drive Only

The primary DOS partition is C:. Therefore, if only a C: drive is needed, only a primary DOS partition need be created. And if only a C: drive is needed, it makes sense that the primary DOS partition spans the entire hard disk.

<b>Entire Hard Disk Space</b>
<b>Primary DOS Partition</b>
C:

### Partitioning Hard Disk Into C: & D: Drive

If one wants a C: and D: drive, first a primary DOS partition is created which does NOT span the entire hard disk. Next, an extended DOS partition is created which spans the remaining unpartitioned hard disk space. Lastly, a single logical DOS drive is created within the extended DOS partition which spans the entire extended DOS partition.

<b>Entire Hard Disk Space</b>	
<b>Primary DOS Partition</b>	<b>Extended DOS Partition</b>
C:	Logical DOS drive
	D:

### Partitioning Hard Disk Into C:, D:, E:, & F: Drives

If one wants three or more drives, for example, a C:, D:, E:, and F: drive, first a primary DOS partition is created which does NOT span the entire hard disk. Next, an extended DOS partition is created which spans the remaining unpartitioned hard disk space. Lastly, the desired number of logical DOS drives are created within the extended DOS partition.

Entire Hard Disk Space			
Primary DOS Partition	Extended DOS Partition		
C:	Logical DOS drive	Logical DOS drive	Logical DOS drive
	D:	E:	F:

## IX. On The Active Partition

The active partition is the partition the computer looks to for the presence of an installed operating system. In other words, in order for a computer to boot an operating system, not only must an operating system be installed, but the partition to which the operating system is installed must be marked as active.

**Note:** As the computer tries to boot an operating system from the active partition, the active partition is also known as the boot partition.

Active partition is another unfortunate and oft confusing term coined by Microsoft. But as active partition is the term used by the Windows 9x/ME provided partitioning tools, active partition will be used throughout this page. However, if it helps one's understanding, then by all means feel free to substitute boot partition for active partition.

Only one partition may be designated as the active partition. Even if one has multiple hard disks installed, only one partition may be marked as the active partition. Here, when one has multiple hard disks installed, the active partition must reside on the first hard disk, also known as hard disk 0.

MS-DOS and Windows 9x/ME were designed to be booted from an active primary DOS partition.

## X. On The Windows Provided Partitioning Tools

Although the Windows 9x/ME provided partitioning tool and the Windows 2000 Professional and Windows XP (Windows 2000/XP) partitioning tools are accessed by different means and have different interfaces, the Windows provided partitioning tools are all basically the same program. Moreover, the partitions created by the Windows 9x/ME and the Windows 2000/XP partitioning tools are functionally equivalent.

### The Windows 9x/ME Partitioning Tool

**FDISK.EXE** is the only partitioning tool provided with Windows 9x/ME. FDISK.EXE is a stand-alone DOS-Mode program which is included on a Windows 9x/ME Startup Disk.

**Note:** For additional information on the Windows 9x/ME Startup Disk see [On The Windows 9x/ME Startup Disk](#) (Steve's Tech Resource).

The primary DOS partition, the extended DOS partition, and the logical DOS drive are not only Windows partitions, they are also MS-DOS Partitions. As such, the DOS-Mode partitioning tool, FDISK.EXE, can be used to create partitions compatible with MS-DOS and with all versions of Windows, including Windows 9x/ME and Windows 2000/XP.

When FDISK.EXE is used to partition a hard disk one specifically creates a primary DOS partition, an extended DOS partition, and any logical DOS drives. FDISK.EXE can also be used to mark the active partition. In fact, after the primary DOS partition is created, FDISK.EXE automatically prompts one to mark an active partition. Here, as MS-DOS and Windows 9x/ME were designed to be booted from an active primary DOS partition, the implication is to mark the primary DOS partition as active.

**Note:** Even if one opts out of marking an active partition after the primary DOS partition is created, the installation of DOS and Windows 9x/ME automatically marks the primary DOS partition as active.

## The Windows 2000/XP Partitioning Tools

**SETUP.EXE:** No matter how one initiates the installation of Windows 2000/XP, the installation procedure includes the running of SETUP.EXE. Built into SETUP.EXE is a partitioning tool which is functionally similar to the Windows 9x/ME partitioning tool, FDISK.EXE. Unlike FDISK.EXE, however, the partitioning tool built into SETUP.EXE is not a stand alone program. Rather, the partitioning tool built into SETUP.EXE is intimately tied to the installation of Windows 2000/XP. As initiating the installation of Windows 2000/XP can make changes to one's system that can be difficult to reverse, the Windows 2000/XP partitioning tool built into SETUP.EXE should be used if and only if one is, indeed, in the process of installing Windows 2000/XP.

**Disk Management:** After Windows 2000/XP is installed a partitioning tool is available through Disk Management. Disk Management is located under Control Panel | Administrative Tools | Computer Management | Storage.

**Note:** Using the Disk Management partitioning tool, one will notice that the names of the three Windows partition types do not include the word, "DOS." Hence, primary DOS partition become primary partition, extended DOS partition becomes extended partition, and logical DOS drive becomes logical drive. The partitions are functionally equivalent, just the names have changed. The change in name is meant to reflect the absence of DOS as an integral part of the Windows 2000/XP operating system.

When using the Windows 2000/XP provided partitioning tools, one simply creates partitions and SETUP.EXE automatically assigns the partitions created as primary, extended, and logical as logic would apply. Specifically, SETUP.EXE automatically designates the first partition created as the primary partition. If additional partitions are created SETUP.EXE automatically assigns the remaining unpartitioned hard disk space to an extended partition, and the additional partitions created are automatically designated as logical drives within the extended partition.

SETUP.EXE automatically marks the primary DOS partition as active.

Need to check on Disk Management.

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## XI. On Third-Party Partitioning Tools

There are a number of third-party partitioning tools which can be used to create Windows partitions. Perhaps two of the best known and widely used are [Norton PartitionMagic](#) and [VCOM/Avanquest Software Partition Commander](#).

The Windows provided partitioning tools suffer from a number of limitations. Most third-party partitioning tools overcome the limitations of the Windows provided partitioning tools.

### Overcoming The Windows Partitioning Tools' Two Partition Limit

The Windows provided partitioning tools suffer from what is known as the two partition limit. Here, the first partition created must be a primary DOS partition and the second partition created must be an extended DOS partition. Granted, the Windows provided partitioning tools allow one to create multiple logical DOS drives within the extended DOS partition, but the single primary DOS partition followed by an extended DOS partition defines the two partition limit characteristic of the Windows provided partitioning tools. The two partition limit of the Windows provided partitioning tools is not a function of the capabilities of the hard disk, but is a function of the capabilities of the Windows provided partitioning tools themselves.

As mentioned above, MS-DOS and Windows 9x/ME are designed to be booted from an active primary DOS partition. That the Windows partitioning tools only allow the creation of a single primary DOS partition makes multi-booting any combination of these operating systems impossible.

Most third-party partitioning tools, on the other hand, do not suffer from this two partition limit. Rather, third-party partitioning tools have a four partition limit. Here, one can create either four primary DOS partitions or three primary DOS partitions and an extended DOS partition. Again, if an extended DOS partition is created any number of logical DOS drives can be created within the extended DOS partition, but the ability of the third-party partitioning tools to create either four primary DOS partitions or three primary DOS partitions and one extended DOS partition defines the four partition limit which distinguishes the third-party partitioning tools from the Windows provided partitioning tools.

The ability of the third-party partitioning tools to create multiple primary DOS partitions allows one to set up multiple-boot combinations of MS-DOS and Windows 9x/ME not possible if one partitioned a hard disk with the Windows provided partitioning tools. Here, one can create as many as four primary DOS partitions and install any combination of MS-DOS and Windows 9x/ME to the four primary DOS partitions. Then, in order to load a particular operating system, the third-party partitioning tool is used to mark the appropriate partition as active, and when the computer is started the

operating system associated with the active partition is loaded.

**Note:** If one's third party partitioning tool comes with a boot loader, also known as a boot manager, one can boot operating systems installed on logical DOS drives. For example, Windows 2000/XP comes packaged with a boot loader, a limited boot loader, but a boot loader nevertheless. The boot loader packaged with Windows 2000/XP allows one to boot Windows 2000/XP from a logical DOS drive. Here, if one wants to dual-boot either MS-DOS or Windows 9x/ME with Windows 2000/XP, first install DOS or Windows 9x/ME to the active primary DOS partition. Then install Windows 2000/XP to a logical DOS drive. The boot loader included with Windows 2000/XP should automatically configure itself to allow one the choice of which operating system to load each time the computer is started.

Further discussion of boot loaders/managers and of setting up a multiple-boot computer is beyond the scope of this page. Time permitting a new page on boot loaders/managers and on setting up a multiple-boot computer will be put together.

## Nondestructive Repartitioning

Using the Windows provided partitioning tool, FDISK.EXE for Windows 9x/ME, and SETUP.EXE for Windows 2000/XP, one can change the partition structure of a hard disk. To change the partition structure of a hard disk is to repartition the hard disk.

Need to check on Disk Management.

There are a number of reasons why one might want to repartition a hard disk.

- Add a drive.
- Merge drives.
- Resize drives.

Repartitioning a hard disk with FDISK.EXE or SETUP.EXE always results in the loss of data. The reason for this is that in order to change a partition with FDISK.EXE and SETUP.EXE that partition must be deleted and then recreated, and when a partition is deleted the data it contains is deleted as well.

For example, say one has a C: drive, the primary DOS partition, which spans the entire hard disk and one would like to create a C: and a D: drive. To do this with FDISK.EXE, the first step is to delete the primary DOS partition. After the primary DOS partition is deleted one recreates the primary DOS partition with a new desired new size. Then one creates an extended DOS partition out of the remaining unpartitioned hard disk space and a logical DOS drive is created within the extended DOS partition. It is in the first step, the deletion of the primary DOS partition that the data contained on C: is lost.

The same holds true when one wishes to merging drives and/or resizing drives with the Windows provided partitioning tools: no matter the case, whenever a hard disk is to repartitioned with the Windows provided partitioning tools, the partitions representing the drives one wants to change must first be deleted, and when a partition is deleted that drive's data is lost. When a partitioning tool requires the deletion of partitions in order to repartition a hard disk, that partitioning tool performs what is known as destructive repartitioning.

Need to check on Disk Management.

And if all this deleting of partitions were not bad enough, one must remember that a partition is a grouping of adjacent cylinders. What this means is that drives D: and F: cannot be deleted and then combined into a single, larger drive, only drives D: and E: or drives E: and F: can be deleted and then merged. Likewise, if one would like to resize two partitions, they can be resized only if they are adjacent to one another. If they are not adjacent to one another, any partition(s) in between must also be deleted as part of the resizing process.

With the third-party partitioning tools, however, it is possible to add drives and to resize drives without losing any of the data contained on the involved drives.

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## XII. On BIOS Imposed Maximum Partition Size Limitations

There exists a FAT16 imposed 2.1GB maximum partition size limitation. FAT16 is the default file system for MS-DOS and for the first release of Windows 95, Windows 95 OSR1.

**Note:** For additional information on file systems see [On Formatting \(Draft\)](#) (Steve's Tech Resource).

Besides the FAT16 imposed 2.1GB maximum partition size limitation, there exists BIOS limitations which impose 528MB, 2.1GB, 4.2GB, 8.4GB, 33.8GB, and 137GB maximum partition size limitations. Therefore, if one is unable to create a partition larger than 528MB, 2.1GB, 4.2GB, 8.4GB, 33.8GB, or 137GB the problems is not with the new hard disk, but with one having an older BIOS which does not supporting large hard disk partition sizes. When this is the case there is a possible fix, a BIOS upgrade, and a possible work around, using the hard disk manufacturer's so called installation software.

**Note:** Further discussion of the BIOS imposed partition size limitations is beyond the scope of this page. Time permitting a new page will be put together on the BIOS imposed partition size limitations.

## BIOS Upgrade

If one's BIOS chip is real old a BIOS upgrade involves physically replacing the BIOS chip on the motherboard with a newer BIOS chip. If the BIOS chip is of a more recent vintage the BIOS upgrade involves replacing the BIOS code with newer code in a software mediated process known as "flashing" the BIOS. The Read Only Memory (ROM) of a BIOS that can be flashed is of the Electrically Erasable Programmable Read Only Memory (EEPROM) type.

Either way, a BIOS upgrade is tricky and if not done properly, or if something goes wrong, a failed BIOS upgrade can result in non-bootable machine with a motherboard that needs to be returned to the manufacturer or replaced. In particular one must take care to have correctly identified the current BIOS, and to have either ordered the correct replacement BIOS chip or to use the correct program to flash the BIOS. Because of this, a BIOS upgrade is not to be taken lightly and if one has any questions/doubts the BIOS upgrade is probably best left to a professional.

## Using The Hard Disk Manufacturer's Installation Software

If a BIOS upgrade is not feasible, a possible work around is to use the hard disk manufacturer's so called "installation software." When one buys a new hard disk retail, the manufacturer's installation software should be included in the box. If one buys an hard disk OEM (meaning the hard disk is packaged only in an anti-static bag) one will have to go to the hard disk manufacturer's Web site to acquire the installation software. Carefully read the documentation that comes with the installation software.

- [MaxBlast 5](#) (Maxtor/Seagate).
- [DiscWizard](#) (Seagate).
- [Data Lifeguard Tools](#) (Western Digital).

**Note:** In addition to allowing one to create partitions larger than one's BIOS would otherwise allow, the installation software likely provides a formatting tool. Therefore, when using the hard disk's installation software one may find it unnecessary to use the Windows provided partitioning and formatting tools.

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## XIII. Additional Reading

- [FDISK /MBR Rewrites The Master Boot Record \(69013\)](#) (Microsoft).
- [Definition Of A BIOS Limitation Or BIOS Capacity Barrier](#) (Seagate).
- [Why Is The Capacity Of The Drive Only Showing 8.4 GB, 32 GB, Or 137 GB When The Capacity Is Significantly Larger?](#) (Seagate).
- [BIOS Limitations](#) (Seagate).
- [Why Can I Only See 127 To 137 GBytes Of My 160+ GB Drive In Windows 98SE?](#) (Seagate).
- [Why Can I Only See 127 To 137 GBytes Of My 160+ GB Drive In Windows Me?](#) (Seagate).
- [Why Can I Only See 127 To 137 GBytes Of My 160+ GB Drive In Windows 2000?](#) (Seagate).
- [Why Can I Only See 127 To 137 GBytes Of My 160+ GB Drive In Windows XP?](#) (Seagate).
- [Why Can I Only See 127 To 137 GB Of My 160+ GB Drive In Windows Vista?](#) (Seagate).
- [How To Install And Troubleshoot ATA Hard Drives](#) (Seagate).
- [How To Install And Troubleshoot Serial ATA \(SATA\) Hard Drives](#) (Seagate).

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