FAQ - Hardware

- Electricity and Power Supplies
- The Motherboard
- Memory
- Floppy Drives
- Hard Drives
- I/O Systems
- PCs on a Network
- PCs on the Internet
- Printers

ELECTRICITY AND POWER SUPPLIES

Q: What is the difference between a transformer and a rectifier?

A: Thanks for the question. A rectifier is a device that converts alternating current to direct current. A transformer is a device that changes the ratio of current to voltage. A power supply inside a computer is both a rectifier and a transformer. The rectifier part of the power supply steps down the 120 volts house supply to 3.5, 5, and 12 volts. The transformer part of the power supply changes the AC to DC. So, coming to the power supply is 120 volts of AC current. Leaving the power supply going to the system board, hard drive, and other components is 3.5, 5, and 12 volts of DC current.

Q: I was wondering if it is okay to have your computer on a carpet floor? Thank you for your help.

A: Thanks for an excellent question. The issues having to do with placing a computer on carpet are static electricity and ventilation. If the case is properly grounded, placing a PC on carpet that has short fiber or loop is okay. Deeper cut plush or shag carpeting should be avoided because these deeper cut carpets can block the ventilation opening in the case (usually located below the front panel) causing the computer to overheat. The rule of thumb is that if the carpet fibers are touching the front of the case, you should not put the case on the floor.

No matter where you place the computer, it should be properly grounded. Always use a grounded outlet (one that has room for three prongs). Use a receptacle tester to verify that the ground on the outlet is wired correctly. Another tip to remember is never put a PC on the floor where it can be easily kicked.

Q: When working with hardware, when is it important to not ground yourself?

A: That's an important question! Let's start with why it's important that you should be grounded when working with electronic equipment in the first place. The primary need for grounding yourself is to protect the hardware from damage due to electrostatic discharge (ESD). A grounding strap connects your body directly to the equipment and prevents a voltage charge from developing that could damage the equipment when you touch it.

An example of static we are all familiar with occurs when walking across carpet (which increases your voltage potential) and then touching someone (who has a lower voltage potential). The shock you feel is the discharge of current that brings you and the other person back to the same voltage potential. While this type of charge can be greater than 5,000 volts, you might not even notice a discharge of 3,500 volts. However, electrical components may be damaged by less than 100 volts. This means that without proper grounding, you can damage electrical equipment and never know it.

Saving equipment sounds great until you realize that it often requires wiring yourself to a piece of hardware that is in turn connected to a live electrical outlet. Which may lead to the question, "When should I not ground myself?" So how is the person working with the equipment protected from an unwanted electrical shock or worse?

A 1 Mega ohm resistor is typically placed in the grounding strap connecting the person to the equipment. This resistor limits the current flow to 250 micro amps at 250 Volts rms. This amount of current is just below the typical level that is noticeable to the human body and at which the nervous system starts to have problems. Before using a wrist strap, you should insure that resistance between the strap and grounding plug is approximately 1 Mega ohm.

After you are protected, then you can safely insure the equipment will not be damaged. The equipment should be grounded preferably to an earth ground and always without using a resistor. Always make sure to follow all precautions and directions that come with any anti-static equipment.

Besides making sure you are using a proper grounding strap, there are situations when you should not be grounded at all. When working inside equipment such as a power supply or monitor, you should not be grounded because these devices contain powerful capacitors that hold their charge even after the power is disconnected. If you happened to touch one of these circuits, you might receive a dangerous charge as the charge flows from the capacitor to you (the ground). A PC repair technician should never attempt to work inside these devices unless you have been certified to do so because of this danger. Send monitors and power supplies to a certified service center for repair or simply replace them.

Q: When choosing a UPS, what is the difference between the VA and the Watts rating? Also, is it possible to connect two computers to one UPS as long as their combined VA/UPS rating is less than that of the UPS? What if only one of the computers is connected with a serial port (SMART) cable?

A: Thanks for the question. Properly sizing an Uninterruptible Power Supply can be a daunting task. At the heart of the confusion is your very question. What are VA's and Watts, and how do they affect me?

VA or Volt-Amps is the product of the voltage a piece of equipment requires times the current it draws. The actual power used by the equipment expressed in Watts is typically 70% of its VA. The UPS industry will often use a 60% factor to arrive at the Watt requirement to be on the safe side.

The primary concern is to not overload a UPS. Add up the VA ratings of each piece of equipment you wish to protect and then divide by a factor of .6. The result is the approximate size of UPS you should use. Select the closest UPS rating above the number you came up with. This will provide a 40% cushion to insure safety. If the required rating is high enough, it may make more sense to use multiple UPSs.

If the total requirements of your two computers do not exceed 60% of your UPSs rating, you can safely connect them.

A serial cable is used to allow information from the UPS to pass to a computer. This information is primarily used to shut the computer down "gracefully" before the UPS battery dies after power has been lost. Some UPSs have multiple serial ports for data connections.

If you only have one port or cable, connect it to the computer with the most important data. Finally, you will need to load and configure the software supplied with the UPS or included in your operating system.

Q: The electric outlets in my house do not have the ground. This is bad for my computer, right? What should I do?

A: Yes, I'd say so. Damage from ESD (electro-static discharge, AKA-static electricity) and/or data-loss may result from an ungrounded computer. An earth-ground is both a safety feature and a means of dissipating any static or induced charge that might affect how a component functions.

The best thing to do is to have a qualified or licensed electrician install a grounded outlet or to run a ground to a water pipe from the outlet box so that you can use a grounded outlet receptacle. Considering all of the safety issues when working with electricity as well as local building regulations, I would recommend that you not attempt this yourself.

THE MOTHERBOARD

Q: In your book you refer to the Intel Itanium: the Next Generation Processor. Are you talking about the new Pentium IV?

A: Thanks for the question. The Itanium, formerly known as the Merced, is actually not the same as a Pentium IV processor. Designed for next generation, high-end workstations and servers, the Itanium is a completely new design. These processors are projected to hit the market in the first half of 2001 and will initially be running at about 733 MHz and 800 MHz, with 1+ GHz versions to follow.

The Itanium uses an entirely new architecture from the Pentium line. It's about as different from the Pentium as the Pentium is from the 80486. The Itanium uses a new set of instruction code known as "Explicitly Parallel Instruction Computing," or EPIC for short. EPIC allows for more instructions per clock cycle than the older CISC instruction code used by the Pentium CPUs.

The new processors will also use 64-bit memory addressing, rather than the 32-bit memory addressing used by the Pentium. This feature means we can have more than 4 GB of RAM addressable by the CPU. Other improvements include onboard L1, L2, and L3 cache, enhanced ECC and backward compatibility to software designed for older x86 processors.

For more information, see this web site: www.sharkyextreme.com/hardware/guides/itanium/

Q: Why would you want both ISA and PCI expansion slots on a system board?

A: You'd want both ISA and PCI slots on a system board so that you can use older ISA cards as well as the newer PCI cards in the same system. For example, you might have an old modem card that is ISA and a new sound card that is PCI.

By the way, the trend is to have only one ISA slot on the system board or none at all as ISA is slow, hard to support, and definitely on the way out.

Q: I always understood that Pentium class CPUs even up to the P3 are 32-bit processors. Yet, I've come across in another book where Pentiums are called 64-bit, or dual 32-bit. Could you clear this up for me? Thanks!

A: Yes, I think I can help clear this up. First, you are right, the Pentiums are all 32-bit processors, including the Pentium III and Pentium IV. What that means is that the CPU's Arithmetic and Logic Unit (ALU) processes 32 bits at a time. This is called the word size of the CPU. The Pentiums have a data path size of 64 bits and also have two Arithmetic and Logic Units. Each ALU can process 32 bits and sometimes they can process simultaneously. This is why the Pentiums are called dual 32 bit processors. Each ALU can process 32 bits and together transmit 64 bits in and out of the processor. Remember, though, that the Pentium is still a 32-bit processor. The first Intel processor for PCs that is a true 64-bit processor is the Itanium, which is not yet on the market. Software is written to use 32-bit processing. To take advantage of the Itanium's 64-bit word size, all that software must be recompiled. Microsoft has announced it will come out with a new version of Windows that will use 64-bit processing about the same time that Intel comes out with the Itanium. Thanks for the question, Jean

Q: I have an Asus motherboard, which I took from my brother after he upgraded his computer. The CPU is an Intel Pentium II 400MHZ (the big CPU). After I installed it in my computer, it loaded Windows ME fine. When I start using the mouse to perform any function the whole system freezes, so I formatted the hard drive again and removed all other cards in the system and left only the video card and installed win98. I had the same problem.
I changed the memory and bought new one 128MB one piece. It did the same thing. Can you help?

A: Sounds like you've had a frustrating time and tried several different things. The two things you didn't mention checking were CMOS and the mouse itself.

Check your CMOS settings to ensure that the type of mouse you are using is enabled. What type of mouse are you using? A serial mouse can cause this type of problem if there is a resource conflict on that serial port. If you have a PS/2 mouse, is there any device assigned to IRQ 12? Again, this can cause a conflict. Did the mouse work during setup until the time the install wizard began configuring devices? If the mouse worked until then, there is a good

chance that there is a resource conflict. It is possible that the mouse is bad. Try using another mouse if possible.

I want to encourage you! When you get this problem solved, you're going to end it with a very nice system that you pretty much built yourself!
Thanks for the question,

Q: I just wanted to know what CISC is and what other technology is competing with it.

A: Thanks for the question. CISC stands for Complex Instruction Set Computing. CISC technology applies to the CPU and is one of two design concepts used for CPUs. The other one is Reduced Instruction Set Computing (RISC).

To understand CISC and RISC, you must first know that CPU design has traditionally been a balance between function and speed. The CISC approach integrates many functions into the processor chip that were previously performed by programmers in software. The goal of CISC is to make programming software easier because the CPU has many different functions that a programmer can make use of. The downside of this approach is that with the many complex instructions the CPU is capable of, speed is sometimes sacrificed.

The RISC approach removes many of the built-in functions that were infrequently used and focuses on having just a few highly optimized commands. This approach increased the raw speed of the CPU, but placed a greater burden on software designers and utilities that optimize and translate software to work with the processor.

Now as a famous radio personality would say, here is "the rest of the story". The semiconductor technologies of today have advanced to a point where CPU designers don't have to make nearly as many sacrifices when designing their chips. If it will help performance, then stick it in there! Need some new functionality? Then put it on the chip! The so called CISC and RISC chips of today incorporate many similar features and are getting more and more alike with each new generation. They certainly do not represent the original design philosophies that gave rise to these terms.

To illustrate this, the PowerPC G4 chips in today's Macs have a larger instruction set than today's Pentiums. However, the PowerPC, Alpha, and SPARC processors are considered to be RISC. The Intel family and compatibles are still considered to be CISC processors. Present day CPU's really encompass more than these terms imply.

Q: How can I find out if the P-IV processor in my computer is the original one?

A: Thanks for the question. The only way to prove your processor is the original one is through documentation that may or may not have been provided at time of purchase. There are on and off problems with counterfeit processors, that is, processors marked with higher performance numbers than they actually provide or even different manufacturer markings.

Unfortunately it can be very difficult to tell if the processor is what it is claimed to be until the CPU is installed and performing. One way to feel more confident that you are getting what you pay for is insisting on product documentation. But again this can be faked.

When purchasing processors, if you want to be as sure as you can be that you are getting what you pay for, buy the boxed version of the processor instead of an OEM version (without the box). Expect to pay a slight premium. The only difference is the packaging... literally. The slick packaging of the consumer product is expensive to duplicate and therefore less profitable to fake.

Q: I have an IBM Aptiva 2159-S90 which uses the access station (with Floppy drive and CDROM) to plug into the Main PC and power it up. The Aptiva takes a long time to power up. When it does, it goes to the familiar "IBM" screen but when it prompts for F1 to get to setup, the screen goes blank and the green light on monitor goes back to amber, losing all video. Any suggestions would be most helpful.

A: Let me start by saying that IBM is very sparse with their support information and I have been unable to locate much outside information about this problem with an Aptiva. However, this link will take you to a handbook that may help: ftp://ftp.software.ibm.com/pc/pccbbs/aptiva/p76h6287.pdf

From your post, I am not totally clear about the exact symptoms of the problem either. A slow boot can be caused by many factors ranging from a corrupted file system, a failing HDD, power-supply, or even flaky RAM or CPU. All of which are bad news. On the other hand it can also be caused by a fragmented file system, in which case noticeable improvement is relatively easily had by running Windows Disk Defragmenter from Start>Programs>Accessories>System Tools. It does not sound like that is your only problem though. From your post it sounds like the system locks up during the boot process. A slow boot followed by a lock-up would tend to point to a more serious problem.

Try booting into Safe-Mode. If that works I would reload the video drivers. I assume that you are pretty sure that the system does not complete the boot process after it loses video. If you are not sure try booting and leaving it alone for a half-hour. It is possible that it is so slow that the video will come back if and when protected mode drivers are loaded.
After a half hour resulting with no video you can test whether windows actually loaded. Login if necessary, being careful as you type since you can not see what you are doing on the screen. Next press the Windows key, then the up arrow key once and Enter twice. That will cause the system to stand-by, shut down or reboot if windows has completed loading, so look for signs of activity.

I am sorry I could not be more specific but the nature of this problem is very hard to diagnose without being in front of the system.

Q: Why is there no socket 6 for CPU's?

A: Thanks for the question. There was an Intel standard for socket 6 CPUs and motherboards, which was based on the socket 3 standard. However, the standard was developed for the 486 when the Pentium was replacing 486s as the de-facto standard for a new PC. Few, if any, manufacturers decided to invest in this standard because it was virtually obsolete when published.

In case you're interested, here are the socket 6 specifications:

Intel Socket 6 Specification
Designation: Socket 6
Number of Pins: 235
Pin Rows: 4
Voltage: 3.3 volts
Motherboard Class: 486
Supported Processors: 486DX4, Pentium OverDrive
Socket 6, 235 pin ZIF PGA (19x19), 3.3v, 25-40MHz

MEMORY

Q: What is the difference between SIMM and DIMM memory modules?

A: A SIMM (single in-line memory module) is a 32-bit memory module used with older personal computers. That means a SIMM can receive data using a 32-bit data path. If error checking (called parity) is included, another 4 lines are used for the parity information, and the SIMM then uses a 36-bit data path. SIMM's have a 72-pin connector and support various memory capacities up to 64 megabytes. SIMMs were popular on older 486 computers that used a 32-bit wide data path from the CPU to memory.

Then the Pentium CPU came on the scene, which used a 64-bit data path – twice as wide as the 486's data path. As the Pentium was introduced, the need for higher capacities and wider data paths arose. This resulted in the creation of memory modules that effectively combined two SIMMs. The resulting DIMM (dual in-line memory module) has a 64-bit wide data path. DIMMs have a 168-pin connector and support a wide range of memory capacities, currently up to 2 GB.

Two SIMMs are required to fill a memory bank for a Pentium processor where one DIMM will do the job. That's because a Pentium pours data into RAM using a 64-bit data path and one DIMM has that same 64-bit data path, but it takes two SIMMs working side-by-side to receive data from the Pentium.

Q: What is the difference between L1 and L2 cache memory? And where are L1 and L2 cache located?

A: These are a very good questions and I'm glad to get the opportunity to discuss them! Both questions used to have very simple answers, but things have gotten a little more

complicated beginning with the Pentium II, and now it's not so easy to distinguish between L1 and L2 cache. It used to be that L1 cache was located on the processor integrated circuit (IC) and L2 cache was located on the system board. That was really the difference between them because they are both used pretty much the same way. L1 cache is faster than L2 cache because it's closer to the CPU. In those days, you couldn't see L1 cache because it was embedded inside the IC along with the CPU, but you could see the L2 cache chips or modules on the system board and could even upgrade L2 cache with an additional memory module called a COAST.

But, beginning with the Pentium II, L2 cache has been moving closer and closer to the processor and out of sight to the naked eye. The Pentium II and later Pentiums put the L2 cache inside the processor housing – not on the same IC as the Pentium II, but on the same tiny circuit board inside the housing. Still, they're both inside that processor housing now and there's none on the system board proper. You can't see either one and there's nothing to upgrade.

So, what's the difference between them now? Actually, in my opinion, there's practically no difference. It's all memory cache and it's inside the housing, so who cares if it's called L1 or L2. Intel is still making a distinction, so we'll all do the same, but my guess is it won't be too long until Intel starts calling it all just memory cache. Things will be simpler then!

Q: When is it appropriate to use a Pentium MIMX rather than a Pentium II in a computer system?

Why does memory want to be refreshed?

A: Thanks for two good questions. In an old system, if you're replacing the CPU, you must use whatever the system board supports. That might be an MMX or a Pentium II. Check out the system board documentation. If you're selecting a new system, then, if you can afford it, choose the Pentium II. It's a couple of steps above the Pentium MMX. The Pentium MMX was designed for home use and performs well with games. Let your budget decide!

Why does memory want to be refreshed? Microchips are manufactured using one of two technologies: TTL (transistor-transistor logic) or CMOS (complementary metal oxide semiconductor) technology. CMOS microchips cost more than do TTL microchips. Most CPU microchips use the CMOS technology and, of course, the microchip that holds system board setup data uses CMOS technology. (We even call it the CMOS chip.)

The major difference we need to be aware of between CMOS and TTL besides the cost is that TTL microchips can't hold information longer than just a few milliseconds before the data fades away and must be rewritten to the chip. CMOS chips can hold their data as long as there's electricity powering the chip. RAM chips are built as TTL chips primarily to keep the total system cost low. However, these RAM chips must then be refreshed about every 4 milliseconds.

Because of all that time spent refreshing, RAM can be pretty slow compared to how fast it could be if it were made of CMOS chips. To compensate, system board manufacturers decided to put a little CMOS RAM on a system board along with a lot of TTL RAM. Use the CMOS

to hold data that's about to be used next and use the TTL RAM to hold data that won't be used for a while. That's the concept behind a memory cache made of static RAM using more expensive CMOS technology and dynamic RAM using less expensive TTL technology.

Q: What is the difference between SIMM and DIMM memory modules?

A: Good question. Single in-line memory modules (SIMMs) and dual in-line memory modules (DIMMs) provide a simple method of adding random access memory (RAM) to a computer. Both are small circuit boards with solder attached memory chips and a connector down the length of one edge. However, there are some very distinct differences between these two types of memory.

The earliest SIMMs had a 30-pin connector providing an 8-bit path for memory access. As memory requirements increased, 72-pin SIMMs were introduced which had a 32-bit data path. Once again, to meet ever increasing demands for memory and bandwidth, the 64-bit DIMM was introduced with a 168-pin connector.

So, why did the name change from "single" to "dual"? To find the answer, we have to look at the edge connector on these memory modules. With SIMMs, the contacts on opposite sides of the edge connector are electrically tied together. As pin counts increased, this style of connector would just keep getting longer and soon become impractical.

A better solution was to develop a way to gain more contact density out of a similar length connector. To do this, the contacts on one side of a DIMMs edge connector are isolated from the contacts on the other side of the connector. Each side of the connector has unique contacts thus doubling the density of a given length of edge connector.

Because of the design differences of the edge connector, DIMM sockets are different in design from that of SIMMs. SIMMs are installed at an angle and then "rocked" upward to a perpendicular position (in relation to the system board). This maximizes the pressure on one side of the edge connector to insure a reliable connection. A DIMM, on the other hand, is inserted in a perpendicular manner directly into its socket. This insures even pressure for the contacts on both sides of the edge connector. Because of the differences in the edge connectors, DIMMs and SIMMs have unique sockets and are not interchangeable.

The doubling of the connector density and data path effectively makes one DIMM equivalent to two 32-bit SIMMs. Thus, the use of the "dual" terminology.

Q: Why is DRAM less expensive than SRAM?

A: In a nutshell, SRAM is more expensive to produce. The S in SRAM stands for Static because it holds its charge as long as power is available. The D in DRAM stands for Dynamic. It is designed with tiny transistors and capacitors that can only hold their charge for a very short period of time, and power is continuously refreshed in a continuous cycle. Access to SRAM is up to six times faster because, in order to read or write to DRAM, the process must

wait until the appropriate time in the refresh cycle. Because it is so prohibitively expensive, only small amounts of SRAM are used where their speed makes the most difference, like in L1, L2, and L3 cache.

Q: I was looking at some computers at retail Web sites, and I noticed that the most expensive computers have RDRAM. What is RDRAM and how does it differ from DDR SDRAM?

A: RDRAM (a.k.a. RAMBUS) was originally the only option for use with the P4. Its design and licensing generally make it more expensive than DDR SDRAM. Currently many models of motherboards are made for use with the P4 and DDR SDRAM. The fact that originally you had to use RDRAM with the P4 aggravated some PC enthusiasts and RAMBUS vs. DDR became another battle in the war between AMD and Intel. It is still a pretty contentious debate as to which is "better," and expert opinions often follow preference for Intel or AMD. Suffice to say that they both have strengths and limitations, and unless you have a compelling reason to do otherwise, don't base a decision to purchase a system on whether it uses one or the other.

Q: Can you please tell me about Flash ROM?

A: Flash ROM is a type of Programmable Read-Only Memory that can be erased electrically and "written-to" by following a special procedure. PCs use Flash ROM chips to store BIOS programming, and many devices use them to store information on removable cards, such as digital cameras to store pictures. Flash ROM is used because, like all read–only memory, it is non-volatile and will hold its information even when a power source is not present.

Flash ROM is used to store BIOS so that it can be upgraded without removing it from the system. Upgrading BIOS is manufacturer/model specific, so follow the exact procedure recommended!

Some BIOS chips may actually be EEPROM or Electrically Erasable Programmable Read-Only Memory. Most of these chips are protected by a foil sticker, which might be imprinted with the manufacturing information. But not every chip with a foil sticker is an EEPROM. EEPROMs are capable of being erased by exposure to ultraviolet light so care should be taken not to remove the sticker or expose any chip with a foil sticker to direct sunlight.

FLOPPY DRIVES

Q: I would like to know how flat ribbon cable works when it is connecting the MI/O CARD and has 2 drives connected: A and B.

A: That's an interesting question. The design of the flat ribbon cable used for attaching floppy drives to a computer has its roots in the first personal computers and has not really

changed over the years.

A ribbon cable has always been used to attach floppy drives to the computer's floppy controller. Normally the floppy controller will support two drives typically referred to as logical drives A and B.

With a typical flat ribbon cable, a problem arises when the floppy controller tries to distinguish one drive from the other. Early floppy drives had a drive select jumper used to determine if the drive would be recognized as A or B. As long as the two drives were set uniquely, they both would be recognized. In practice this often caused confusion when the jumpers were not set correctly.

To make drive selection easier, a clever change was made to the flat ribbon cable. The control lines used to distinguish the A and B drives were reversed on the ribbon. Reversing the lines was accomplished by a twist in a few of the wires between the A and B drive connectors.

This allowed both floppy drives to be configured identically, and the connector on the ribbon cable determined whether the drive was A or B. The drive connector closest to the floppy drive controller and before the twist is recognized as drive B. The furthest connector from the floppy drive controller and after the twist is drive A.

Newer floppy drives assumed the use of this type of cable and eliminated the drive select jumper altogether. The most difficult part of connecting a floppy drive today is making sure the pin 1 side of the ribbon cable (the side with a colored stripe) is connected to pin 1 of your drive's connector (usually labeled with a 1 or with a square solder pad where it connects to the circuit board).

HARD DRIVES

Q: If a hard drive is too small to physically fit snuggly into the drive bay, what can you do?

A: Good question! You can improvise. Go to a computer parts store and purchase a universal bay kit. It has brackets that fit into the larger bays to hold the smaller hard drives. First, insert the kit into the bay and make sure the kit fits correctly. Be sure to notice just where the screws should go to hold the bay securely. Then remove the kit from the bay and install the hard drive into the kit. Use four screws – two on each side. Then install the entire kit and hard drive into the bay and use enough screws to securely hold the kit in place.

Q: What is maximum partition you can partition FAT32?

A: That's a very interesting question. Windows documentation says that FAT32 logical drivers that are 32 GB and larger will be created with a cluster size of 64 sectors. It doesn't mention a maximum size, but we can figure out what it would theoretically be. A FAT32 entry is 32 bits wide, but only 28 bits are actually used. So the largest cluster number that FAT32

can support is a 28-bit cluster number. What's the largest 28 bit number? 1111 1111 1111 1111 1111 1111 1111 = 268,435,455. Multiply that by 64 sectors per cluster and you get 17,179,869,120 sectors. Multiple that by 512 bytes per sector and you get 8,796,092,989,440 bytes. Convert to GB and you get about 8,800 GB. That's a pretty large drive!

But, there's a catch. The partition table of a hard drive contains entries that the drive will hold FAT32 logical drives. These partition table entries are only designed to contain information for a FAT32 drive up to 2,047 GB. So, logically speaking, the limit is 2,037 GB. I think it'll be a while before the hard drive manufacturers catch up to that!

Q: When two hard drives are connected to the same data cable, how does BIOS know which is the master and which is the slave?

A: Great question! The BIOS knows which drive is master or slave by one of two methods: By the cable connections or by jumpers set on each hard drive. Choices for the jumpers on a hard drive are Single, Master, Slave, and Cable Select (CS). The Single setting says to BIOS, "there is only one drive on the cable" and it controls the IDE connection. The Master setting says, "there are two drives on the cable" and this drive controls the connection. The Slave setting says, "this drive will not be controlling the connection". The Cable Select setting says, "the jumpers will not be used to determine which drive is master and which is slave", but the cable itself controls the connection. When using Cable Select, the drive furthest from the system board controls the IDE connection, and the drive nearest the system board is the slave drive. When Cable Select is used, a special IDE cable designed for that method must be used. Most often, a system uses the drive jumpers to control the master/slave configuration.

Also, know that which drive controls the IDE connection doesn't have anything to do with which drive is the boot device. That setting is made in CMOS setup.

Q: I have a notebook called Comusa Celeron 300mhz, windows me……after I got a virus, I installed windows me, but the mouse pad does not work and also most of keys of the keyboard do not function at all. Also when I reboot my computer, I get this information error: Umb upper limit segment adress:eb6d
Please tell me step by step what I can do to solve these problems.

A: Sounds like you got a very nasty virus. Hopefully you have backed up any important information. It is likely that you will have to Fdisk, Format and reinstall everything. If the files on the computer are so important that you can't live without them, you may want to seek a professional data recovery service. To try to avoid this, the first thing I would do is to try and boot using a recovery boot disk made before the virus was present and not used after the virus was present. In other words, one that can not possibly be infected. Make sure that it is write-protected so that the virus can't spread. If you don't have one, have some one you know and trust make a boot disk for you. This disk should be formatted under Win9x with system files transferred. Also the disk should have Fdisk.exe and Format.com at the minimum. Again, before you boot with this disk, make sure it's write protected so that it doesn't become infected. Once you have this disk, follow these steps:

Boot the computer with the boot disk in the A: drive.

At the A:\> prompt, test all the keys. Do all of the keys work? If they do then likely your BIOS is OK and go to step 10. If the keys do not work, then go to step 24.

Reboot the computer and go through the appropriate steps to adjust CMOS setup. Press the "delete" key for example, but it differs from manufacturer to manufacturer.

If the keys will work, look for an option to set everything to default settings and go to step 4. If the keys do not work then go to step 24.

Select "restore to defaults" or similar option.

Find the option "auto-detect IDE HDD" or similar.

Select "auto-detect IDE HDD" or similar and verify that the drive capacity matches your drive.

Select the "save settings and exit" or similar in BIOS setup. Be sure to type "Y" to save the settings. Computer will reboot.

At the A:\> prompt, test all the keys. Do all of the keys work? If they do, and you choose not to use a data recovery service, then go to step 10. If the keys do not work, then go to step 24.

At the A:\> prompt type "fdisk /mbr" this rewrites the Master Boot Record where some viruses reside.

Since this is a portable system it may have a suspend partition that should be removed so that the virus cannot re-infect from there. At the A:\> prompt type "fdisk" and type "Y" when asked if you want large disk (FAT32) support, unless you have a compelling reason not to (dual boot with DOS 6.22 for example.)

Select option 4 to display information. If there is no small "non-DOS" partition, go to step 15. If this partition is present, go to step 13.

From the Fdisk main menu choose option 3 and follow the steps to remove the existing partitions.

From the Fdisk main menu choose option 1 and accept default to use entire drive and make active.

Exit Fdisk and reboot.

If you have problems using Fdisk, the virus might be affecting the partition table. To solve this problem, download the utility Zapart.exe from www.firmware.com/support/atapro, and run this program. It will completely erase the partition table and Fdisk will be looking at a completely clean drive. Then run Fdisk again. (Don't use this utility unless the above steps won't work.)

At the A:\> prompt type “Format c: /u” this unconditionally formats the C: drive. Type “Y” to proceed and format drive.

Reboot and re-enter BIOS setup. Select option to “create suspend partition” or similar.

Look for option to set boot sequence (usually under “Advanced CMOS Options” or similar) and change to boot from CD-ROM first (if appropriate for your install disk.)

Place Installation CD or Floppy in the drive.

Save settings and exit.

System will reboot and follow directions to install OS and drivers. If you are using a WinME upgrade you will have to load Win9X first and then WinME.

If the keyboard still does not work or other serious problems persist then go to step 24, otherwise you’re done.

At this point you need to take the system in to be serviced by someone familiar with this model. While there may be other things that you could possibly try, for instance, adjusting a physical setting or removing the CMOS battery to clear BIOS, laptops are very specialized and should be worked on by those familiar with them. In fact, if you open the case of your laptop, you often void its warranty.

Q: What was or is FAT12 used for? Is FAT16 used on 3.5” drives?

A: Thanks for the question. FAT12 is used on floppy disks. FAT16 is used on hard drives under Windows 95, Windows 98, Windows NT and Windows 2000, although in most cases you will want to use FAT32 under Windows 98 or Windows 2000 instead of FAT16. In fact, Windows 2000 requires that you use FAT32 rather than FAT16 in some cases.

Q: For practice, I got an old discarded PC from work. It was a 386 and I upgraded it with a discarded 486 motherboard, put in more memory, 2 hard drives (both around 549 mg) etc, and it works. Now I am trying to install an old CD-ROM, so we can put on Windows 95 and other stuff from discs. The problem is, that right now because the 2 hard drives, there is no other slot to plug in the cable for the CD-ROM . Then I read in your book, that sometimes you can connect the CD-ROM through the audio card. I tried it, but it did not accept it. I have all the drivers for the CD-ROM, I refer to them in the config.sys and autoexec.bat programs, and I got some old diskettes, so my audio card is installed from DOS. Somebody suggested, that this particular audio card (it is a SoundBlaster), does not recognize other than Panasonic or Sony CD-ROMs. So I am stuck at this point. Can you suggest something? Technically, it should work, I took out this CD-ROM and the audio card from another computer, which had an upgraded Pentium motherboard. The audio card did work with this CD-ROM, but if I remember right, the CD-ROM

was not plugged into the audio card, it had a designated slot on the motherboard (which I don't have on the 486 motherboard). This is not a life/death situation, I am a VERY senior citizen, who simply got tired of being ripped off by computer repair guys for the smallest problems, so I decided I will learn how to do these, and I have a lot of fun. I added new hard drives, changed video and audio cards on my newer computer, and upgraded my daughter's computer also. I even brought back to life my very first IBM PC, which had a 20 mg hard drive, and that works too. I would appreciate your advice, but if you don't have time for it, that is OK also. I read your archive all the time.

A: When you installed the two hard drives, you must have used two IDE cables, each connected to a different IDE slot on the system board. Right? Each hard drive is configured as the single device on its IDE channel. Also, since the CD-ROM drive had been connected directly to the system board in the Pentium system, I'm assuming it must be an IDE drive.

An IDE cable has room for two devices. There are two connections on an IDE cable – one at the end and one in the middle – giving room for two IDE devices on a single cable. Connect the CD-ROM drive to one of these connections. Configure the hard drive on the same cable as the master and configure the CD-ROM drive as the slave. You make the configuration by setting jumpers on the hard drive and CD-ROM drive.

Also, when I mentioned the possibility of connecting a CD-ROM drive to an audio card, this only works when the CD-ROM drive is not an IDE drive but a proprietary drive that is designed to be controlled by an audio card. You still see one around occasionally, but not often. Thanks for the question. I'm glad you're enjoying the book and your new-found skills!

Q: Where can I attach a second hard disk drive? Which specifies my hard disk configuration? What are the hard disk parameters and which ones can be configured in CMOS?

A: Most system boards will support up to four IDE devices with controllers built into the main-board itself. There are usually two IDE channels, a Primary, and a Secondary. Each channel will support up to two devices called a "Master" and a "Slave". Look at your system board and you'll probably see two 40-pin IDE connectors somewhere on the board, one is primary and the other is the secondary channel. There should be at least one IDE cable running from one connector to your current hard drive. On that same cable you can connect a second drive (slave drive on the primary channel), or you can use a different cable to connect your second drive to the second IDE connector (master drive on the secondary channel). It's best to use the secondary channel with a second cable so as to not interfere with the performance of your first drive on its channel. You must set the jumpers on the hard drives to tell the IDE controllers which are master, slave or single devices.
If your BIOS has an auto-detect feature, then you might not have to set anything in CMOS. Let the BIOS do that for you. Just set the jumpers on the drives, install them in the case, connect the cables and turn on your PC. Let the BIOS do the configuring. Then partition and format your new hard drive.

If you have older BIOS that does not auto-detect or if you have a much older BIOS that does

not support the newer and larger hard drives used today, then you might have to do a BIOS upgrade or use software to get around the problem. How to do that is too much information to give here. Check out Chapter 7, Hard Drive Installation and Support, from the Guide to Managing and Maintaining Your PC. You'll find several pages explaining everything.

Q: I teach a PC Repair class and we are just starting the section on hard drives. We have been talking about hitting the various "walls" in the hard drive industry (528MB/8.4GB/137GB), and their workarounds. What is currently happening to get us past the 137GB wall? Are we going to see a complete overhaul of the ATA system, and if so, will the new standard be backwards compatible with our current systems?

A: That's a very interesting question. For those not familiar with the 137 GB limit for ATA hard drives, let me explain that first, and then we'll look at what's being done about it.

In a nut shell, the 137 gigabyte barrier exists because the original ATA design specification that controls how addresses are sent over an IDE data cable only provided for 28 bits to be used to address each sector on a hard drive. The largest number you can possible address when using 28 bits is 268,435,456, which is 2 to the 28th power. Therefore, you can only address that many sectors on the hard drive when using the current ATA design. If each sector is 512 bytes, then you can only access 268,435,456 x 512 bytes, which gives you a grand total of 137.4 gigabytes.

That seems like a pretty large hard drive, but the industry recognizes it won't be large enough in the not-too-distant future. The solution to this barrier is a new ATA standard, which has been named the ATA/ATAPI-6 standard. You can read about it on the ANSI NCITS T13 Technical Committee's web site at www.T13.org. The T13 committee is responsible for all the ATA/ATAPI standards.

The new ATA standard will provide for 48-bit addresses. This allows 144 petabytes (144,000,000 gigabytes) to be accessed. The ATA/ATAPI-6 standard is backward compatible with previous versions. New drives are already appearing which provide storage sizes above 137 gigabytes.

As an interesting aside, the next storage limit will be 2.2 terabytes (2 to the 32nd power). This barrier, however, exists because of the operating system, not the hardware. The barrier is caused by operating systems accessing data at 32 bits.

Thanks for an interesting question,

Q: Can you compare & contrast SCSI & IDE drives?

A: Thanks for the question. A lot could be said about comparing IDE and SCSI. I'll try to give you the bottom line...

SCSI and IDE technologies apply to the drives themselves as well as the interface between the drives and the motherboard. Also, SCSI and IDE drives can be hard drives, CD-ROM drives, tape drives and so forth. However, floppy disk drives have their own interface and so they are never SCSI or IDE.

You can recognize a SCSI or IDE drive by looking at the data cable that connects the drive to the system. IDE drives use a 40-pin data cable and most likely connect directly to a connector on the motherboard that is labeled IDE1 and IDE2 or Primary IDE and Secondary IDE. Today's motherboards have two IDE connectors and can accommodate data cables that can connect to two drives: one drive connects at the end of the cable and one in the middle. That means you can have up to four IDE drives in a system. IDE drives are always internal drives, not external.

SCSI interfaces can be by way of a SCSI connector on the motherboard or by way of a SCSI interface card called a SCSI host adapter. More expensive motherboards might or might not have a SCSI connector in addition to the standard IDE connectors. The connectors on the motherboard or host adapters use either 25 pins, 50 pins, 68 pins or 80 pins, depending on the SCSI standard used. SCSI drives can be either internal or external drives.

IDE drives are less expensive, easier to install, and generally not as fast as similar SCSI drives. One thing that adds to the cost of a SCSI system is the host adapter, which can be a little pricey. However, once you have a good SCSI host adapter installed, it can support several internal and external drives which can help give you a very fast system. However, there are a bunch of different SCSI standards, and some are not compatible with others so you have to know quite a bit about SCSI when putting together an SCSI system. The SCSI host adapter, drives, cables, and terminators must all use compatible standards. Also, one drive using a slower standard than the others will slow down the entire SCSI system.

So the short of it is IDE is easier to install, slower and less expensive than SCSI. When choosing between IDE and SCSI, use IDE because it is easier and costs less and use SCSI when speed is important.

As a final word, FireWire (sometimes called 1394) is slowly replacing SCSI as the new industry standard for fast drives for microcomputers. It's a whole lot easier to install than SCSI and prices are coming down.

Q: I have a question about SCSI connectors. In chapter 8, our instructor said that the first SCSI connectors had 25 pin connectors. But in the chapter, you say that "in an attempt to trim the size of the connector, a 25 pin SCSI connector was designed for narrow SCSI." This leads me to believe that 25 pin was not the first choice. Can you tell me what cable type was used for the first version of SCSI?

A: Thanks for the question. The SCSI standard has evolved quite a bit and can be somewhat confusing. Let's look at a little background first.

The first defined SCSI standard is called SCSI-1. This now obsolete standard used an 8-bit interface and low density 50 pin internal and external connectors. The most common external low density connector is often referred to as a Centronics connector and looks like

the connector for a printer cable at the printer end.

The standard also defined a 50 pin D-Shell connector that never really caught on. To further confuse the matter, Apple computers tended to use a 25 pin D-Shell SCSI connector that was identical to the parallel port on Intel based computers.

Some SCSI cards for the PC also used this 25-pin connector. The main problem was that the SCSI interface could easily be confused with the standard parallel port. Connecting a cable to the wrong interface often resulted in a damaged circuit board.

More recent SCSI standards defined higher density interfaces with smaller connectors that are much easier to work with.

One final point of clarification, the term "narrow" used with SCSI refers to the data interface (how many bits are transferred at a time) and not the physical connection. 8-bit SCSI is generally called narrow SCSI.

Which connector came first? Actually, that's difficult to say. All of the connectors described above were used with the SCSI-1 interface. In the PC world, the Centronics style was undoubtedly the most common, but I'm not sure I would venture to say which actually came first.

Q: I have a 30 gigabyte hard drive, but when I check the capacity of the hard drive, all I see is 27.8 gigabytes. On the hard drive it self, it says that it contains 30 gigabytes of space. I was just wondering where the other 3 gigabytes are?

A: Your missing hard drive space is more an issue of marketing than anything else and has to do with the way drive capacity is calculated. I'll explain how the calculations are done. Not knowing the model drive you have, I'll use the 30-gigabyte drive installed in my machine as an example. When I look at the specifications of my drive, they show a formatted capacity of 30,020 MB (megabytes) of storage. That equals 30 gigabytes right? Wrong.

Because the world of computers is binary (based on the number 2), it doesn't convert nicely to the numbering system that we are accustomed to which is based on the number 10. In the binary world:

- 1 kilobyte (KB) = 1024 bytes (which is 2 raised to the 10th power)
- 1 megabyte (MB) = 1024 bytes x 1024 bytes = 1,048,576 bytes
- 1 gigabyte (GB) = 1024 bytes x 1024 bytes x 1024 bytes = 1,073,741,824 bytes

To find the actual storage in GB of my hard drive, I need to divide the total number of MB available on the drive by 1024 to find the equivalent number of GB:

30,020 MB / 1,024 = 29.32 GB

So my 30 GB hard drive is really a 29.32 GB drive. It is a common practice for storage devices to be "creatively" sized like this. This practice has been around for a while. You didn't loose any storage, it's all in the marketing and the calculations.

Q: What should I do if my cluster goes bad and my PC can not boot or read the C: drive?

A: First, I'll assume that you know you have a bad cluster because you've received some type of error message about bad clusters or you have run some type of diagnostic software which has reported bad clusters or sectors. This can certainly prevent your computer from booting, especially if the bad sectors are located where the operating system or boot information is stored. Before we discuss what you can do about bad clusters, let me give you a little background information about them.

The fact is most hard drives have some bad sectors. If you have one without any bad sectors, just give it some time. Today's hard drives use some fancy footwork to hide a small number of sector problems. These modern drives set a little drive space aside to use as spares for replacing sectors that are found to be bad. Each region of the hard drive has a predefined number of these replacements.

When bad sectors on an area of a hard drive exceed the available spares, the un-replaced bad sectors will be reported when diagnostics are run. If the number of bad sectors continues to grow or they are located where boot or operating system information is stored, the drive will need to be replaced.

A utility called SpinRite offered by Gibson Research (www.grc.com) will test a hard drive's surface and refresh the data on the drive without loosing data. In some cases, this utility can reclaim sectors inadvertently marked bad and even recover data. However, no utility can repair a sector that is truly bad.

If you are using Windows 98, you could also boot from a Windows 98 startup disk and try to recover your data, scan the disk for errors, and reinstall Windows. Here's what to do:

• Boot from the Windows 98 startup disk (If you don't have one, you can create it on another Windows 98 PC)
• Use the Copy command to copy important data to floppy disks or another media.
• Use Scandisk to scan the disk for errors, marking bad sectors as unusable
• Use the Fdisk and Format commands to repartition and reformat the drive (Any bad sectors marked by Scandisk will not be used when formatting the drive)
• Reinstall Windows 98

If this doesn't work, then the next step is to replace your hard drive.

Q: I have a couple of questions for you:
(1) When trying format my hard drive, I get a saying "format aborted". Why is that?
(2) I'm considering upgrading my hard drive from the current 2GB's to, say, 6GB's. The computer is fairly old, circa 1995, so do you think I would need to upgrade the motherboard as well, or do you think my old board would support the larger drive?

A: A Format Aborted error would generally indicate a problem with the partition tables on the drive or a physical problem with the drive itself. It might also arise if you are trying to format with a different version of FAT than it was partitioned for. You might try re-partitioning the drive with fdisk or a similar utility. Use the version of fdisk that is on the setup or startup disk of the OS you intend to run. If that does not work it means the drive will probably need to be replaced.

You may run into a HDD size limitation from a motherboard circa 1995, though I doubt it, if you stick to a 6 Gig drive. You may be able to upgrade the BIOS to support a larger drive as well, but again, with a board eight years old you may not be able to. Check the web for documentation on the board that you have. You should find the manufacturer and model stenciled on the board somewhere.

I/O SYSTEMS

Q: I'm looking for info about the standard PCI video graphics Card, AGP graphics card and AGP multifunction/TV Tuner card . Actually I'm looking for the comparison between these three cards i.e. Resolution and color capabilities, Video memory, Refresh Rates, System Requirements, Monitor Sizes, connectors, Frame Rates, Trianles Per sec, Memory, Video Processor.

I know I'm asking too much but please provide me some info. Your quick response will be appreciated.

A: Thanks for the question! It's a big one requiring some research! Here's what I'd do if I were you looking for this information. I'd go to the web sites of the major video and tuner card manufacturers and examine their white papers, technical support pages, and product comparison tables. I'd also check out sites devoted to reporting on the latest computing technologies and search for information on video and tuner cards. Here are some web sites to get you started, but you can find others by using search engines:

Some video card manufacturers:
3DLabs at www.3dlabs.com
ATI Technologies at www.ati.com
Avance Logic at www.avance.com
Creative Labs at www.creative.com
Diamond at www.diamondmm.com
Intergraph at www.intergraph.com
SiS at www.sis.com.tw

Search these sites for reviews, comparisons and/or explanations of the technical terms:
CNET, Inc at www.cnet.com
PC Guide at www.pcguide.com
Terran Interactive at www.terran.com
The Computer Paper at www.tcp.ca
Tom's Hardware Guide at www.tomshardware.com

Q: I have an IBM monitor, which is 9-pin and was manufactured in 1986. Can I use it with the latest color computer?

A: The short answer is yes. Before you decide to do this you will have to obtain a display adapter that will work with your monitor. Since damage could occur to the monitor and/or the system if you get the wrong one, I suggest you take the monitor to a trusted computer shop and have them select the right one for your particular system and OS. You should also adjust your display settings to two colors so that your picture is optimized. However, it might be to your benefit to buy an inexpensive, used 15" monitor that will plug right up to a 15-pin video port found on most systems today.

Q: I am having a serious problem with my two display adapters. I encounter a hardware conflict whenever I try to install a new display adapter. I have tried changing resources but this does not seem to be working at all. Please help!

A: Thanks for the question. Having dual monitors is a great help in many situations and well worth the time to get them up and working.

Since I am not sure what OS and display adapters you are using, I can only give general ideas. Windows 95 did not offer support for multiple adapters so if you are using 95 that is one potential problem. If you are using Windows 95, consider upgrading to Windows 98. Next, if you have an older PnP card or you are using a legacy card that uses jumpers to control resource settings that could be causing the problem. (On the PnP card, you might be able to remove all the jumpers to allow the system to set its resources.) Another potential problem is that Windows 98 supports multiple adapters as long as they are some combination of AGP or PCI but not EISA. Finally, make sure that the system will recognize each adapter installed alone to confirm there is not a problem with one of the adapters.

Q: My mouse doesn't work. I swapped a known good mouse, checked the connectors, and disabled, enabled, and disabled the mouse through the BIOS Setup. What else can I do? Could the problem be the motherboard?

A: The problem might be with the motherboard, but let's first look at a few other possibilities. There is a chance that you have a virus on your PC. They often prevent hardware devices from working correctly. Always check to see if a virus is present before getting too deep into diagnosing problems. It will save you a lot of time.

Swapping the mouse with a known, good/similar one is the best way to see if the mouse is the problem. Since another mouse did not fix the problem, check to see if the drivers for the mouse loaded correctly. To check your driver, you will have to navigate the Start menu with your keyboard. Do this:

• Use CTRL + Esc to open the start menu and then navigate with the arrow keys, Tab key, and Enter key.

• Select “Settings”, “Control Panel”, and then “System” to open the System Properties windows.
• If your operating system is Windows 95 or 98, then select the “Device Manager” tab. If you have Windows XP, select the “Hardware Tab” and the “Device Manager” button.
• In the list of devices displayed, highlight the “Mouse” or “Mice” section and press the right arrow key to see the devices installed.

If the driver has loaded correctly, there should be a PS/2 or serial mouse driver without red or yellow lines through it. If the mouse driver did not load correctly, you can try removing it and rebooting the system. The driver should reinstall on boot, and this might correct the problem.

If the mouse driver loaded without errors, then functionally the operating system “sees” the mouse controller hardware as working. All we are missing are inputs from the mouse itself. This may be the result of a problem with the mouse connector on your motherboard. If so, your best option is to locate a serial mouse to use on an open COM port. Or, if you are currently using a serial mouse, then try a PS/2 mouse. The next best option is to replace the motherboard.

Q: I have a GeForce3 TI 200 video card, and I am using the drivers that came with the card. Now, do I need to download the latest nVIDIA Detonator 29.42 drivers? Will they increase the performance?

A: In most cases, you’ll want to keep updating drivers for your hardware devices as new drivers become available. An updated driver in some cases might increase performance, but the primary reason to update a driver is compatibility with new software and hardware released since the original driver was written. A newer driver will also include fixes to problems with older versions (often referred to as bugs, sometimes referred to as “features”) and may even support new options or functionality for your video card.

Some manufacturers such as nVIDIA will notify you when new drivers are available. Just look for their “Driver Update Notification” link on the driver download page.

A final note about your question: Definitely do not install a driver that is not designed specifically for your hardware device. Don’t use the driver for the nVIDIA Detonator card with the Geforce3 TI 200 card. Only install drivers written specifically for your particular hardware and operating system. Just installing a software driver will not turn your GeForce into a Detonator graphics card or enhance its performance. An incorrect driver may cause a “detonation” of your operation system, however!

The most recent driver for the GeForce family of graphics cards is version 30.82. It can be downloaded from www.nvidia.com/content/drivers/drivers.asp. And be sure to download the driver written for your Operating System.

PCs ON A NETWORK

Q: Explain to step by step, how to network a room of 10 computers?

A: You don't have a simple question, do you? First, I'll give you a quick overview of things you need to consider and plan. Then a high-level step-by-step. Of course, it's impossible to cover all the details. But here goes....

The first step is planning. Think about how the network will be used. This will dictate what network model to use and what operating systems to run. Will the machines be purchased or if they are already on hand what hardware/software configurations do you have to work with? Ten machines is borderline between peer-to-peer and client-server. If there will be sensitive data stored on the network or a need for a database, go with a client-server model. If not, then go with a peer-to-peer network. If your machines already have a particular type network interface card, for instance 10Base2, you may want to keep a bus architecture. If there are no NICs or no majority of styles, Fast Ethernet is probably the way to go. Also, will this network connect to the Internet or other LANs? If the answer is yes, then determine what standards the other networks are running so that you can provide connectivity. What protocol(s) will you use? TCP/IP is necessary for the Internet but is slower than IPX/SPX and NetBEUI. What about name resolution? HOSTS or LMHOSTS files, WINS, DNS? There is a lot to think about.

After you have a plan in hand, the next step is to implement it. Purchase necessary equipment (NICs, hubs, cabling, etc...) and run the cables. Set up and test your machines. Make sure that the OS is set up correctly and that all drivers are installed. Since you will almost certainly be running TCP/IP, go ahead and assign a static IP address and use the loopback PING command to test that your NIC is good to go in each machine. Make any administrative additions, (set up user and computer accounts, edit HOSTS files, set up DHCP scopes, etc...) Lastly, put the components in place and connect the cabling. Test each component again. Troubleshoot any problems. Instruct the users on network use.

For a Step-by-Step for a Simple Peer-to-Peer Fast Ethernet Network:
1.Get necessary NICs, cables and hub(s).
2.Test the PCs to be sure they are working before you make changes.
3.Install the NICs and TCP/IP.
4.Assign static IP addresses.
5.Test NICs by PINGing your loopback address.
6.Set up File and Print sharing.
7.Place machines and hub(s) and cables.
8.Connect each cable to a PC on one end and the hub on the other.
9.Test the network.

If all of this seems hard to understand, you need to study a good networking book or take a course on networking before you begin.

Q: Can you use a USB hub for networking computers together? Possibly with an adapter that has a USB on one end and an RJ45 on the other end, like a peer-to-peer?

A: There may be a pure USB network but I have not heard of it. There are, however, external NICs that have RJ45 or Wi-Fi connectors to connect to the network, and USB connectors to connect to the PC. In this case, you are still using an Ethernet hub and not a USB hub.

PCS ON THE INTERNET

Q: Are there any limitations when one has to make a decision between using Static IP addresses or Dynamic IP addresses? And what leads companies to pick one from the other?

A: Thanks for a very good question. There is no technological limitation that would prevent a company with thousands of PCs from using static IP addresses. However, it would be a nightmare to administer! When using static IP addresses, someone would have to manually configure each and every PC, at the very least, setting up the IP address and subnet mask. You can see that this would be extremely time consuming. For this reason alone, most large networks make most PCs DHCP clients, getting their IP configuration from DHCP server(s). DHCP stands for Dynamic Host Configuration Protocol, and just one server can assign IP addresses to thousands of clients as well as assigning other configuration info as well. Of course, DHCP servers have to be administered, but, in comparison, administering DHCP servers is far more efficient than dealing with thousands of clients. Of course, if you only have a small workgroup, static IP is probably the way to go.

Q: My question concerns the new and forth coming IPv6 standards. How will they maintain backward compatibility when they change IP addresses from four-8 bit segments to four-32 bit segments? Will people have to upgrade all of their existing protocols?

A: You've asked a very good question. The problem with going from 32 bits for an IP address to 128 bits is the main reason IPv6 has not caught on any faster. Yes, we'll all have to upgrade our software and, in many cases, firmware as well. To say the least, it's going to be a big job converting over. All the issues have not been ironed out on Version 6, and it doesn't look like we're going to see a mad rush in that direction any time soon.

In the mean time, the problem of running out of IP addresses has been partially solved by the growing popularity of network address translation (NAT). Using that, all the PCs on a network use private IP addressing and a proxy server makes all the requests to the Internet in behalf of these PCs using its one IP address. That means an entire network only needs one public IP address.

Because of NAT, it's not so urgent that we all convert to IPv6.

PRINTERS

Q: Can you explain what a print driver is?

A: A driver is software that is used by applications and operating systems to interact with a device in a generic manner without knowing how to communicate directly with the device at a detailed level. Let's use a printer driver as an example.

Imagine you are the developer of a word processing application. People using your program will surely want to print the letters they type, so somehow you need to support sending their document to a printer. You could write the code for a specific printer and include it in your application. You would also need to do this for every model printer you want to support. Back in the early days of PC's, this is the process that was often followed. It was very possible to wind up with a program that might "not exactly" work with your printer.

To help sell printers, hardware manufacturers started writing small software programs that provided a generic software interface for the increasingly complex hardware of their printers. These programs, known as drivers, were initially written to interact with a specific application such as Word Perfect or Lotus 123. The result was that users of major software packages had a wider selection of printers to choose from. If a user's particular application did not have a driver written specifically for their printer, they would have to try using a driver for a similar printer and hope it worked.

Then along came Windows, where a new approach to printing was used. Instead of the application dealing with the printer hardware and drivers, the operating system took responsibility for managing it. The software application developer's job was easier because they only had to write their application to send a print job to the operating system and let the OS take over from there. Application developers no longer had to worry about which device was being printed to. Printer manufacturer just had to provide the driver for an operating system instead of a host of applications. The Windows operating system managed the printing process to the printer.

Today most every time you hear the term "driver" it means software that lets an operating system interact with some type of hardware or sometimes another piece of software. Think of drivers as translators between hardware and the operating system.