

Thomas H. Russell

HARD DRIVE TECHNOLOGIES

How Hard Drives Work

- Hard drives come in two major types: the traditional type with moving parts; and a newer, more expensive technology that has no moving parts

How Hard Drives Work

- Magnetic Hard Drives

A traditional Hard Disk Drive (HDD) is composed of individual disk, or platters, with read/write heads on actuator arms controlled by a servo motor – all contained in a sealed case that prevents contamination by outside air

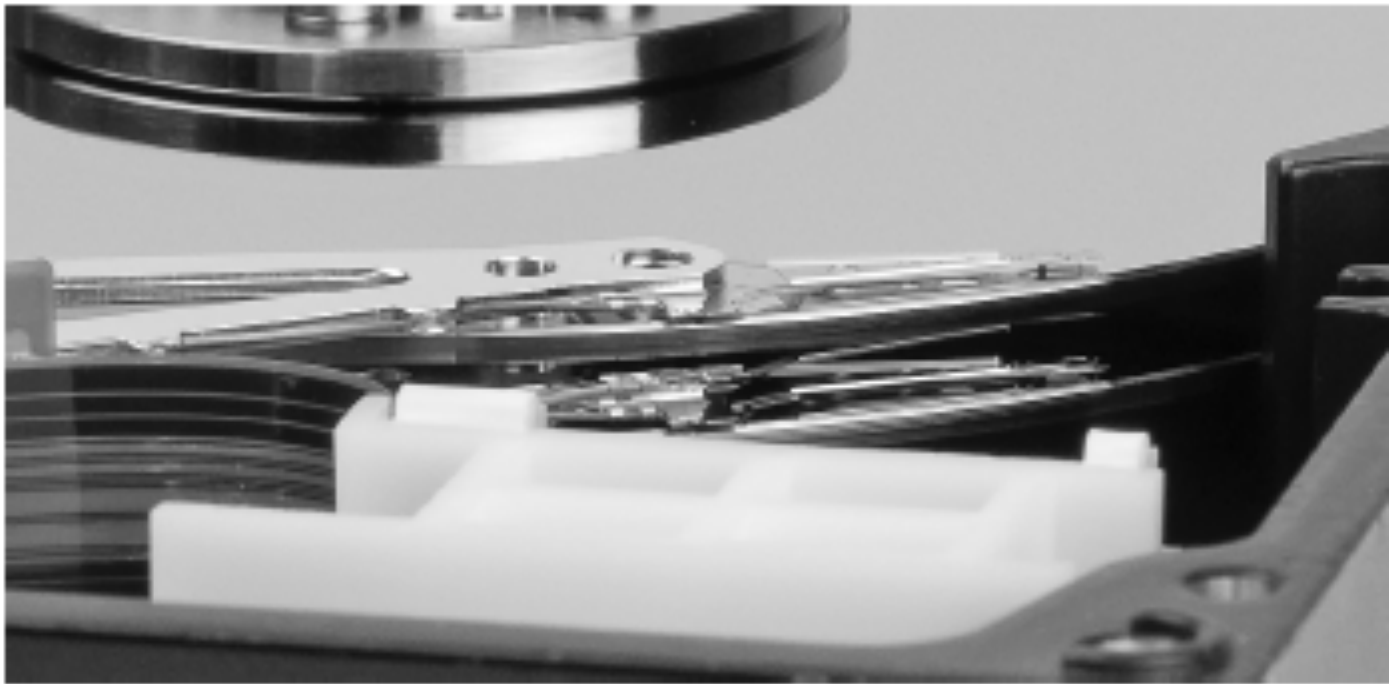
How Hard Drives Work



How Hard Drives Work

- ① The aluminum platters are coated with a magnetic medium. Two tiny read/write heads service each platter, one to read the top of the platter and the other to read the bottom of the platter. These are called *magnetic head drives* or *platter based hard drives*.

How Hard Drives Work



How Hard Drives Work

- Spindle or rotation speed.

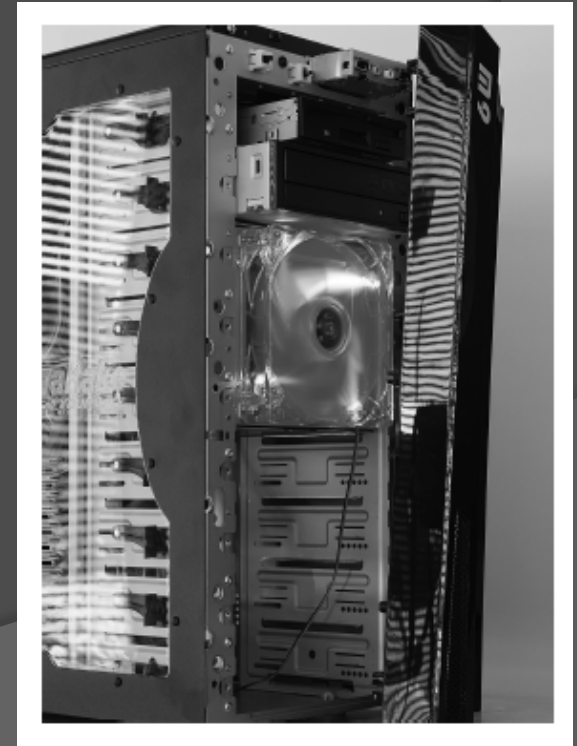
Hard drives run at a set speed. Older drives run at 3600 RPM, newer ones at 15000. The faster the speed, the faster it can store and retrieve data. Common speeds are 5400, 7200, 10,000, and 15,000

How Hard Drives Work

- Spindle or rotation speed

Drives make heat. You can add a drive fan, get a bigger case or both.

Bay Fan



How Hard Drives Work

- Solid State Drives (SSD)

These drives use semiconductors and transistors. No moving parts means no heat.

Solid state drive



How Hard Drives Work

- Solid State Drives (SSD) has form factors of 1.8, 2.5 and 3.5
- Some have special slots on the motherboard and can be installed as add-ons PCI cards.

M2 SSD



How Hard Drives Work

- Hybrid Hard Drives
- These drives combine flash memory spinning platters.
- These drives save boot time and add battery life.

Parallel and Serial ATA

- ⦿ ATA (*advanced technology attachments*) hard drives are often called integrated drive electronic (IDE) drives
- ⦿ There are two types: parallel ATA (PATA) or serial ATA (SATA)

Parallel and Serial ATA

- PATA drives send data in parallel on a wide 40- or 80- wire data cable called a ribbon cable.
- SATA drives send data in serial, using only one wire for data transfers.

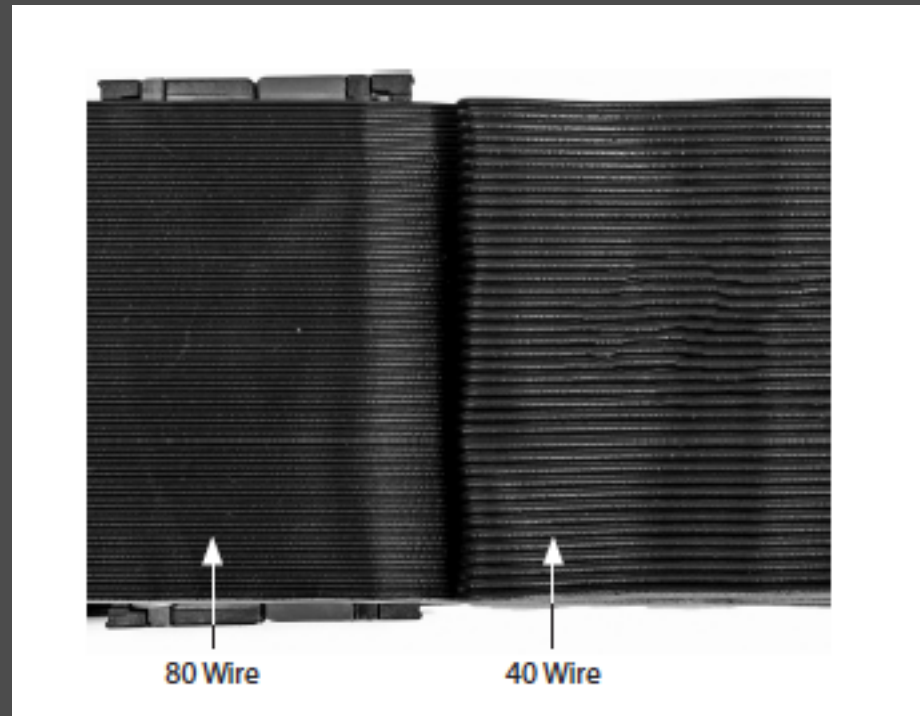
Parallel and Serial ATA

- PATA – all PATA Drives use a standard Molex power connector.



Parallel and Serial ATA

- PATA – drives that go 66 MBps or faster require an 80-wire cable



Parallel and Serial ATA

- You can connect up to two PATA drives – including hard drives, optical drives and tape drives – to a single ATA controller. You set jumpers on the drive to make one master and one slave.

Parallel and Serial ATA

- ⦿ PATA – Flat ribbon cables impeded airflow
- ⦿ cables had a limited length of only 18 inches
- ⦿ Drives could not be hot-swapped. You had to shut down the computer before installing or replacing.

Parallel and Serial ATA

- SATA – solved these problems.
- Point-to-point connection to all drives and the *host bus adapter* (HBA)
- Look the same as PATA – except power connections



Parallel and Serial ATA

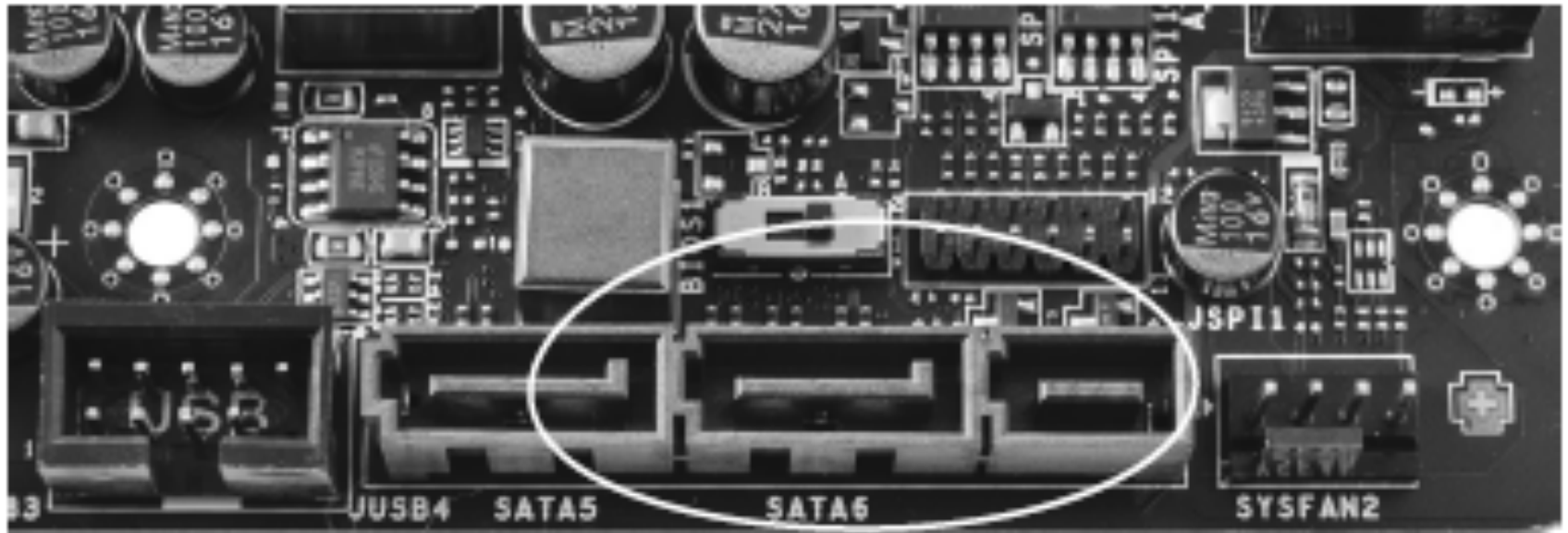
- Because SATA devices send data serially instead of parallel, the SATA interface needs fewer wires – 7 instead of 80. This results in much thinner cabling.

Parallel and Serial ATA

- The latest version of SATA (SATAe) or SATA 3.2, ties cable drive directly to the PCI express bus on motherboards.

Parallel and Serial ATA

- SATAe has unique connectors but provide full backward compatibility with earlier versions of SATA.

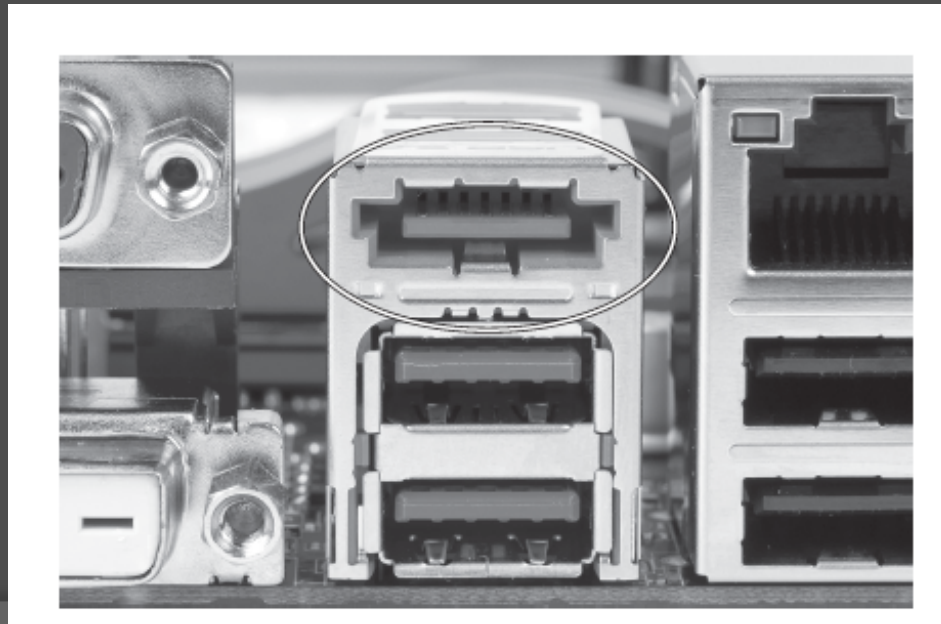


Parallel and Serial ATA

- AHCI – *Advanced Host Controller Interface* unlocks some of the advanced features of SATA, such as hot-swapping and native command queuing.

Parallel and Serial ATA

- External SATA (eSATA) drives use connectors similar to internal SATA but are keyed differently so you can't mistake one for the other.



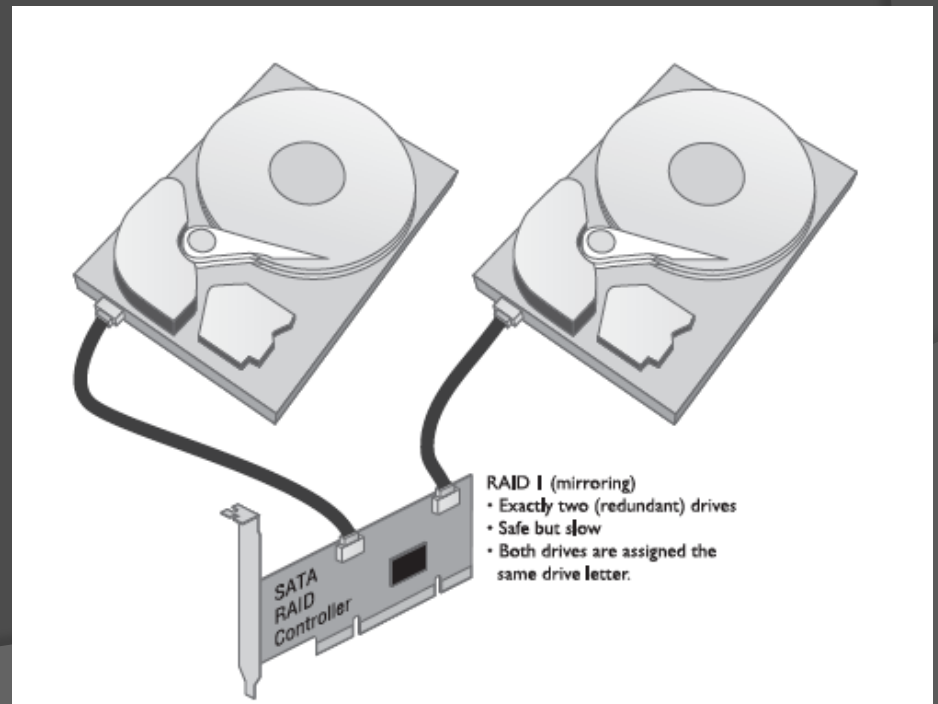
Parallel and Serial ATA

- You can upgrade laptop systems to support external SATA devices by inserting an eSATA ExpressCard



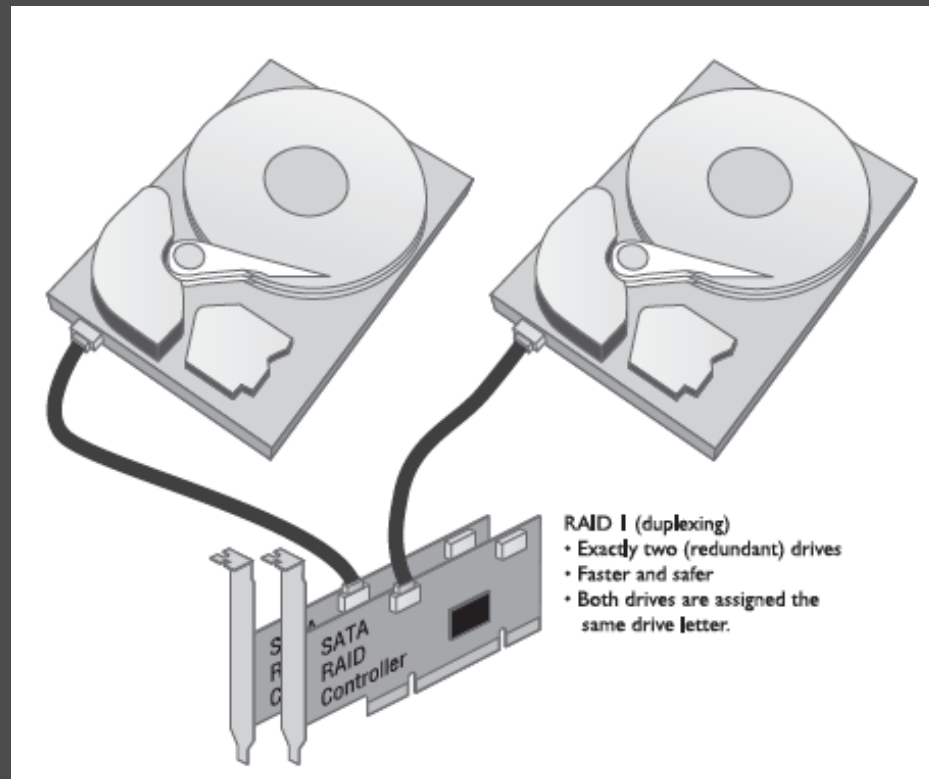
Protecting Data with RAID

- To prevent data loss you can install a hard drive controller that reads and writes data on both drives. This is called disk mirroring.



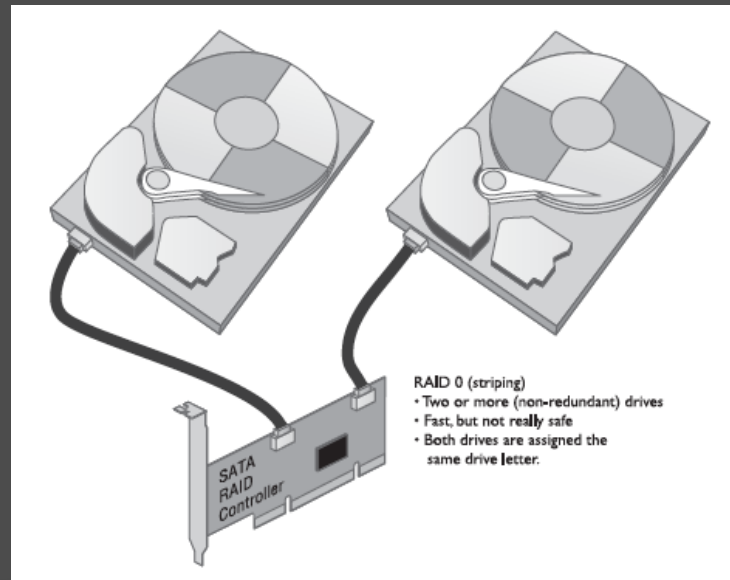
Protecting Data with RAID

- Or you can use a separate controller for each drive. This is called *disk duplexing*.



Protecting Data with RAID

- Disk stripping is spreading the data among multiple drives. It provides no redundancy. Files are split into multiple pieces, half to one drive and half to the other.



Protecting Data with RAID

- The one advantage of disk stripping is speed. But if either drives fails, all data is lost.

Protecting Data with RAID

- RAID uses multiple drives for data protection and increasing speeds. It stands for The *Redundant Array of Independent Disk*, (RAID). An *array* describes two or more drives working together as a unit.

Protecting Data with RAID

- **RAID 0—Disk Striping** Disk striping requires at least two drives. It does not provide redundancy to data. If any one drive fails, all data is lost.
- **RAID 1—Disk Mirroring/Duplexing** RAID 1 arrays require at least two hard drives, although they also work with any even number of drives. RAID 1 is the ultimate in safety, but you lose storage space because the data is duplicated; you need two 2-TB drives to store 2 TB of data.
- **RAID 5—Disk Striping with Distributed Parity** Instead of dedicated data and parity drives, RAID 5 distributes data and parity information evenly across all drives. This is the fastest way to provide data redundancy. RAID 5 is by far the most common RAID implementation and requires at least three drives. RAID 5 arrays effectively use one drive's worth of space for parity. If, for example, you have three 2-TB drives, your total storage capacity is 4 TB. If you have four 2-TB drives, your total capacity is 6 TB.
- **RAID 6—Disk Striping with Extra Parity** If you lose a hard drive in a RAID 5 array, your data is at great risk until you replace the bad hard drive and rebuild the array. RAID 6 is RAID 5 with extra parity information. RAID 6 needs at least five drives, but in exchange you can lose up to two drives at the same time. RAID 6 is gaining in popularity for those willing to use larger arrays.
- **RAID 10—Nested, Striped Mirrors** RAID levels have been combined to achieve multiple benefits, including speed, capacity, and reliability, but these benefits must be purchased at a cost, and that cost is efficiency. Take for instance RAID 10, also called RAID 1+0 and sometimes a "stripe of mirrors." Requiring a minimum of four drives, a pair of drives is configured as a mirror, and then the same is done to another pair to achieve a pair of RAID 1 arrays. The arrays look like single drives to the operating system or RAID controller. So now, with two drives, we can block stripe across the two mirrored pairs (RAID 0). Cool, huh? We get the speed of striping and the reliability of mirroring at the cost of installing two bytes of storage for every byte of data saved. Need more space? Add another mirrored pair to the striped arrays!
- **RAID 0+1—Nested, Mirrored Stripes** Like RAID 10, RAID 0+1 (or a "mirror of stripes") is a nested set of arrays that works in opposite configuration from RAID 10. It takes a minimum of four drives to implement RAID 0+1. Start with two RAID 0 striped arrays, then mirror the two arrays to each other. Which is better: the RAID 10 or the RAID 0+1? Why not do a bit of research and decide for yourself?

Protecting Data with RAID

EXAM TIP In preparation for the CompTIA A+ 220-901 exam, you'll want to be familiar with common RAID levels, the minimum number of drives in a given level array, and how many failures a given array can withstand and remain functional.

RAID Level	Minimum Drives	Number of Functional Failures
RAID 0	2	0
RAID 1	2	1
RAID 5	3	1
RAID 6	5	2
RAID 10	4	Up to 2
RAID 0+1	4	Up to 2

Protecting Data with RAID

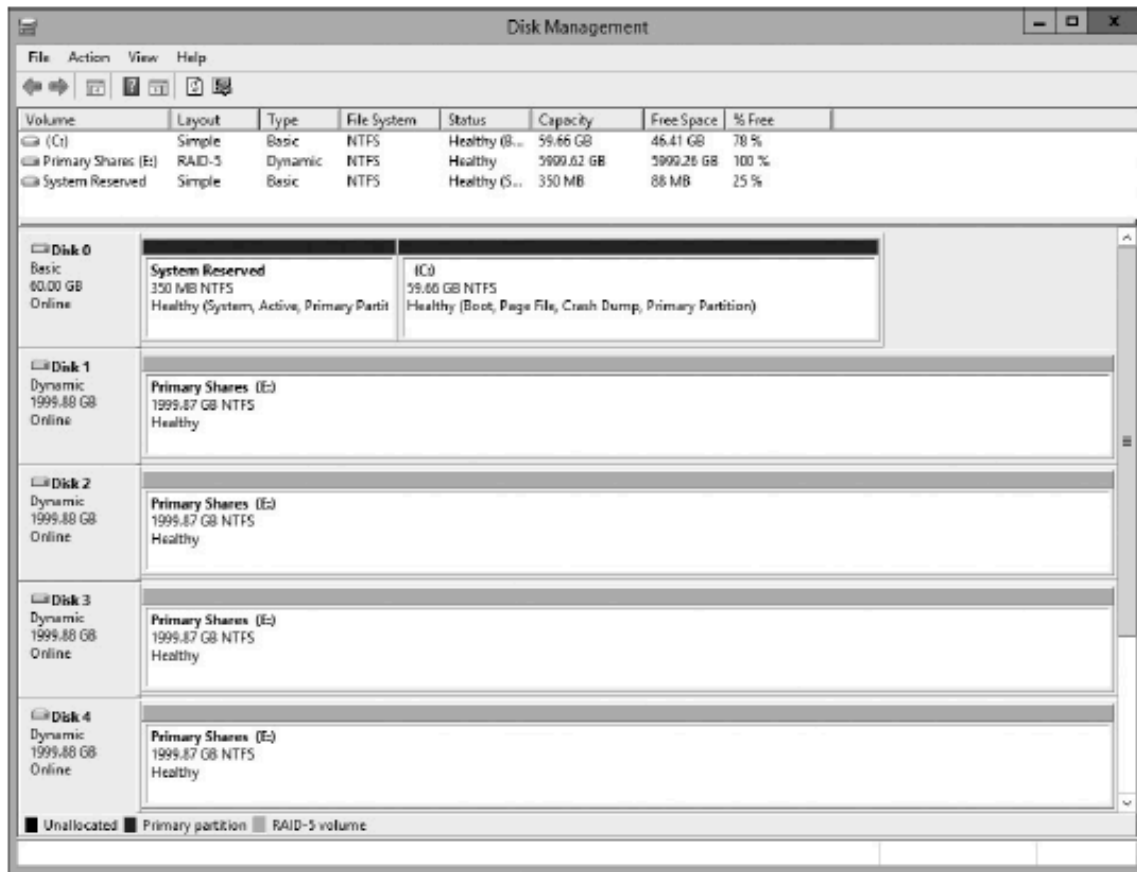
- Implementing RAID
- RAID levels describe different methods of providing data redundancy or enhancing the speed of data throughput to and from groups of hard drives.

Protecting Data with RAID

- Hardware vs. Software

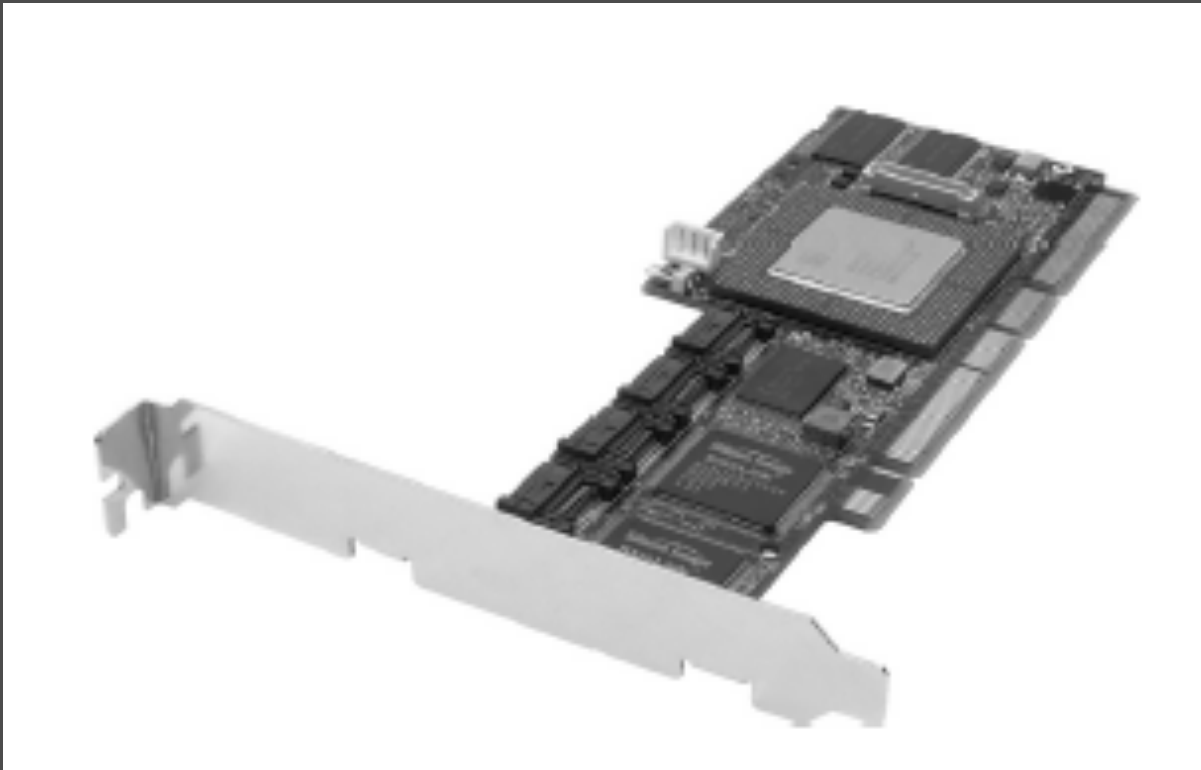
Software is used when price takes priority over performance. Hardware is used when you need speed along with data redundancy.

Disk management tool of computer management in Windows Server



Protecting Data with RAID

Hardware RAID centers on an intelligent controller – either a PATA or SATA controller that handles all of the RAID functions



Protecting Data with RAID

Most RAID setups are hardware based. Almost all of the hardware solutions provide hot-swapping – the ability to replace a drive without without disturbing the operating system.



Installing Drives

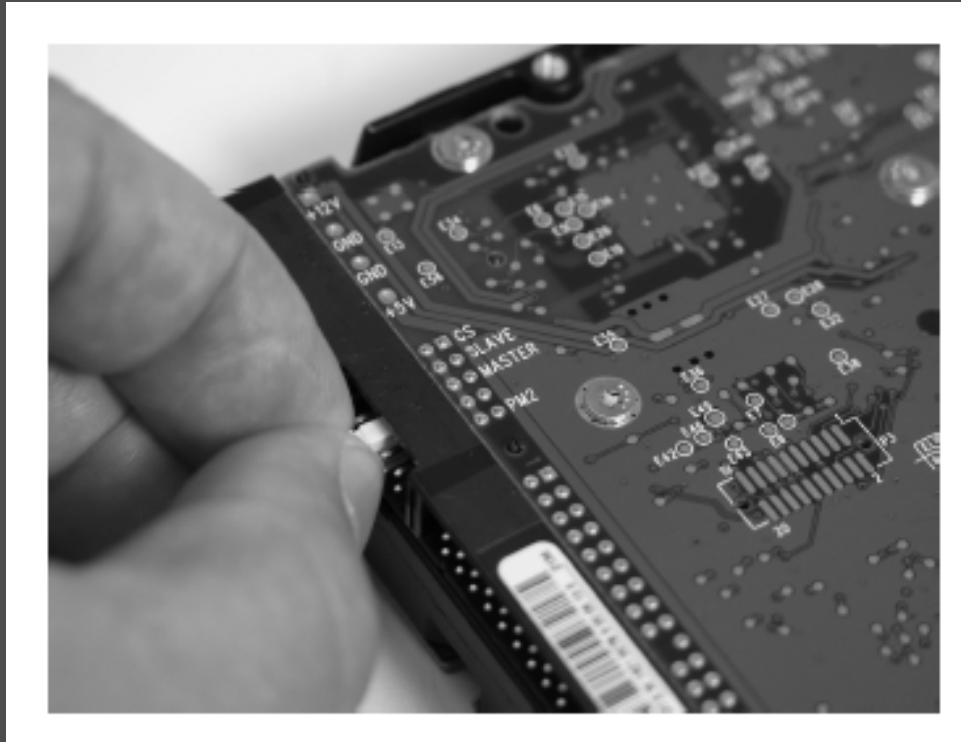
- Decide where you are going to put the drive
- Look for an open ATA connections
- Is it PATA or SATA?.
- Is it a dedicated RAID controller?
- Many motherboards have built-in RAID controllers that have a CMOS setting that enables you turn the RAID controller on or off.

Installing Drives



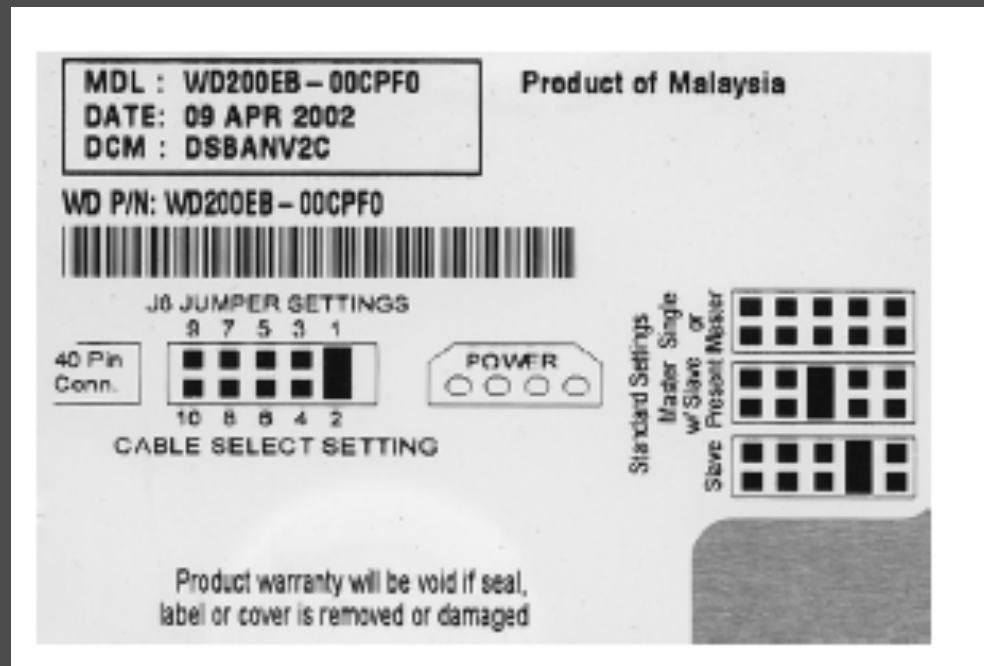
Installing Drives

If you have only one hard drive, set the drives jumpers to master or standalone. If you have two drives, set one to master, the other to slave. Or set both to cable select.



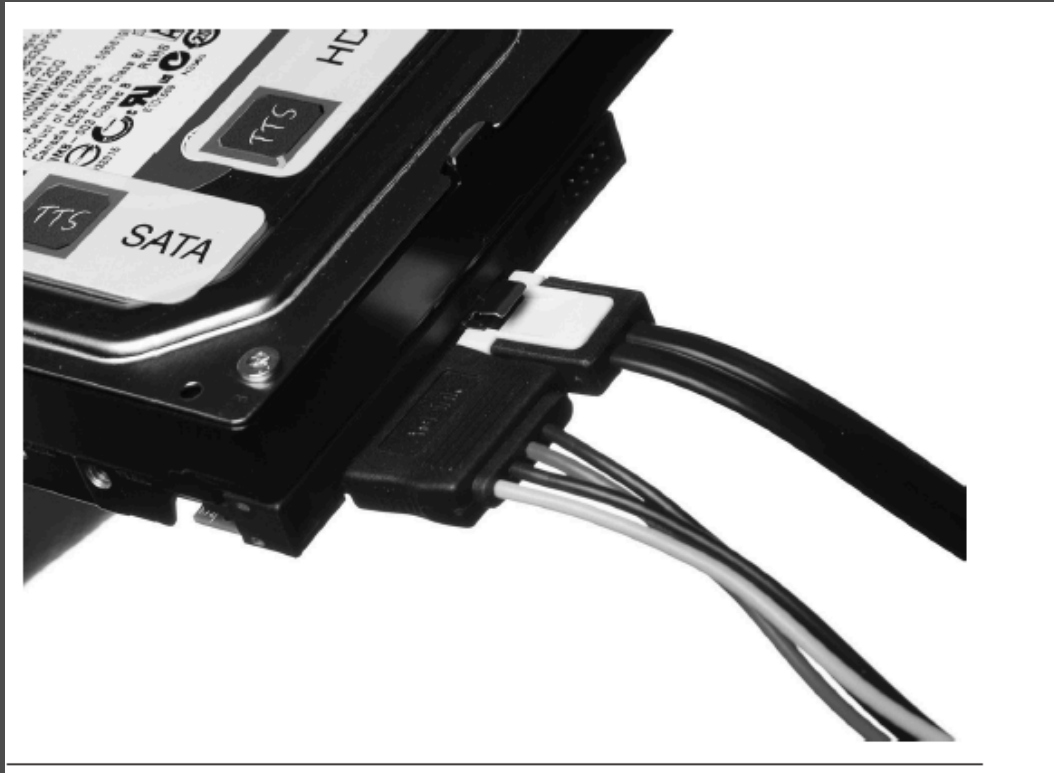
Installing Drives

- Read the front of the drives, most have a diagram that explains how to set the jumpers.



Installing Drives

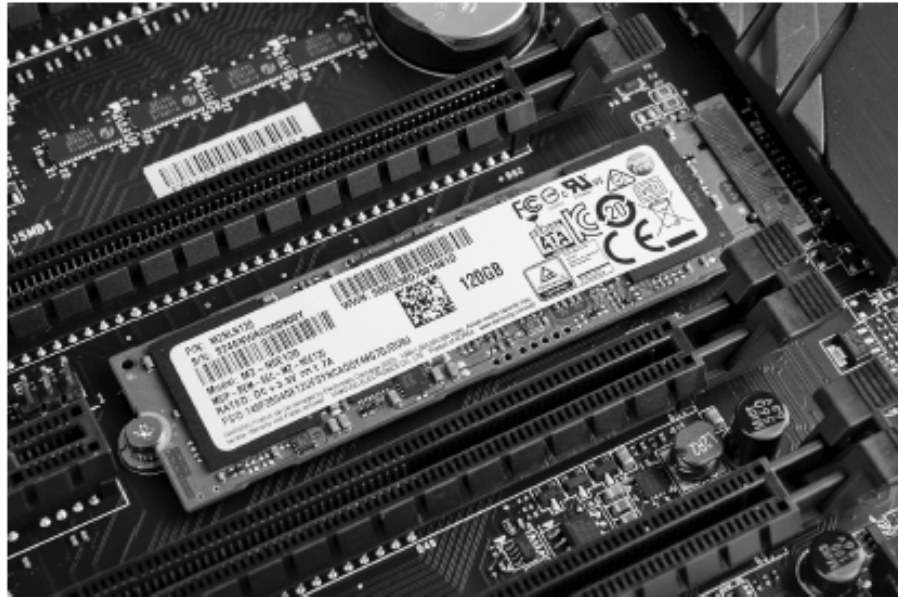
Installing SATA is easier than installing PATA because there is no master, slave or cable select configuration. SATA supports only a single device per controller channel



Installing Drives

● Connecting solid state drives –

M.2 and mSATA drives slip into their slot on the motherboard or add-on card, then either clip in place or secure with a screw. Both standards are keyed, so you can't install them incorrectly.



Installing Drives

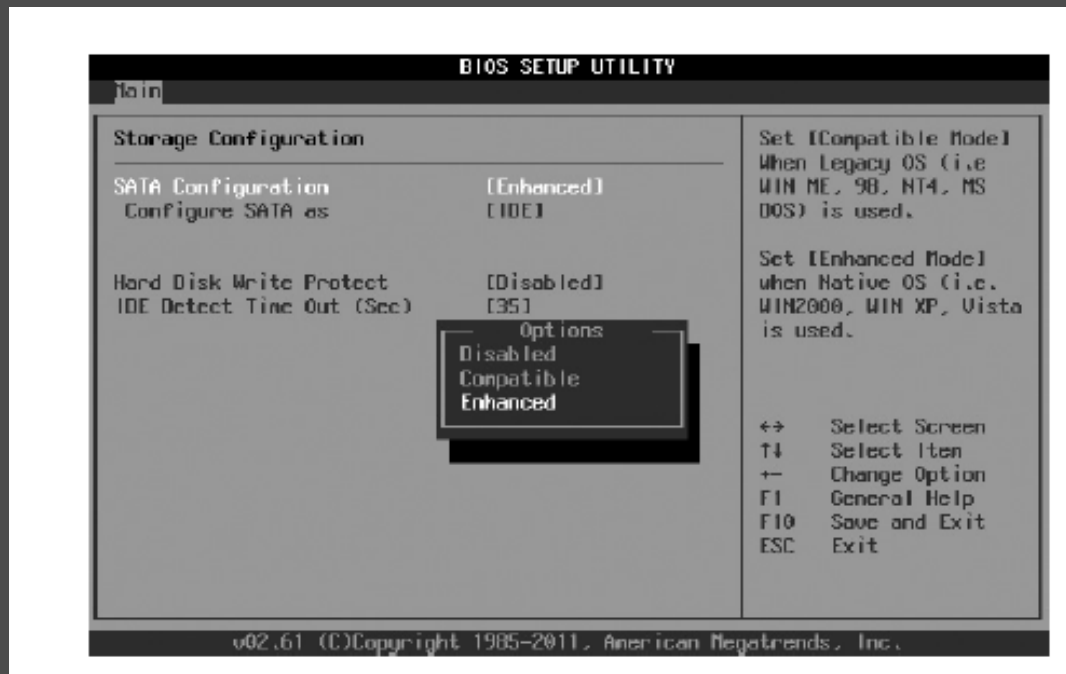
- BIOS Support: Configuring CMOS and Installing Drivers.

Motherboards provide support for the ATA hard drive controllers via the system BIOS, but they require configuration in CMOS for the specific hard drives attached.

Installing Drives

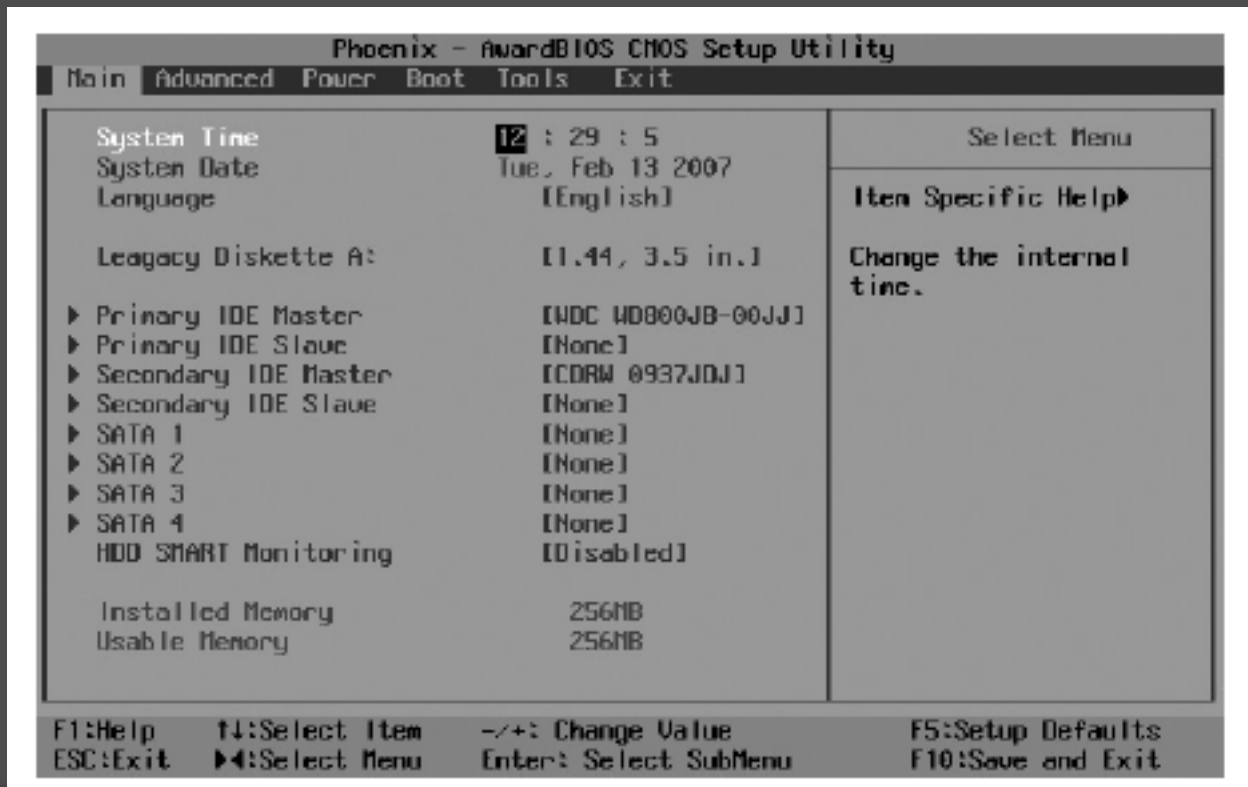
Configuring the controllers:

- First, make sure they are enabled. Scan through your CMOS settings to locate the controller on/off options.



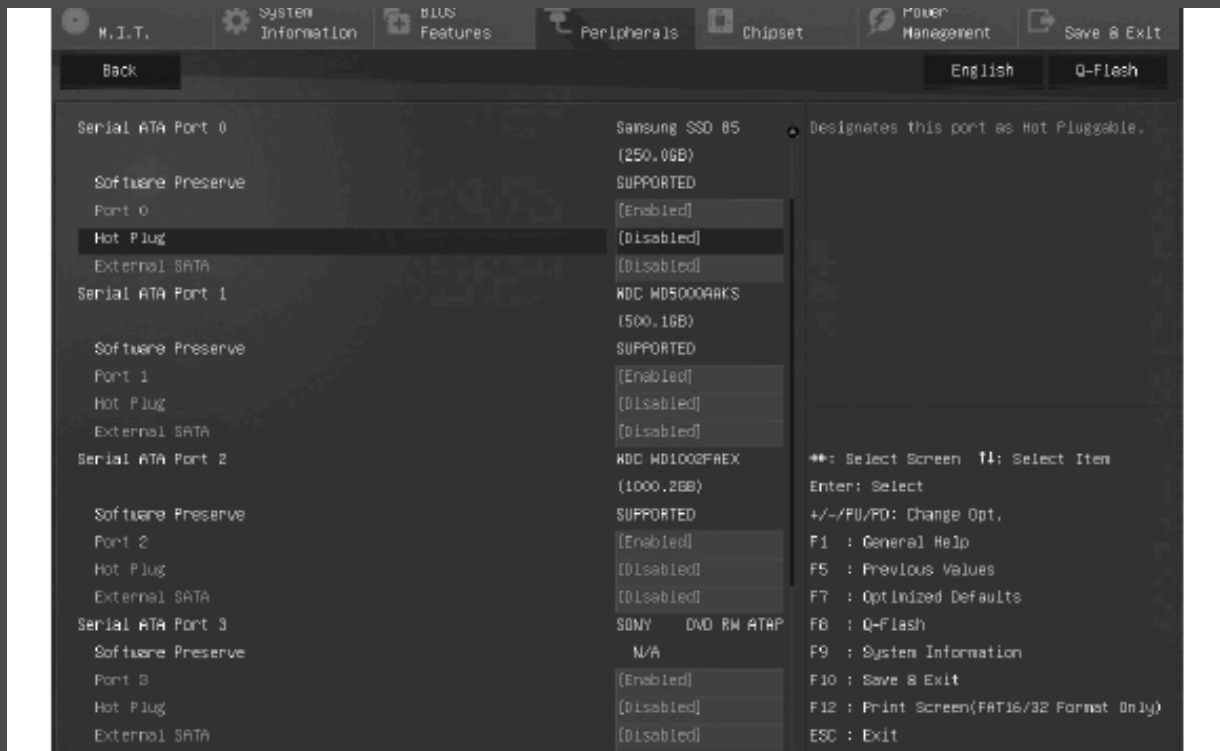
Installing Drives

- Autodetection – means the drive should appear in CMOS.



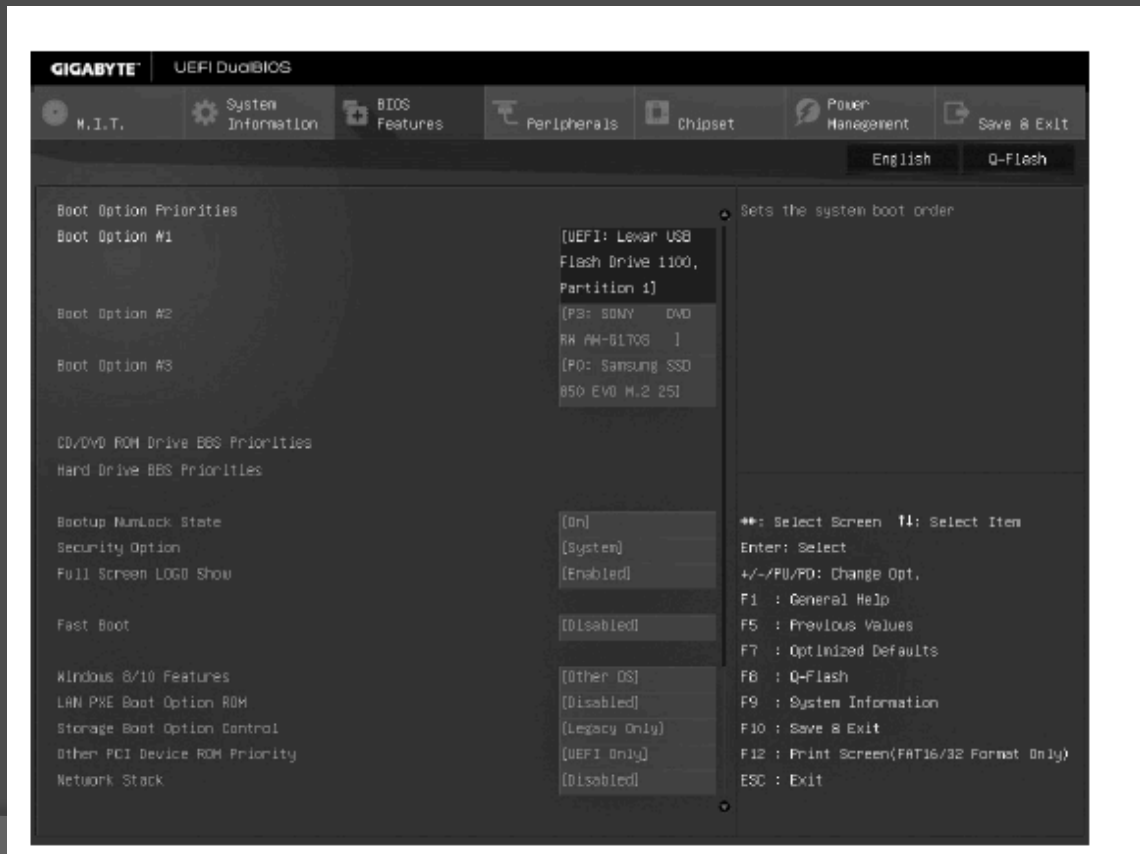
Installing Drives

Motherboards with SATA connections use a numbering system and each motherboard has its own. A common one is the first Boot device is channel 1, the second 2, and so on. So instead of names of drives, you see numbers.



Installing Drives

- Boot Order: You assign boot order priority to drives and devices in CMOS.



Hard Drive Technologies

- The End

Thomas Russell
Information Technology Teacher