This course will enable you to do the following things:

Trouble-shoot BIOS setup programs,
trouble-shoot operating system installation problems,
trouble-shoot video problems,
trouble-shoot hard disk problems,
trouble-shoot RAM-related problems,
trouble-shoot application software-related problems,
trouble-shoot user-imposed problems, and
trouble-shoot registry problems using the Windows registry editor.

The course will also have entire class sessions devoted to the following issues:

Linux operating systems
Residential and commercial broadband Internet connectivity
Home and small-office networking
Windows 7, as compared to Windows Vista and Windows XP
Connected Personal Digital Assistants (PDAs)
System imaging with Norton Ghost Enterprise Edition
Macintosh PCs and the Mac Operating System
Practical computer repair sessions at the MarketPro computer shows

DRAFT VERSION: APRIL 9, 2010

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FOREWORD

These course materials were originally developed for use in the PC Hardware, PC Repair, Repair and Maintenance of Personal Computers, and the Build-Your-Own PC courses which I taught at Prince George's Community College, in Largo, Maryland. I developed these materials myself, with a view towards making complex issues in PC hardware and maintenance easy to understand. Through several years of teaching these courses and refining these materials, I believe this manual will be a useful resource for the reader.

I would like to express my deep gratitude and sincere thanks to a number of people who have made the development and implementation of this course possible over the years:

- My wife, Joyce, and my three children (Christina, Matthew and David), who have shared me with hundreds of students over the years;
- William Lauffer, the dean of Engineering Technology at Prince George's Community College, who gave me the opportunity to develop and teach these courses;
- Dirk Faas, Bradley Faas, Darrell Mattheis, Tony Magnotto, Robert (RC) Glanden, Pam Mitchell, Ron Able, Robert Malinowski, and all of my engineering assistants, who have made me look good so many times and have helped so many students when there wasn't enough of me to go around 20 students at a time;
- The board of directors for my non-profit organization, Research Technology Associates. They are people to whom I give permission to tell me what to do, and their advice is invariably always excellent; and
- Lisa Collins, one of my former students who became one of my teaching colleagues, who actually gave me the idea and the encouragement to develop this course.

Reproduction of these course materials without the express written permission of the author is prohibited. If you would like to obtain a copy of these materials, if you would like to have me come and teach my courses for your organization, or if you would like to license this curriculum for use with your school or non-profit organization, please contact me at the following address:

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COURSE SYLLABUS: ADVANCED PC TROUBLESHOOTING AND CONFIGURATION (ENT 2860)

INSTRUCTOR: William (Bill) Lloyd
President, Research Technology Associates, Inc.
Telephone: Home - 301/782-3585 (9:00AM - 10:00PM Mon - Sat)
Cell - 202/531-3925

No calls on Sunday, please.

Please call ONLY WHEN NECESSARY; leave a message at home, and I will return your call as soon as possible. You may leave a message on my voice mail by calling my PGCC office phone line. Bring computer problems to class when possible.

OFFICE HOURS: By Appointment Only; I will work with you and your schedule as much as possible. See me for details. My office at PGCC is in L210B, and my mailbox is in L112A.


CLASS TIMES: Classes are held as listed in the Semester Course Listing.

MISSION STATEMENT: This course will enable you to do the following things:

1) Trouble-shoot BIOS setup programs, including the standard and advanced setup options, PNP/PCI setup issues, integrated peripherals, auto detection features, wait states, and custom configurations;
2) Trouble-shoot operating system installation problems, including issues with LBA mode and EZ-Drive software, hard disk and memory problems, and lockups;
3) Trouble-shoot video problems, including issues with bad/incorrect video drivers, wrong resolution settings, selecting the wrong monitor type, and getting into safe mode;
4) Trouble-shoot hard disk problems, including file corruption, file naming problems, bad sectors and using Scandisk, fatal 0E exceptions, and viruses;
5) Trouble-shoot RAM-related problems, including unreliable XMS / page fault errors, RAM timing, mixing SIMMs with DIMMs, and fatal OE errors;
6) Trouble-shoot application software-related problems, including bad install programs, service packs and patches, conflicting DLL file versions, 16-bit vs. 32-bit DLLs, and user error;
7) Trouble-shoot user-imposed problems, such as powering down Windows, deleting directories, not running uninstallers, deleting icons, running multiple operating systems, and viruses; and
8) Trouble-shoot registry problems using the Windows registry editor.

These types of problems will be demonstrated and resolved in class, using overhead display projectors. Different types of PCs, different BIOS chipsets, and different operating systems will be used in the class.
The course also will have entire days dedicated to a single topic. This enables us to focus deeply on issues that more advanced computer technicians need to understand. Here is a list of “topic days” that will covered in the course:

- Linux operating systems
- Residential and commercial broadband Internet connectivity
- Home and small-office networking
- Comparing Windows 7 to Windows Vista and Windows XP
- Connected Personal Digital Assistants (PDAs)
- Macintosh PCs and the Mac operating system
- System imaging with Norton Ghost Enterprise Edition
- Practical computer repair sessions at the MarketPro computer shows

**CLASS RULES:**

- Feel free to ask lots of questions;
- Food and drink are permitted in lecture class, but NOT in the lab;
- Have fun!

**GRADING POLICY:**

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<th>Percentage</th>
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<td>20 percent</td>
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<td>Test 2 at 10th week</td>
<td>25 percent</td>
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<tr>
<td>Final Exam</td>
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<tr>
<td>Lab Attendance/Reports/Pop Quizzes</td>
<td>25 percent</td>
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100 percent

Tests will consist of multiple-answer, fill-in-the-blanks, and short-answer questions. Lab participation will be graded by attendance at the labs, taking part in the exercises, completing the PC evaluation forms, and using normal precautions in handling the equipment. Class attendance will be not be graded per se, but your presence and participation in class is expected and encouraged. Any rescheduling of tests will be granted when you contact me in advance, or if some unforeseen emergency occurs.

**CLASS EXPECTATIONS:**

This class is the final chapter of a three-part training program that will prepare the student to become expert in the building, configuring and trouble-shooting of IBM-class microcomputers. It is assumed that the student has been through the ENT 1840 (PC Hardware) and ENT 2840 (PC Repair) courses, and that he/she is familiar with the PC repair and troubleshooting techniques taught in these courses.

Students are strongly encouraged to build (or obtain) a PC during the scope of this class, and to use that PC to learn about the highly technical aspects of PC configuration and troubleshooting. There will be numerous opportunities to test non-working and problematic computers, but the student may need to have their own PC for experimental kinds of troubleshooting and problem resolution. **This may require sabotaging, dumping and reloading an entire hard disk of data. Production or home computers should not be used for such purposes.**

Experimentation with different types of computers and computer problems is strongly encouraged. The degree to which students can both “foul-up” and “fix up” computers as frequently as possible will dictate the richness and value of this class to the student.
Lectures will use class demonstrations and overhead projection units so that students will see how to resolve problems. Lab sections will be supervised by the instructor and several engineering assistants. However, lab sections will be largely self-directed, with the instructor and engineering assistants providing assistance and materials.

Several class days will be entirely dedicated to working “The Help Desk” at the MarketPro computer shows held throughout the Washington DC area. We offer a service where customers at the show bring in their problematic laptops and PCs, and we work to repair or diagnose the problems. This will provide you with an extraordinary opportunity to work on actual consumer PCs with issues such as viruses / malware, hardware failures, operating system corruption, application installation and removal, and laptop power problems. These days are considered lab sessions, and attendance is expected at the computer show.

If you have any questions concerning this syllabus or the goals of the course, please see me. Welcome to the class.
PLACES TO GET A HARDWARE TOOLKIT

The toolkit you need for these courses should be simple, and cost less than $20.00. It should include at least the following things:

- Phillips and flat blade screwdrivers (small and medium size)
- A 3-claw part grabber
- A chip inserter and chip extractor
- A TORX head screwdriver
- A 1/4” and 3/16” nut driver
- Perhaps a container to hold small parts and screws

Things you do NOT need include:

- A soldering gun
- Magnetic tools
- Drills

If you have a small volt-ohm meter, that's good; it may be useful in some instances. We have voltmeters in the lab, so you don't have to run out and buy one immediately. However, a power-supply testing device, available at computer shows for about $20.00, is a very handy addition to your hardware toolkit.

To buy such a toolkit, look in places like:

- Sam's Club
- NewEgg online
- PC shows
- Radio Shack
- MicroCenter
- Office Depot
- Staples
- Electronics stores

Plan to have your toolkit with you for all class sessions, and especially when we attend the MarketPro computer shows to offer the “Help Desk” service.
DEVELOPING A SOFTWARE TOOLKIT

In addition to having tools such as a screwdriver or a volt-ohm meter, you will need to develop a "software toolkit" that will enable you to address issues such as:

- Operating system repair and reinstallation
- Installing drivers for key system devices
- Installing application software (provided that the customer has a legal license for the program)
- Installing anti-virus, anti-spyware and other utility applications
- Running diagnostic applications

This does not necessarily require you to purchase such CD disks. Many times these disks can be obtained and copied without concern over software piracy issues. The instructor has CD / DVD duplicating resources that will allow us to copy and distribute disk media that will help you to perform the assigned tasks in the course. These disks include things like system recovery disks for various brands of PCs, driver installation CDs, and major application installation disks.

The course reference disk also has a wide variety of software that will assist you in removing temp files and unneeded entries in the Windows registry, cleaning off viruses and spyware, and trouble-shooting various issues. All of the applications on the course disk can be copied and distributed freely to others. The course disk serves as a foundation for your ever-growing software toolkit.

Whenever possible, keep original copies of these disks protected in a safe location. Make copies of these disks, and use those for your regular service work. Only use the original disks to make copies that can be used in the field; never use your originals for service repair work.

Copies of system restoration disks can be obtained from the major PC manufacturers for a nominal shipping charge. Check the manufacturer’s websites for further information.
CLASS READING ASSIGNMENTS

You likely have already read the Scott Mueller textbook, Upgrading and Repairing PCs, 19th Edition, or a similar text used in the ENT 1840 and 2840 classes, so there are no required readings from that book. You should do some review of the text, and have it available as a guidebook for your reference.

For the BIOS Companion book, you will be expected to review the entire text by the 8th week of the class, and then use it as a guide whenever you have random problems with PCs. I will let you know what is crucial to remember from this text during the lecture session for the class.

What if I don’t understand something?

Don't worry. Make a note of your questions, and bring them up in class. This is your opportunity to fill in gaps in your understanding of how PCs work. This course notes text is written in fairly non-technical English, so it will serve as a good tool for learning.

Will the readings be on the test?

Yes. I will elaborate on this as the course progresses. The main focus of this class is the discussion time you will have with me in lecture, and the lab time you will have with your PC.

See me with any questions.
TROUBLESHOOTING BIOS AND CMOS SETUP-RELATED PROBLEMS

The BIOS setup program on most PCs is intended to allow the user to easily and quickly set up the most important parameters necessary for the POST (Power-On Self Test) to run correctly. Most of these types of things can be set by an average PC technician without great difficulty. However, there are a number of BIOS Setup issues that are not quite so straight forward.

For example, the Advanced CMOS Setup allows you to enable things like built-in virus protection, shadow RAM regions, boot sequences, RAM timing and wait states, and so forth. The Plug-and-Play and PCI Configuration Setup lets you set how PCI bus connections and devices should operate, whether you have installed a Plug-and-Play compatible operating system, and so forth.

Each motherboard's settings and options may be different, and depending upon the motherboard "chipset" you have (the set of IRQ, DMA, and keyboard controllers that are permanently mounted onto the system board), different revisions of the same board or BIOS may have different features.

So HOW do you set a motherboard up correctly, or for maximum performance?

Documentation

Before attempting to modify any "non-standard" parameters of a CMOS setup program, you should consult the documentation that came with the system board. If there is no documentation available, at least go to the web site for the BIOS manufacturer and attempt to locate some helpful information about that board, and the revision level of the BIOS chip. Here are the web addresses for some of the major BIOS manufacturers:

- Award: [www.award.com](http://www.award.com)
- Phoenix: [www.phoenix.com](http://www.phoenix.com)
- AMI: [www.ami.com](http://www.ami.com)
- Microid Research: [www.mrbios.com](http://www.mrbios.com)

Try to have some paper documentation about the product before making any changes, if that is at all possible.

Recordation

Make a paper record of what the BIOS settings are for each sub-section of the setup program BEFORE you begin tinkering with the settings. At least this way, you will be able to get back to square one if you make any mistakes in working with the setup program. You may be able to print out a copy of each of these sub-sections by using the PrintScreen (or Shift - PrintScreen) button on your keyboard. Try printing out these settings before going to the trouble of writing them down on a piece of paper.

There are also utilities that let you save the CMOS values to a disk file, and then restore those values by booting from a floppy disk and running the restore program for the CMOS values. See your instructor for details on how to obtain such a utility for yourself.

Experimentation

It has been said that experimentation is the basis for all good research. This instance is no different. In order to find the maximum level of performance for your BIOS and chipset, you will have to tweak the settings, reboot the computer, and see what happens. If it works, then bravo ... if it doesn't, then go back and undo that change you just made. The key is: make only one change at a time, in order to make sure that you can analyze correctly the improvement or impairment of the system's performance.

With some BIOS products, there will be a selection in the Setup program that allows you to choose the "original" settings from the manufacturer, the "optimal" settings, or the "fail-safe" settings from the manufacturer. You may want to try these options in the Setup program, and notice what changes were made in each sub-section of the program, before venturing out on your own.

By the way, DON'T PUT ANY PASSWORDS INTO THE SETUP PROGRAM UNLESS ABSOLUTELY NECESSARY. You may be able to clear the password (and all the rest of the CMOS data) by temporarily
moving a jumper on the system board or removing the CMOS battery. But if you can't do that, you may be stuck with a system board that has a password that you can't eliminate, ESPECIALLY when you have forgotten the password. The password can prevent BOTH your booting to the operating system AND entering the CMOS Setup program as well. There are better ways of safeguarding your data than with a CMOS password.

Education

The Expert's Creed is stated as follows: Ask the one who has the experience. Many local vendors have been doing BIOS troubleshooting and configuring longer than you have, so it pays to consult them for their advice. Your presence here in this class is testimony to this idea. Once you have done the job of CMOS configuration several (or more) times, you will learn (as the experts have) that there are certain features that always should be turned on or off in a CMOS setup program (i.e., setting PCI configuration to Auto, making sure the shadow RAM settings are correct, turning off the Boot sector virus protection before installing your operating system, etc.). The more you do this kind of work, the more you experiment, the better you will get at this process. But start by asking your local parts supplier or computer guru a question like ...

"Is there anything I should know about setting up this system board before I buy it?".

Standard and Advanced CMOS Setup Options

The Standard CMOS Setup program in all BIOS products allows you to input the most critical specifications for your computer, such as the floppy drive types, the hard drive auto-detection feature, the date, the time, the memory size, and so forth. Anyone with a minimum of repair training can input this information with little difficulty. The information in this segment of the setup program, especially the hard drive parameters, must be exact and correct, or else the device(s) will not be recognized or work properly. If the hard drive device type is set to "Not Installed", the drive will not be recognized.

The Advanced CMOS Setup allows you to manipulate other issues that relate to booting correctly and speed optimization. This includes such things as setting the boot sequence (CD-ROM then C:, or C: then A:, etc.), enabling specific shadow RAM ranges, enabling boot sector virus protection, enabling a floppy drive seek at boot time, enabling cache memory (both external and internal CPU caches), enabling the quick or full Power-On Self Test (POST), system CPU speed, enabling RAM parity checking, and various password checking options.

Advanced Chipset Setup Options

The Advanced Chipset Setup options allow you to control the motherboard chipset (DMA and IRQ controllers, keyboard controllers), the way memory is addressed and refreshed, the way memory is tested, the wait states for memory, CPU and bus connections, the way ISA bus connections address devices, and other such features. In order to make changes in this portion of the setup program, documentation for the motherboard or advice from and experienced technician is required before making substantial changes.

Power Management Options

The Power Management options let you enable or disable the power-saving (or Green) features of the motherboard. Such motherboards can issue commands to specific devices (i.e., the hard disk, the monitor) to power-down (or go to sleep) after a set number of minutes of inactivity. Many of these features are set by device or by IRQ level. If your system seems to stop operating properly after 10 - 20 minutes, you may be encountering a situation where power management features are powering down your system.
PNP/PCI Setup Issues

The PNP/PCI Setup portion of the program allows you to control the configuration of the PCI bus connections on the motherboard, and the way Plug-and-Play devices are polled and configured. You can also tell the system board that a PNP-capable operating system (like Windows 2000 and above) is installed, the speed and method by which PCI devices are to be addressed, enabling PCI VGA Palette snoop (allowing a multimedia device to check the video card to see what color palette is being used), whether data from PCI devices will move in streams or blocks, how the built-in drive interfaces will pass data along the PCI bus, and also system monitoring features such as fan speed, CPU temperature, and voltages on the motherboard. Using the Automatic option is the best choice for most systems.

Integrated Peripherals

This portion of the setup program allows you to enable, disable and/or configure the built-in peripheral devices on your motherboard, such as the floppy drive controller, IDE interfaces, serial/parallel and PS/2 ports, and any other built in devices such as sound cards, video cards, SATA or SCSI host adapters, and so forth. Devices can be both enabled and configured to operate at a specific configuration (i.e., the first serial port can be configured to work as COM1:, COM3: or disabled; the parallel port can be set to work in standard parallel port (SPP), enhanced parallel port (EPP), or enhanced communications port (ECP) mode.). Make sure that these system board devices are configured properly, or else the devices may conflict with other devices installed in the bus connections on the board.

Auto Detection Features

This portion of the setup program allows you to automatically detect the installed hard drives in your system. The Cylinder/Heads/Sectors-per-track (CHS) parameters from the detected hard drives are passed to the Standard CMOS Setup part of the program, and if logical block addressing (LBA) mode or some other form of sector translation is needed to access the drive as a single partition, those options will be made available to the user at detection time. If the drive cables are not attached correctly, or if the master/slave jumpers are set incorrectly, or if the drive is defective, the drive will not be detected.

Custom configurations

The CMOS Setup program will normally come with an option to load the factory default settings for the entire program, an option to load the values used for the previous boot, perhaps an option for "optimal performance", and also perhaps an option for "fail-safe operation". Beyond that, you are able to tweak any of these settings on your own beyond what the manufacturer provides for you with these canned configurations.

A note from the author: There is a book that is worth it's weight in GOLD as it relates to BIOS features. It's called The BIOS Companion, and it's written by Phil Croucher. His book can be obtained over the Internet at www.electrocution.com. I strongly recommend your obtaining this book as a permanent desk reference about BIOS and CMOS Setup issues.

NOTES
TROUBLESHOOTING ISSUES WITH OPERATING SYSTEM INSTALLATIONS

What to Do When Windows Doesn't Install Properly

Normally, the operating system of your choice should install itself on your computer just fine, with a minimum of problems. A specialized script file, called an .INF file, contains the instructions needed for the install program to correctly run on your computer, and it has instructions to follow if it encounters specific issues or problems while installing the operating system. However, there may be specific problems on your computer that the script file cannot overcome, and the install program may bomb (quit abruptly) on you unexpectedly. When that happens, you should explore the following issues before calling Microsoft (or your vendor) for assistance. Below are some possible reasons why Windows will not install properly.

System Board Mis-configuration

If your system board has something mis-configured in the CMOS Setup program, your operating system (or other software) install program may bomb on you. Use the instructions contained in this guide on CMOS Setup Configuration for assistance in correcting this type of problem. Many times, using the "Original" default factory settings will solve this type of problem. If it does not, you may want to explore some of these issues listed below.

CPU Speed Over-Clocking

Making a CPU operate at a speed that is faster than rated is easy to do, but it may cause specific kinds of failures on your PC, especially when an operating system install disk is attempting to identify exactly what type of components you have in your PC. You may also cause the CPU to overheat, which will permanently damage the CPU and possibly the motherboard as well. Make sure that any CPU timing jumpers, including voltage jumpers, have been set correctly on your PC before doing any software installations.

CPUs must be set to a specific megahertz speed, a specific clock multiplier, and a specific voltage level ... make sure you have set your system board correctly before proceeding very far with any software (or hardware) installations. Use the documentation from your system board, and also from your CPU manufacturer, to ensure that these settings are correct.

Memory Mismatches, Mis-timed Memory, and Memory Failures

Random Access Memory (RAM) can be very finicky, and so can certain types of motherboards. When adding memory to a system, it is important that you install memory SIMMs (Single In-line Memory Module) or DIMMs (Dual In-line Memory Module) that match each other in type and speed. The SIMMs or DIMMs don't have to have the same memory size, but they must run at the same speed, and they must be the same type (i.e., fast page, EDO, synchronous DRAM, etc.). Also, you should never install both SIMMs and DIMMs on the same system board, UNLESS the manufacturer's documentation explicitly states that it is OK so to do. Usually DIMMs run at 10 - 20 nanoseconds, while the fastest SIMMs run at 55 - 70 nanoseconds. Pushing those SIMMs to keep pace with the much-faster DIMMs will certainly cause memory failures, and may cause the over-heating of the SIMMs as well.

Secondly, the CMOS Setup program may have an option under the Advanced Chipset Features where you can set the memory timing. It is usually best to set this option to AUTO, and let the motherboard automatically determine the speed of the memory units. If you do set this option manually, set the value to exactly what the memory speed is rated. The factory that manufactured the memory will have marked the speed rating on the chips, usually with something like "-6" or "-60" (for 60 nanoseconds). If the system board will not let you set the speed correctly, select a speed that is SLOWER than the chips are rated. Faster SIMMs can go slower, but slower SIMMs can't reliably go faster.
Finally, do NOT assume that since the memory is new, it must be in good working condition. If you encounter memory that you suspect is defective, use a memory tester to check the SIMM or DIMM in question. If such a tester is not available, install the memory into a known-good system board and see whether it works correctly or not. Return any defective memory to your vendor for replacement.

Cache Memory Failures

Cache memory is just as likely to fail as traditional SIMMs or DIMMs. Many Level 2 cache (also known as the external cache) memory units are made as proprietary plug-in modules, or are chips that plug into sockets on the motherboard, or may even be soldered into the system board. Level 1 cache (also known as the internal cache) is built into the CPU itself; if that cache is blown (usually from overheating), the CPU must be replaced.

Cache memory failures manifest themselves as an inability to get to an A: or C: prompt, even when it seems that the system is attempting to boot normally. Also, cache memory failures can cause random lockups and illegal operation errors while in Windows.

If you suspect that there may be a cache memory failure in the system board, start by disabling the Level 2 cache in the Advanced CMOS Setup part of the BIOS Setup program. If the cache cannot be disabled in the setup program, simply remove the cache memory from the system board. If this resolves the problem, replace the Level 2 cache, re-enable the cache in the Setup program, then test the system again. If the system still fails with a known good Level 2 (or L2) cache unit, the system board should be replaced, or you can look at some of the other options listed in this section of the curriculum.

Hard Disk Problems

As with memory units, obtaining a new hard disk is not an assurance that the unit is in perfect working condition. The best first way to determine if a drive is working correctly is to perform an auto-detect of the drive from the CMOS Setup program. If the drive is correctly detected, make sure to select the option for logical block addressing (LBA) mode if applicable, and make sure that the specifications match up to the manufacturer's documentation. If the drive is not detected, then the drive is not connected to the drive cable (or power cable) correctly, or the drive's master/slave jumpers are not set correctly, or the drive is not operating at all, or the drive interface may not be functioning correctly.

If the drive is detected but disk problems persist, run SCANDISK on the disk to determine the nature of the problem. If uncorrectable errors exist on the disk in significant numbers (five percent or more of the total disk space), or if the drive continually develops new disk flaws, replace the drive.

If the drive is under warranty, be sure to contact your vendor or drive manufacturer for assistance in replacing the drive. Most hard disks have a 2 - 3 year warranty on them, so be sure to look at the manufacture date to see if you are still in the warranty period. Contact the drive manufacturer for details on how to return an in-warranty drive.

If the disk still has unusual errors on it, dump everything off the disk, reinstall the operating system, and then scan the disk for viruses. Be sure to use clean, non-viral, write-protected disks when installing the operating system or checking for viruses.

CD-ROM Read Failures and Install Disk Failures

Many newer CD-ROM drives have problems with vibration when operating at maximum speed. These problems will cause intermittent read failures ... if such failures happen when you are installing an operating system or application software, the install program may bomb on you. The only way to prevent or recover from such problems is to buy well-known brand-name CD-ROM drives that have a good reputation for consistent operation. Buying cheap CD-ROM drives may end up costing you valuable time and endless frustration when installing your operating system.
Also, if you have problems with the CD-ROM drive not being read correctly, be sure to use the driver software that actually came with the drive. A Toshiba or Mitsumi brand driver may work on a "no-name" drive, but occasionally these drivers will fail to operate your "no-name" drive ... using the manufacturer-supplied drivers should remedy the problem.

Further, you may find that your operating system or application software has been duplicated onto cheap, flimsy or defective CD-ROM disks (or floppy disks). Make sure that the data surface of your CD-ROM disks are clean, fingerprint-free, and have as few scratches as possible. If there are imperfections in the disk media, obtain replacement disks from the manufacturer or vendor. A little bit of Pledge furniture polish on the CD may clean up a balky install disk, but be sure to wipe the disk totally clean before using it in the drive.

System Board or Major Component Failures

Your install process may uncover for you some flaw in the system board, or some major component, like a drive interface or video card. When you suspect that this is happening, use a good general-purpose PC diagnostic program to assure yourself that all of the system components are working properly. If something is defective, note this and return the component to your vendor or manufacturer for replacement. Also, notice if something is getting hot on the system board; this is usually a good indicator that something is defective.

Video RAM Failure on a Video Card

Occasionally, your install process may find that the video RAM on the video card is defective. This manifests itself as an inability to display video correctly, or an inability to use the entire color palette, or when Windows will only boot to safe mode, or you get a constant error message that your video card is incorrectly configured. When you suspect that this is happening, use a good general-purpose PC diagnostic program to assure yourself that the video card is working properly. You can also swap in a known-good video card to see if the problem goes away. If something is defective with the video card, note this and return the component to your vendor or manufacturer for replacement.

Windows Incorrectly Installs Components or Features

Many times Windows will incorrectly install a component in your system when you first load the operating system. For example, many times you will find that off-brand sound cards will be installed as "Other Devices" instead of "Sound, video and game controllers". When that happens, delete the mentions of the mis-installed device from the "Other Devices" section of the Windows Device Manager, and then run the driver install disk for that device that came from the hardware manufacturer. This will typically solve the problem, and allow the affected device to operate normally.

Windows Upgrade Problems

Windows can be a real mess if you are not prepared with the right driver software for your computer. Many Windows users are now reporting that when they install an upgrade to the operating system, the sound card, modem or video card drivers on their computers go haywire. That is because many of the core .DLL files and driver files that came with the previous Windows version don't (or may not) work with the newer Windows operating system or the updated drivers that came with the upgrade.

Each Windows operating system version will have an entirely new set of Dynamic Link Library (.DLL) files that have the same names as their older Windows counterparts. Even though the new Windows DLL files have the same names as their previous version's counterparts, these files are not necessarily compatible with certain drivers or install scripts. Make sure that you have drivers that are designed to work in your current (or upgraded) Windows environment. You will need to check with your hardware vendor or manufacturer to make sure that everything is in order before doing any installation work.
Viruses

A virus, especially a boot sector virus or a stealth virus, can easily corrupt an operating system or application install program. Be sure that your install disks are clean before beginning the installation; check the disks on a known-clean system with a reputable anti-virus program (AVG Anti Virus, for example). If necessary, run an anti-virus program on your hard disk (and a SCANDISK, if possible) before doing an operating system installation. Further, be sure to disable any virus-protecting terminate-and-stay-resident (TSR) programs before doing any kind of software installation ... many software installation programs appear to be viral to the TSR program, and may cause the install program to bomb.

Using Original System Install Disks

Whenever possible, use only the original system disks to install any software program. This ensures that no strange errors crop up when loading your software. If you do use backup diskettes, make sure that they are exactly the same as the original disks.

Upgrade Disks vs. Full-Install (OEM) Disks

There are two different types of software installation disks available from the manufacturer: original equipment manufacturer full-install disks, and upgrade disks. Full-install, original equipment manufacturer (OEM) disks presuppose that you have no software of any kind on your hard disk, or that you do not have the previous revision of the specific software on your hard disk. Upgrade disks are for those persons who have a previous version of the software on their hard disk already, and who only need to move up to the most current version of the software.

Make sure you know which software package you need to do the installation, since the two packages are NOT interchangeable. You cannot do a full install of any Windows version from the upgrade disk, and you cannot upgrade any Windows version with an OEM full-install disk.. Once you obtain the correct disk, you will be able to successfully install your operating system or application.

LBA Mode Translations

Logical Block Addressing (LBA) mode allows the user to lie to the BIOS about the architecture (or geometry) of the hard disk, so that the entire disk can be addressed as a single partition. Normally, hard disks with more than 1024 cylinders cannot be addressed as a single unit, and must be partitioned and addressed with special software, such as what comes with OnTrack's Disk Manager product. LBA mode lets the user (and computer) reduce the number of cylinders reported in the CMOS Setup, while increasing the number of read/write heads by the same proportion in the setup program. By doing this, you can have drives that are larger than 512 megabytes (the maximum of what could be addressed without LBA mode) addressed as single partitions on your PC.

In order for this feature to work correctly, you must enable LBA mode in the CMOS Setup program BEFORE performing an FDISK and FORMAT on the hard disk. If you don't do this, FDISK will partition the disk only to 512MB in size, and you will need to delete the partition table, reboot, and re-FDISK the drive in order to correct the problem. Most current PCs enable LBA mode by default.

Hard drives larger than 528 MB need to use the LBA (logical block addressing) mode feature in the system BIOS for the whole drive to be recognized. ALL PCs have some form of LBA mode built into the BIOS.

However, some system BIOS products have an older version of the LBA mode feature that only will recognize drives up to 127GB. If this is the case, you will need to upgrade the BIOS version with software from the PC or system board manufacturer, or use a smaller drive that the current BIOS product will accept.
Using EZ-Drive and Other Such Programs

For those motherboards that do not have an up-to-date LBA mode version (or the BIOS cannot be upgraded), there is a program called EZ-Drive that can potentially provide a solution. EZ-Drive provides at a software level the same LBA translation capabilities that are found in the ROM BIOS firmware. It will allow motherboards with older LBA versions to access and use hard drives larger than originally designed. Many hard drive manufacturers provide a copy of EZ-Drive when you purchase a new drive.

HOWEVER, EZ-Drive may give you significant problems when running Windows, especially if your PC becomes infected with a boot sector virus. In many cases, you will lose ALL your data on the disk, because the boot sector virus significantly corrupts the LBA translation table written to the boot sector.

As a general rule, NEVER use EZ-Drive to install a hard disk on a computer UNLESS you know that the motherboard does not support the LBA version you need, and you have no other options for upgrading the system. Also, be sure to read the EZ-Drive documentation carefully BEFORE installing the drive and/or your operating system on that drive. Further, the ONLY way of getting rid of the EZ-Drive software on the hard disk (short of a low-level format) is to use the EZ-Drive disk to UNINSTALL the software. Therefore, if you get a copy of the EZ-Drive install disk, be sure to keep it, since you may need it to uninstall the software at a future date on some poor soul's PC.

Service Packs from Microsoft

Instead of issuing revised versions of Windows (or other application programs), Microsoft made available to the customer via their web site programs called service packs, which when run will update Windows with revised versions of specific files that have had reported problems. These service packs are available from Microsoft at no charge for Windows XP, Vista, Windows 7, and for the Microsoft Office XP/2003/2007 suites. Service packs for older operating systems and application suites are still available on the Internet, but Microsoft no longer makes these resources available on their website.

These files are self-extracting archive files that will automatically unpack and then install the proper components on your PC. If you encounter unusual problems on your PC, it is possible that running a service pack upgrade may fix the problem.

Visit the Microsoft web site at http://www.microsoft.com for more details.

Summary and Lab

As always, with any software upgrade, read the reviews from the major PC information sources (PC Magazine, InfoWorld, PC Week, etc.) BEFORE jumping into a system upgrade. Learn from the experience of others before becoming a victim of new technology. Practice on a non-production system before doing the real thing on a production PC.

The rest of this lecture and lab will be devoted to simulating different kinds of operating system install problems, showing the proper solution to each problem. You will want to take notes of this session, or record the session if you wish.

NOTES
TROUBLE-SHOOTING VIDEO PROBLEMS

Many times you will find that the user has mis-configured the way that the video card is delivering a signal to the monitor. When that happens, the display may be distorted, unreadable, or the system may just go dark on you. This segment of the course will explore how to deal with problems related to video card failures and misconfigurations.

Video Hardware Failures

Occasionally the video card itself will fail. You will know this is the case if you hear an audio error code from the PC indicating a video adapter failure. Such an audio error code will should like 1 long and 2 short beeps, 1 long and 3 short beeps, or 1 long and 8 short beeps. When this occurs, you may want to try the following things before replacing the video card:

- Re-mount the video card in the bus connection, and see if this corrects the problem. Occasionally board creep will cause the card to malfunction, and re-mounting usually solves the problem. You may also want to try inserting the board into another socket to see if that resolves the problem.
- If the video RAM is socketed on the video card, make sure that the RAM is inserted correctly into the sockets or connectors on the board. If you suspect that the socketed RAM is defective, remove the RAM, re-install the board, and see if the problem resolves itself. If the RAM is defective, contact your vendor or manufacturer for replacement RAM.
- If the video card is HOT, that may be an indication that a component on the board is defective. If this is the case, replace the board immediately. Some video cards actually have heat sinks and cooling fans on them, to ensure that the board does not overheat.

If the video card does prove to be defective, replace the card with another of similar type. If possible, try to install an exact replacement card, so that you will not need to reconfigure any video drivers in Windows. If you do install a different brand or model of card, be sure to install the vendor-supplied video drivers, so that the user will get the maximum performance level from the video card.

Issues With Bad/Incorrect Video Drivers

In order for the user to get the optimum performance from their video card, you must ensure that the correct video driver is installed in Windows (for that SPECIFIC version of Windows). These drivers are usually installed from a CD-ROM disk that was supplied by the video card manufacturer. Many video card manufacturers have put their drivers onto the Windows operating system installation CD/DVDs. If you select the wrong driver for the brand and model of video card you have, you may get no video at all, or distorted video at best.

It is very possible that the manufacturer provided you with a buggy, non-working set of drivers ... when that happens, you will need to contact the manufacturer to obtain the most up-to-date set of drivers (usually available from their Internet web site or FTP site).

Also, some video driver install programs that work in Windows version X do NOT work in Windows version Y. Be sure that your set of drivers will work with the operating system version you are choosing. If you are not sure, contact the manufacturer or your parts vendor to obtain the correct software. You may want to download those drivers BEFORE you perform an operating system upgrade.
Running the Video Driver Install Program

To install the video card driver, insert the vendor-supplied CD/DVD disk into the optical drive. Then, go to the Add/Remove Programs applet in the Control Panel. Click on the Add New Programs button, then point to the install program on the CD/DVD disc, and press Enter. Follow the directions on the screen to correctly install the program. These programs will automatically make the changes in the Control Panel for you, thus saving you a few steps in the configuration process. You can simply install the video driver by putting the installation CD/DVD into the optical drive, and allow the AutoRun feature to start the driver installation wizard. The A+ certification exam, however, recommends the first method as the preferred way to install any software application or driver.

Incorrect Video Resolution Settings

Once the driver has been installed, some utility program will probably also be installed that lets you modify the resolution (640 X 480 to 1280 X 1024), the number of colors (64 to millions of colors), and the refresh rate of the monitor (the frequency at which the monitor operates; usually 60, 72 or 75 Hz). Run the utility program, and then select the resolution, numbers of colors, and refresh rate you desire for your system. HINT: unless you have a "multisync" monitor, select 60 Hz as your standard refresh rate; check the documentation on your monitor to determine your monitor type. SVGA monitors will operate at 60, 72, 75, 83, 85 and 90 Hz refresh rates; older models may only do 60 and/or 72 Hz. Normally, this is all you need to do to improve the video performance on your monitor.

You should also know that the number of colors displayed by your monitor is not a function of the monitor, but the video card itself. The amount of installed video RAM along with the software drivers will determine how many colors can be displayed. Old VGA monitors can display 32 million colors, but can't display them at higher levels of resolution or faster refresh rates. These higher resolution levels usually demand a faster refresh rate on the monitor, which is why Super VGA and XGA monitors are superior to older VGA monitors.

But now my screen is all messed up ...

If you try to make your video card (or monitor) display at a rate greater than is possible, your screen may turn into a jumble, or Windows may just go blank and lock up.

If this happens, re-boot the computer, then press F8 when the PC begins booting up; select "safe mode" from the menu on the screen, and then re-run the video setup utility program, this time selecting the correct video resolution. You can also make changes from the Control Panel Display icon. Right-click on the Desktop and select the Properties option. In the Display Properties applet, make sure your video card is set to a resolution level and refresh rate that your monitor will accept.

Testing Your Video Card With A Good Diagnostic Program

If your video card is displaying an image but is nevertheless defective, you may get a variety of video display problems. Use a good diagnostic program like MicroScope 2000 to thoroughly test your video card. MicroScope 2000 has a proprietary operating system that is less troublesome than what Microsoft provides, and it will allow for a full test of your video card and all of it's video RAM. Windows (any version) will only allow diagnostic programs to test the first 256 kilobytes of video RAM. Checkit and QaPlus are good diagnostic programs as well, even though they cannot test the entire amount of video RAM.

Selecting the Wrong Monitor Type

In any version of Windows, not only can you select the type of video card you have, but also the type of monitor. That means that Windows knows what the maximum refresh rate and display properties are for your monitor, and will allow you to get optimum performance from your video sub-system.
HOWEVER, if you tell Windows the wrong information concerning the brand and model of monitor you are using, you may get no video at all. Therefore, it is important to set the brand and model of your monitor correctly in the Display icon of the Windows Control Panel. Windows knows of a wide variety of monitor brands and models, and you can select yours from a list within the Display Control Panel.

If your monitor type is not listed in the Control Panel, then select "Plug and Play Monitor" in the "Standard Display Types" segment of the Display Control Panel. This monitor type selection generally will ensure proper operation of your monitor while in Windows. You then can adjust the video properties up to a more acceptable level for you or the customer.

**Getting Into (and Out Of ) Safe Mode**

In safe mode, Windows uses default settings (VGA monitor, no network, Microsoft mouse driver, and the minimum device drivers required to start Windows). You will not have access to CD-ROM drives, printers, or other devices. You will use safe mode to access Windows when something is not working correctly, or when you have accidentally set Windows to use the wrong display type or resolution.

Once the POST test is completed and the computer begins to boot, press F8. A menu will then appear on the screen, from which you can choose the booting mode you desire. If you want to start Windows without network support, choose Safe Mode. If you want to start Windows with network support, choose Safe Mode With Network Support. You can then make whatever changes you need to in the Windows Control Panel, and reboot the computer for the changes to take effect. This generally corrects any video mis-configuration problems.

**Summary and Lab**

The rest of this lecture and lab will be devoted to showing you various kinds of video display problems ... we will show you some computers with various kinds of hardware and software problems, and show you how specific changes are likely to affect your system's performance. You will want to take notes of this session, or record the session if you wish.

**NOTES**
TROUBLE-SHOOTING HARD DISK PROBLEMS

Hard disks are a common source of computer system failure. Many times, the failure of a hard disk is complete; the motor stops spinning, or the drive electronics fail completely, or the drive is subject to stiction and refuses to spin up consistently. In the case of a solid failure of a hard disk, replacement of the drive is the sole remedy for the problem. Drive data recovery services can recover critical data, but the cost is usually prohibitive for the user. Hopefully, the user has backed up their critical data, and your job as a technician will be that much easier.

This section of the course will discuss what to do when the hard disk failure is not solid or hardware-related. This part of the course will help you to trouble-shoot hard disk problems, including file corruption in Windows, file naming problems, problems when SCANDISK will not repair the disk damage, fatal 0E errors, and viruses.

File Corruption in Windows

In Windows, the operating system has the ability to cache disk reads and writes in extended memory. The net effect of this caching process is to increase the speed and efficiency of disk reads and writes while using Windows.

However, as with any process where an intermediary is present, the disk caching program may erroneously write garbage data to the disk instead of the correct data. Further, the disk caching program may also accidentally overwrite previously existing data on the disk, causing cross-linked sectors. For the sake of explanation, a cross-linked sector is where two files share the same sector of space on a disk; this situation should never occur, but when it does, both files are corrupted. Unfortunately, this problem occurs more often than anyone would like to admit, and it can cause a great deal of damage to your data files.

The SCANDISK utility in Windows will not truly fix the problem of cross-linked files on your hard disk. It's concept of fixing the problem means taking the two files, truncating them (cutting them off midway through the file), and cleaning up the data within the cross-linked sector. This may mean that you lose a substantial part of the data in your file. The only resolution you have is to have a good backup of your data file to replace the corrupted one on your hard disk.

As for file that are corrupted by the disk caching programs, there really is no solution other than restoring a good backup from a floppy or network disk. Running a program like Norton's FileFix may resolve some problems, but an archival copy of your data is the best solution.

If you encounter frequent problems with file corruption on your hard disk, running SCANDISK and/or DEFRAG may help. With serious problems, it may be best to dump Windows from your hard disk and reload the operating system from the installation CD. If the problem is related to a defective or questionable hard drive, replacement is the most reliable solution.

File Naming Problems in Windows

In MS-DOS, files were named using the 8.3 naming convention. That means that the filename could be 8 characters in length, followed by a period, and then a three character file extension. This kind of file naming convention was extremely limiting and somewhat awkward.

However in Windows, you can have filenames of up to 255 characters in length, including spaces. Yet when you leave the Windows environment and go to the DOS prompt, you will find that DOS keeps a second file allocation table, where your long file names have been truncated to conform to the 8.3 filenaming standard. Windows and DOS will generally co-exist peacefully with this arrangement, and generally you will experience no problems with having 2 sets of FATs on your hard disk.
However, if file corruption problems occur upon your hard disk, and if you run the SCANDISK program on your hard disk, you may find that your long file names may become a screwed-up mess. SCANDISK has a history of not correcting problems effectively with files that have long names. If you must run SCANDISK, realize that you may not perfectly solve all of your problems with files using longer names.

**Bad Hard Disk Sectors and Scandisk**

The Microsoft utility SCANDISK will allow the user to correct most typical kinds of floppy and hard disk errors, such as lost allocation units, invalid filenames, and bad sectors. However, there are times when SCANDISK will not be able to recover a bad sector on a hard disk. Further, the bad sector can be severe enough that SCANDISK can cause a complete system failure or lockup. If you encounter a situation where SCANDISK causes a system lockup while running the “thorough” scan option, and the computer locks up completely, you should reboot the computer and begin the process of backing up the data on the hard disk (if that is possible). Then, plan to perform a low-level format upon the disk. Normally, a low-level format will identify the bad sector on the disk, mark the sector as bad, and prevent data from being written to that spot on the disk in the future. Use ONLY the low-level format utility programs designed by the manufacturer on a given drive; such programs are not generic, and you may unintentionally ruin your drive by using the wrong utility program.

Some third-party disk repair utilities like Norton Disk Doctor or Microscope 2000 may have the ability to repair or mark a specific sector on a hard disk as bad, and this may correct the problem in the short term, but this author’s experience has shown that a low-level format on the disk will both fix the immediate disk corruption problem and find the impending problems lurking upon the hard disk.

**Fatal 0E Exceptions**

Fatal 0E exception errors occur for a variety of reasons. Programs on the hard disk required by Windows may have been corrupted. Hardware in the system may have gone defective, and the resulting error may cause Windows to lock up. Also, the hard disk may have specific errors or defects on it that may cause a failure when Windows loads onto your computer. When fatal 0E errors occur, you should do several things before reloading software on your system. First, perform a routine diagnostic on all major computer systems, including RAM, the hard disk, the video card, and the system board. Problems with any of these components can lead to fatal 0E errors. For example, an overheated CPU could be failing, or a hard disk could be having read/write errors, or newly-installed RAM may be incompatible with the existing RAM already installed on the system board.

If the hardware diagnostic shows no problems, then a thorough evaluation of the software on the hard disk is in order. Running SCANDISK, even with it’s shortcomings, is a must. Further, a thorough virus check should be run to make sure that files have not been damaged. Then, the user should be consulted to see what they were doing just before the series of errors began to occur. It may be that the user did something to corrupt a file, delete some program files, change a configuration in Windows, or install something onto the computer that has caused the problem. Undoing the user’s mistake may very well resolve the problem. If these measures do not resolve the problem, then a reload of Windows is in order.

**Viruses**

There are seemingly no end to the different types of viruses that are present in the world today, and no end to the ways that users will get them onto their computers. Despite anti-virus TSR programs and in-depth virus scanners, some viruses will always find a way of getting through and trashing one’s computer. Sadly, most computers are running with no anti-virus precautions at all, and these computers are easy prey to computer viruses and the damage they can cause.
If you are supporting a computer user or a group of users, it is imperative that you install a virus-scanning program on every computer, and you must load an anti-virus terminate-and-stay-resident (TSR) program, that will act as a sentinel to protect from virus attacks, on every computer AND ensure that it loads every time the computer boots. To do anything less is to risk a possible virus infection on a PC or network, which could cause huge amounts of loss to valuable business data if left unchecked.

Good anti-virus software packages include AVG Anti-virus, and Command Software Systems Command Anti-Virus (formerly known as F-Prot). These packages have a known good reputation for protecting against virus infection, detecting infection, and properly removing the infection.

You must also train users to be aware of joke programs, trojan horses, and other types of pseudo-viruses that can wreak havoc on a computer's hard disk. For example, remind people during the holiday season that not every "electronic Christmas card" has a holiday greeting in it, but a leftover Halloween trick in it. Many joke programs and trojan horses damaged important business data on computers during the holidays, so teach your users to beware mail messages from unknown "friends".

Below is a quick summary of how viruses affect a computer system.

Viruses will affect your PC in several different ways . . .

1) **The Boot Sector:**
   - The boot sector is where your operating system files reside on your floppy or hard disk. A virus will go to that location on your disk and corrupt these files (NTLDR, NTDETECT.COM) so that your PC will NOT boot up as expected. **EXAMPLE:** the STONED virus.

2) **The File Allocation Table:**
   - The File Allocation Table (FAT) is a list of all the files on your floppy or hard disk, and where the files are physically located on the disk. A virus will corrupt the FAT so that you cannot locate or access your files. **EXAMPLE:** the CASCADE virus.

3) **The Partition Table:**
   - The partition table on your HARD DISK tells the operating system how big your hard disk is, and what percentage of it is used by the O/S. A virus can corrupt your partition table, which wipes out ALL of your files in an instant. **EXAMPLE:** the MICHELANGELO virus.

4) **.COM and .EXE Files:**
   - Files with these extensions are EXECUTABLE files, which perform a specific action. A virus can attach itself to one of these kinds of files and corrupt the way it operates. These same kinds of viruses can infect .OVL or overlay files, which work along with .COM and .EXE files. **EXAMPLE:** the JERUSALEM virus.

5) **Macro Viruses**
   - A macro virus will execute a set of instructions that have a destructive effect on your Windows registry, configuration files, or your data files. These viruses can be transmitted when you receive data files from someone else’s computer (like a resume file or a spreadsheet), or they can be transmitted by e-mail messages. **EXAMPLE:** the WM-CONCEPT virus.
6) **E-Mail Viruses**

E-mail viruses act much like macro viruses, but are transmitted to you by e-mail as an "attachment" (a secondary message sent to you along with the main e-mail message). Many e-mail viruses are classified as "trojan horses" since they appear to be normal kinds of messages but they carry a destructive load.

**EXAMPLE:** the ILOVEYOU virus.

7) **Logic Bombs**

Logic bombs include a timing device so they will go off at a particular date and time, or when a particular system event takes place (like formatting a floppy disk or performing a scan of your hard disk).

**EXAMPLE:** the FRIDAYTHE13TH virus.

8) **Joke Programs**

A joke program does something to change or mess up the appearance of information on your screen, or affect adversely the operation of your computer. Joke programs are not destructive, and are usually intended as a prank or a practical joke.

**EXAMPLE:** the JAN12000 virus.

9) **Polymorphic Viruses**

A polymorphic virus may take any of the forms listed above, but the virus will mutate into different forms upon every new PC on which the virus infects. It does this in order to evade detection and being destroyed by an anti-virus program.

**EXAMPLE:** the SATAN BUG virus.

A virus program that is worth anything should be able to do the following three things reliably:

1) **SCAN for viruses:** A good program should be able to check your floppy and hard disks for viruses, as well as the RAM of your computer, and detect the presence of a virus in the locations and ways mentioned above.

2) **CLEAN up the virus:** A good program must be able to get rid of the virus it finds in any of these places mentioned above; otherwise, it's useless.

3) **PROTECT YOU from viruses:** A good program must have the ability to load a piece of the program into memory at boot-up time, to protect you from getting a virus in the first place. This type of program is called a "Terminate-and-Stay-Resident" (TSR) program. This program will scan all files being accessed from disk or loaded into memory; if it finds a virus, it will alert you and clean it up.

An example of a good anti-virus program is AVG Free Anti Virus. This freeware program is available from the instructor's course DVD. It has the ability to be updated periodically, so that the programs will detect and protect you from all the newest strains of viruses. These updates are called "signature files" or "definition files", and they contain a database of information that the antivirus program uses to detect and eliminate viruses from your PC. You should update your signature files at least once a month, for maximum protection. If you have a broadband Internet connection, update your anti-virus application as frequently as possible. The application will update automatically, unless you indicate not to do so when installing the program.

Programs like Symantec / Norton Anti-virus and McAfee Internet Security are costly, use a lot of system overhead to operate, require an annual service fee to continue getting signature file updates, and they miss many common viruses. Also, companies like Verizon and Comcast provide anti-virus and Internet security software to their customers for a monthly service charge; these applications are ineffective and not worth the cost. If you must use one of these programs, make sure the application is continually kept up-to-date.
What is Spyware/Malware and Adware?

Spyware (also called malware) refers to any software that covertly gathers user information through the user's Internet connection without his or her knowledge, usually for advertising purposes. Spyware applications are typically bundled as a hidden component of freeware or shareware programs that can be downloaded from the Internet; however, it should be noted that the majority of shareware and freeware applications do not come with spyware.

Once installed, the spyware monitors user activity on the Internet and transmits that information in the background to someone else. Spyware can also gather information about e-mail addresses and even passwords and credit card numbers.

Spyware is similar to a Trojan horse in that users unwittingly install the product when they install something else. A common way to become a victim of spyware is to download certain peer-to-peer file swapping products that are available today.

Aside from the questions of ethics and privacy, spyware steals from the user by using the computer's memory resources and also by eating bandwidth as it sends information back to the spyware's home base via the user's Internet connection. Because spyware is using memory and system resources, the applications running in the background can lead to system crashes or general system instability.

Because spyware exists as independent executable programs, they have the ability to monitor keystrokes, scan files on the hard drive, snoop other applications, such as chat programs or word processors, install other spyware programs, read cookies, change the default home page on the Web browser, consistently relaying this information back to the spyware author who will either use it for advertising/marketing purposes or sell the information to another party.

Licensing agreements that accompany software downloads sometimes warn the user that a spyware program will be installed along with the requested software, but the licensing agreements may not always be read completely because the notice of a spyware installation is often couched in obtuse, hard-to-read legal disclaimers.

Adware is a form of spyware that collects information about the user in order to display advertisements in the Web browser based on the information it collects from the user's browsing patterns.

Adware is considered a legitimate alternative offered to consumers who do not wish to pay for software. Programs, games or utilities can be designed and distributed as freeware. Sometimes freeware blocks features and functions of the software until you pay to register it. Today we have a growing number of software developers who offer their goods as "sponsored" freeware until you pay to register. Generally most or all features of the freeware are enabled but you will be viewing sponsored advertisements while the software is being used. The advertisements usually run in a small section of the software interface or as a pop-up ad box on your desktop. When you stop running the software, the ads should disappear. This allows consumers to try the software before buying it; you always have the option of disabling the ads by purchasing a registration key.

In many cases, adware is a legitimate revenue source for companies who offer their software free to users. A perfect example of this would be the popular e-mail program, Eudora. You can choose to purchase Eudora or run the software in sponsored mode. In sponsored mode Eudora will display an ad window in the program and up to three sponsored toolbar links.

Eudora adware is not malicious; it reportedly doesn't track your habits or provide information about you to a third party. This type of adware is simply serving up random paid ads within the program. When you quit the program the ads will stop running on your system.
Dealing With Spyware

While one may not realize they have installed spyware, there are some signs that it exists on your computer. If you notice any changes to your Web browser that you did not make such as extra toolbars or different homepage settings, as well as changes to your security settings and favorites list, you could have spyware running on your system.

Other signs of a spyware infection include pop-up ads which aren't related to a Web site you're viewing; usually spyware advertisements are adult content in nature and are not displayed in the same fashion as legitimate ads you would normally see on your favorite Web sites. You may also see advertisements when you're not browsing the Web. Clicking hyperlinks which do not work (or take you somewhere you didn't expect), a sluggish system, or your system taking longer to load the Windows desktop are all signs that your computer may be infected with spyware.

With the onset of spyware comes a number of anti-spyware software packages to rid your system of these unwanted and malicious programs. Anti-spyware software works by identifying any spyware installed on your system and removing it. Since spyware is installed like any other application on your system it will leave traces of itself in the system registry and in other places on your computer. Anti-spyware software will look for evidence of these files and delete them if found.

Reputable and effective anti-spyware applications include programs such as AdAware, Malwarebytes Anti-Malware, Spybot Search-and-Destroy, and Microsoft's Windows Defender. You can run one or two of these programs simultaneously on your PC without any adverse effects upon system performance. On the other hand, you cannot run more than one anti-virus application on your PC at the same time. Each anti-virus program will perceive the other anti-virus program as a virus threat, and your system will slow to a crawl in short order.

It is important to remember that not all companies who claim their software contains adware are really offering adware. There is always a chance that adware is spyware in disguise so to speak, and that programs with embedded spyware may not state its existence at all. Programs like Antivirus 360 (made to look like Norton 360), Antivirus 2010 and Internet Security 2010 (made to look like Norton Internet Security 2010) appear to the average user to be legitimate programs, when in fact they are the worst kind of spyware. They will pester the user until they pay the $29.00 fee over the Internet, only to find that their computer is now totally corrupted and the money has gone towards illicit activities. Removing these spyware programs is difficult at best; if left unchecked for more than a few days, they can completely ruin the operating system and user data on a hard drive.

Always stay on the side of caution and be sure to research privacy policies and licensing agreements that come with freeware. You should also become familiar with Internet lists of companies reported to be using spyware. Much like a firewall or anti-virus program, anti-spyware software is crucial to maintain optimal protection and security on your computer and network.

The instructor’s course DVD has a number of effective anti-spyware applications included on it, so that you can install them on any PC. These will ensure that any PC you use is free from malware and rogue software. These programs also are freely available on the Internet, and can be shared without concerns for software piracy issues.

If you find that a virus has corrupted files on a PC past the point of repair, then you should reload the affected software, or if necessary dump the entire hard disk and reload the PC from scratch. As always, a good virus-free backup of the user's hard disk will make this job easier.

This information on viruses is repeated in the section of the notes dealing with user-imposed problems.
Summary and Lab

The rest of this lecture and lab will be devoted to showing you various kinds of hard disk problems ... we will show you some computers with various kinds of hardware and software problems, and show you how specific changes are likely to affect your system's performance. You will want to take notes of this session, or record the session if you wish.

NOTES
TROUBLE-SHOOTING RAM-RELATED PROBLEMS

RAM-related problems are common, and are usually simple to fix. When the technician install known-good, properly-matched, tested memory products, memory errors should be non-existent. If a system rejects the proper type of memory products, and the memory products are known to be operating properly, then the problem more than likely resides with the motherboard, and it should be replaced.

This section of the course will help you to know how to trouble-shoot RAM-related problems, including unreliable XMS memory and page fault errors, RAM timing problems, mixing SIMMs and DIMMs, and fatal 0E errors.

Unreliable XMS / Page Fault Errors

Normally, your RAM will run just fine in your computer. Then one day, your computer displays the “Blue Screen of Death” message:

Unreliable XMS memory at address xxxxxxx.

What this means is that your RAM has failed, and the address given is letting you know at what location in memory the error took place. This may guide you to know which SIMM or DIMM has failed, so that you can replace it and get back to normal operation. But what caused the failure of the SIMM or DIMM? Usually, heat within the system or the heat created by the SIMM (or DIMM) itself has caused the failure. It is also possible that the memory unit was damaged in the process of manufacture and shipping, and the latent damage did not manifest itself until after the unit was put into service. Also, static electricity and/or power surge problems can cause memory failures.

The solution to the problem is simple: replace the defective memory unit with a new, known-good unit. Memory can be tested with specific memory testing machines (which cost a minimum of $1,000 per unit). You can also test memory by installing it into a known-good system board and then running both the POST test at boot-up and a diagnostic program like Checkit or Microscope 2000. Personally, I use a known-good system board and Checkit to test my memory units, and I have my memory vendors test the SIMM or DIMM before I complete the purchase.

RAM Timing

Memory is timed as to how fast it will reliably operate. This timing information is recorded on the chips found on the SIMM or DIMM. Usually the timing marks will look something like this:

512MB, DDR, 400, CL3

The marks shown above indicate that the memory capacity is 512 megabytes, double data rate style, operating at 400 megahertz, with a clock multiplier of three.

When installing memory units into a motherboard, you must install devices of the same speed; installing mismatched memory units will very likely cause problems. A simple inspection of the memory units will prevent you from making such a mistake when installing new memory. If you find that another technician has made a mistake and installed mismatched memory, simply replace some of the memory units in the system until all of them are running at the same speed.
You may also find that you can set the motherboard to operate the SIMMs or DIMMs at a specific speed. This option may be found in AMI and Award BIOS-based systems under the Chipset Options submenu of the setup program. If the user or technician sets the memory speed to an incorrect value in the CMOS Setup program, the motherboard may malfunction for this reason alone. If you are experiencing memory problems on a system with properly-matched, known-good memory units, you may want to check to see if the memory timing value setting in the CMOS Setup program is correct. If the timing setting is incorrect, change the setting to the correct value and reboot the computer. You may also want to contact the motherboard manufacturer or retailer for details on how to optimally configure the memory settings for your motherboard.

Mixing SIMMs with DIMMs

Many newer motherboards will allow you to install both SIMMs and DIMMs onto the same board. However, you should never attempt to use a system that has both SIMMs and DIMMs installed at the same time. The reason is simple: DIMMs run at significantly faster speeds than SIMMs, and the motherboard will attempt to run ALL of the memory units at the higher speed. For example, DIMMs run typically at 12, 10, or 8 nanoseconds, while the fastest SIMMs run at 50 nanoseconds. To push a 50 nanosecond SIMM to run at the same rate as a 10 nanosecond DIMM will certainly cause program errors. Further, the SIMM will certainly overheat when forced to run at a speed that exceeds its capabilities. Unless the motherboard manufacturer explicitly permits simultaneous SIMM and DIMM installation (usually the reverse is the case), you should never mix SIMMs and DIMMs onto a working motherboard.

Fatal 0E Errors

Fatal 0E exception errors occur for a variety of reasons. Programs on the hard disk required by Windows may have been corrupted. Hardware in the system may have gone defective, in particular the memory devices, and the resulting error may cause Windows to lock up. Also, the hard disk may have specific errors or defects on it that may cause a failure when Windows loads onto your computer. When fatal 0E errors occur, you should do several things before reloading software on your system. First, perform a routine diagnostic on all major computer systems, including RAM, the hard disk, the video card, and the system board. Problems with any of these components can lead to fatal 0E errors. For example, an overheated CPU could be failing, or a hard disk could be having read/write errors, or newly-installed RAM may be incompatible with the existing RAM already installed on the system board.

If the hardware diagnostic shows no problems, then a thorough evaluation of the software on the hard disk is in order. Running SCANDISK, even with it’s shortcomings, is a must. Further, a thorough virus check should be run to make sure that files have not been damaged. Then, the user should be consulted to see what they were doing just before the series of errors began to occur. It may be that the user did something to corrupt a file, delete some program files, change a configuration in Windows, or install something onto the computer that has caused the problem. Undoing the user’s mistake may very well resolve the problem. If these measures do not resolve the problem, then a reload of Windows is in order.

Summary and Lab

The rest of this lecture and lab will be devoted to showing you various kinds of RAM-related problems ... we will show you some computers with various kinds of hardware and software problems, and show you how specific changes are likely to affect your system's performance. You will want to take notes of this session, or record the session if you wish.

NOTES
TROUBLESHOOTING APPLICATION SOFTWARE PROBLEMS

There are as many problems involved with software usage as there are software programs available on the market today. This particular segment of the course will not attempt to solve every possible software problem you might encounter as a technician ... no technical manual ever could. However, this section of the course will cover how to trouble-shoot application software-related problems of the kinds found in the text below.

Bad Install Programs

Not every software installation program does a perfect job of putting a new application on your PC. In fact, some installers are downright treacherous. A good installation program should do the following things:

- Create a temporary directory that will be used for the software installation, and then delete the directory from the disk when the installation is completed.
- Check to make sure that it is not overwriting newer files with older ones, thus potentially corrupting the entire system.
- Check to be sure that you really want to reinstall the software if the program currently exists on the hard disk.
- Backup the system Registry files to make sure that if something does go wrong, the damage can be undone quickly and easily.
- Load an uninstaller on the PC for that application, so that the program can be smoothly removed if necessary.

If an install program doesn't do all these things, then there is a serious possibility that your install program could create a problem on your PC while installing the software. You should read the documentation for the install program before attempting to do the software installation, and try the installer on a non-production PC if you have any serious questions. Also, a good backup of the system may be in order if you aren't sure of the quality of the software or install program.

As a rule, you should always install new software onto a PC from the "Add/Remove Programs" icon in Windows. Installing software this way ensures that you have the ability to uninstall the product if something should go wrong with your PC after your new software is installed. In Windows, click on Start, then Settings, Control Panel, Add/Remove Programs, then Add New Programs, then give the name and location of the install program and press Enter. Follow the directions on the screen to correctly install the program.

To uninstall the program, simply return to the Add/Remove Programs icon, select the name of the program you wish to uninstall, and click the "Add/Remove" button. The Windows uninstaller will take care of the rest for you, returning the Windows Registry to the state it was in before the software was installed, and removing all related files from your hard disk.

Service Packs from Microsoft

Instead of issuing revised versions of Windows (or other application programs), Microsoft made available to the customer via their web site programs called service packs, which when run will update Windows with revised versions of specific files that have had reported problems. These service packs are available from Microsoft at no charge for Windows XP, Vista, and for the Microsoft Office XP/2003/2007 suites. Service packs for older operating systems and application suites are still available on the Internet, but Microsoft no longer makes these resources available on their website.

These files are self-extracting archive files that will automatically unpack and then install the proper components on your PC. If you encounter unusual problems on your PC, it is possible that running a service pack upgrade may fix the problem.

Visit the Microsoft web site at http://www.microsoft.com for more details.
Conflicting DLL File Versions, and 16-bit vs. 32-bit DLLs

.DLL files are Dynamic Link Libraries, that contain much of the program code that makes a Windows application work. Each version of Windows came out with its own set of .DLL files. If you accidentally replace a newer Windows .DLL file with one from a previous Windows version, Windows AND the application you just installed will both fail to operate. As a preventative measure, you may want to store somewhere a copy of all of the proper .DLL files for your version of Windows (and applications) in a safe place, just in case something happens to replace one of your .DLL files by accident.

You may also find that within a Windows version, there may have been some updating of .DLL files by Microsoft (or other software vendors) without your knowledge. The general rule is that it is always best to use the most up-to-date version of a .DLL file, unless you know that some kind of software conflict is taking place that would move you to replace a newer file with an older one.

Technical support representatives from different companies may instruct you from time to time to replace such files if an application is malfunctioning. Also, service packs and patches will update critical .DLL files, sometimes fixing the problem, and sometimes creating more of a problem. Be sure to contact the software manufacturer for assistance if you encounter such problems.

User Error

User error is probably the most common reason for computer or application software failure. If a person does not know "the rules of the road" concerning how to use a computer or a typical Windows application, more than likely they will do something destructive to the computer without knowing that they did it, or meaning to do so in the first place. Some of the more common mistakes that users will make include:

- not saving their work regularly
- not backing up their work on a regular basis
- saving files to the hard disk instead of a floppy disk, or vice versa
- forgetting the location of a file, or the name of a file
- forgetting your password
- using the same name for two different files, overwriting one with another
- overwriting good files with bad / blank ones
- deleting files / icons unintentionally
- launching more than one instance of a program, because of impatience with the computer
- printing to a turned-off (or off-line) printer, or to the wrong printer port
- not knowing how to use the "undo" feature in Windows applications
- not having an anti-virus program on your computer
- randomly hitting buttons or keys while the computer is processing some information
- pressing the reset key while the hard disk is writing data to the disk
- failing to read the instructions that appear on the screen
- failing to read the manual
- having a general paranoia of the computer

As a technician, you have the power to fix (or at least determine) the nature of the user error. Your most important task, however, is to ensure that the user learns from their experience, and does not repeat the same mistake again. You should have at your disposal a number of reference works you can suggest that will enable the user to get up the learning curve concerning the use of a computer product.

You should also know of several places where a novice computer user can go to get the training they need to become more skilled in the computing arts. Many local community colleges provide excellent computer courses at a reasonable cost. Always recommend to users that they take time for training in computer use and the specific software applications they use regularly. The price of one class can be much less costly than several repeat repair calls on your part, and more satisfying to the user than just fixing repeated problems.
Summary and Lab

The rest of this lecture and lab will be devoted to showing you various kinds of application software problems. We will show you some computers with various kinds of hardware and software problems, and show you how specific changes are likely to affect your system's performance. You will want to take notes of this session, or record the session if you wish.
TROUBLE-SHOOTING USER-IMPOSED PROBLEMS

Many times you will find that a user will do terrible things to a computer without meaning or intending to do so. User-imposed problems constitute about 35-40 percent of the trouble calls you will encounter on a regular basis. This segment of the class will help you to deal with a variety of user-imposed problems.

Powering Down Windows Without Shutting Down

There are a number of good reasons why users MUST run the “Shut down” feature of Windows when ending their computing session. The shut down routine cleans up any temporary files created while running Windows applications, ensures that all applications are closed properly before powering down, and it preserves a record of how Windows looks so that it will restore that same image when Windows is run the next time. If the user fails to properly shut down Windows, a variety of problems will arise.

Failing to shut down Windows correctly may cause a growing number of temporary files to accumulate in either the \WINDOWS\TEMP or \TEMP directories. While this doesn’t seem like a big issue, Windows will begin to malfunction if more than 50 temporary files exist in these directories. Also, these files can take up valuable disk space, and many software installers will bomb if they detect a large number of "temp files" on the hard disk. As a technician, you should go into these two directories and delete any files with a .TMP file suffix, and also delete any temporary directories you may find as well.

Next, you should run SCANDISK to alleviate any problems caused by lost clusters (files with beginning-of-file markers, but no end-of file markers). SCANDISK will turn these lost clusters into files (which should be deleted), or simply delete these lost clusters from the disk straightaway. Further, you also should run the Disk Defragmenter in Windows to reduce any potential disk access problems.

Certain Windows applications also use temporary files to prevent multiple sessions of a program from running at the same time, and also to note whether the application was properly closed the last time it was used. Also, some older Windows applications will modify the WIN.INI, SYSTEM.INI and/or program-specific .INI files each time the program is launched. If you turn off the computer before shutting down Windows, your application may malfunction.

One way to alleviate the problem of a Windows application that won't launch properly is to re-install the application WITHOUT doing an uninstall beforehand. This will over-write the program files only with new copies of the same files, and will put your application software back to square one, as if it were just installed. Your data files will be unaffected by such a procedure.

Deleting Directories and Failing to Run Uninstallers

Deleting entire directories in Windows as a way of eliminating programs is a MAJOR MISTAKE. Virtually all applications, during the install process, modify the Registry files to expect the presence of certain driver programs or .DLL files. If the user deletes these files and/or directories without modifying the aforementioned files, Windows will display a laundry list of error messages on the screen each time the computer boots the operating system. Further, other programs on your computer may now rely on some of these files which were installed for your "third-party product", and now these other applications may fail to operate as well, because you simply deleted off the directory and files without thinking of the consequences.
It is important that you understand (and that the users you support understand) that one must UNINSTALL a program in Windows for the operating system to work correctly. Windows has an uninstaller program built into the Control Panel, under the Add/Remove Programs icon. By using the uninstaller in Windows, or by using a third-party uninstall program like Microhelp's Uninstaller, you will assure the following things:

- Only the necessary files and directories will be removed
- Files common to multiple programs will be preserved
- The Registry files will be modified to prevent any error message displays on your screen
- Multiple copies of similar files will be removed, and the maximum amount of disk space will be freed
- You will not develop a headache, or have reason to fuss at the user for doing bad things to their computer.

### Deleting Icons

Many people are under the impression that if they delete an icon in Windows, the program goes away. Further, you will find that if they accidentally delete an icon, a user may panic and begin the process of re-installing the affected program all over again. Nothing can be further from the truth. Deleting an icon simply takes an object off of the Windows desktop; the program and all of its related files are still safely stored upon the user's hard disk, including the user's own personal files.

One can re-create an icon from within Windows by right-clicking on the desktop, then selecting New, Shortcut, then specifying the name of the executable file in the dialog box. One can also create an icon (or listing) in the Start menu by using the following steps:

1. Click the Start button, and then point to Settings.
2. Click Taskbar, and then click the Start Menu Programs tab.
3. Click Add, and then click Browse.
4. Locate the program you want to add, and then double-click it.
5. Click Next, and then double-click the menu on which you want the program to appear.
6. Type the name that you want to see on the menu, and then click Finish.
   If Windows prompts you to choose an icon, click one, and then click Finish.

You can also add a program to the top of the Start menu by dragging the program's icon onto the Start button.

If the icon disappeared because the user ran an uninstaller program, the only way to recreate the icon is to re-install the application software. If the icon is pointing to another computer (or server) on the network, the icon will not work correctly unless the person is correctly logged into the network and has the necessary rights to access the program.

### Running Multiple Operating Systems

Some users insist that they need to run multiple operating systems on the same PC, and then will go on to explain to you in great detail the exact reasons for doing such a thing. I have a simple response: **WHY?!?!**

There is no truly compelling reason, in my mind, for running multiple operating systems on the same computer. Yes, you can run Windows XP and Windows 7 concurrently on the same PC with a minimum of problems. Yes, you can use System Commander to control which operating system you boot to on your PC. But running both operating systems (or multiple operating systems) will require the user to keep straight two (or more) potentially conflicting sets of instructions to do major kinds of tasks, not to mention the problems involved in maintaining two sets of application software as well.
The possible problems brought on by using multiple operating systems, and the time you will need to support that one user if he/she gets into trouble, exceeds the amount of time you have available in a day to do such work (including the amount of time you have for sleep as well). Unless there is a mission-critical need for you to maintain two or more operating systems on a single computer, I strongly recommend that you run only one operating system on a PC at a time. If you do venture into running multiple operating systems on a PC, use the following rules to minimize your frustrations:

1. Read any software documentation thoroughly BEFORE jumping into the installation ... have all the facts and procedures in front of you as you begin installing the software.
2. Use well-known, documented operating systems, not beta releases or over-the-net shareware, for your operating systems and control software (such as System Commander).
3. Have the toll-free support phone numbers handy if something goes wrong.
4. BACK UP YOUR DATA BEFORE DOING AN INSTALLATION OF THIS KIND. If things really go badly, you may have to dump the whole hard disk, reformat, and reload everything. A little preparedness beforehand will save you lots of grief later.

**Printing Problems**

In all versions of Windows, printing problems are well documented and very common. Printing problems can come from a variety of problems, such as those listed below.

**Bad Printer Drivers**

The major reason for printer operation failures is that the printer driver is buggy, mis-installed, corrupted, or just plain doesn't work. Further, the print driver may be sending your print job to the wrong LPT port or print queue on the network. Also, users may have installed the Windows XP-compliant driver, thinking it was the Windows Vista-class driver, and now things are in an even bigger mess.

It is imperative that you have a known-good printer driver installed for your specific printer. These drivers should come with the printer when you buy it, or they should be available for download from the manufacturer on their Internet site. If you find that the set of drivers you have is no good, contact the manufacturer for assistance. If the manufacturer's technical support doesn't resolve the problem, return the printer to the place of purchase for an exchange or refund. If that is not an option, use the following guidelines: try to use another printer driver for a similar, LOWER-NUMBERED printer model from the same company.

For example, if you have a Canon BJC-210 printer, and the drivers from the company won't work, use the Microsoft-provided drivers for another Canon printer, like the BJC-200. OR, use an EPSON printer driver: most ink-jet and dot matrix printers have an Epson printer emulation that will get you going. For laser printers, pick an HP Laserjet Series II printer driver: most laser printers will emulate an HP Laserjet II or above. Most ink-jet printers will emulate an HP DeskJet or DeskJet 500 printer.

**Picking the Right LPT or COM Port**

When installing the printer driver, make sure you tell the program to which hardware port the printer will be attached. This can be LPT1: through LPT3:; or COM1: through COM4:.. Make sure you select the correct port, and specify the correct IRQ and port address, if necessary. Sending your print job to the wrong port will ensure your print jobs never show up.
Picking the Wrong Network Print Queue

When installing the printer driver, make sure you tell the program to which network print queue the printer will be attached. Networked print jobs go from your PC to a print queue, which is a holding area for print jobs. Then, the print queue releases the job to the printer in an organized fashion. If you send your job to the wrong print queue, the print job will never show up at the printer you expect. Consult with your networking staff for assistance in selecting the proper print queue for the desired printer. Also, make sure that you select LPT2: as your printer port; LPT1: is normally your parallel port that is physically connected to your PC, and jobs designated to go to LPT2: will be rerouted through your network card to the network's print server.

Picking the Wrong Printer Type

If you tell Windows that you have an HP LaserJet 6p printer, and you REALLY have an Epson ink-jet printer, and you send a document to print, you will get a garbled mess from your printer instead of the print job you expected. If such a problem occurs, make sure that you have selected the right type of printer before you run your print job. This will save yourself much frustration, and lots of wasted paper.

Miscellaneous Problems

In order for a printer to work, it must be turned on, paper must be installed, the ribbon / ink cartridge / toner cartridge must be in good shape, the printer must be on line, the printer cable must be hooked up to the printer AND the back of the PC, the proper printer must be specified in Windows, and the proper document must be opened in your application software. What I have just stated is patently obvious to you the technician ... it is not necessarily so to some users. Be sure that all of the basic issues about printing have been addressed when responding to such trouble calls. I have been paid for nothing more than turning a printer on-line, or making sure the paper was inserted into the printer, or pressing the power cord firmly into place on the printer. Hopefully, I have made my point.

Viruses

There are seemingly no end to the different types of viruses that are present in the world today, and no end to the ways that users will get them onto their computers. Despite anti-virus TSR programs and in-depth virus scanners, some viruses will always find a way of getting through and trashing one's computer. Sadly, most computers are running with no anti-virus precautions at all, and these computers are easy prey to computer viruses and the damage they can cause.

If you are supporting a computer user or a group of users, it is imperative that you install a virus-scanning program on every computer, and you must load an anti-virus terminate-and-stay-resident (TSR) program, that will act as a sentinel to protect from virus attacks, on every computer AND ensure that it loads every time the computer boots. To do anything less is to risk a possible virus infection on a PC or network, which could cause huge amounts of loss to valuable business data if left unchecked.

Good anti-virus software packages include AVG Anti-virus, and Command Software Systems Command Anti-Virus (formerly known as F-Prot). These packages have a known good reputation for protecting against virus infection, detecting infection, and properly removing the infection.

You must also train users to be aware of joke programs, trojan horses, and other types of pseudo-viruses that can wreak havoc on a computer's hard disk. For example, remind people during the holiday season that not every "electronic Christmas card" has a holiday greeting in it, but a leftover Halloween trick in it. Many joke programs and trojan horses damaged important business data on computers during the holidays, so teach your users to beware mail messages from unknown "friends".
User’s Lack of Knowledge in Using Application Software

No amount of tutoring on your part will ever substitute for a user taking the time to learn how to use an application, reading the manual or a good instruction book, using the program on a regular basis, and perhaps even taking a class on the particular application. The rule is simple: the more you work with a program, the better you will be able to use it. The more training you afford yourself, the better you will perform. When you encounter novice computer users (and you will), help them to learn "the rules of the game". In Windows, one application should work the same as another, and use the same kinds of commands to copy, print and edit files. Be patient, and teach them with sound doctrine and careful instruction. Help them to defuse their frustration, while helping them to learn the process of finding the answer, not just calling you for an answer. The proverb goes something like this: if you give a man a fish, he will depend upon you for fish; if you give a man a fishing pole, he will learn to feed himself. So should your instruction be with users.

However, you will encounter people who have NO BUSINESS touching a computer until they have taken a class or two on the subject. When you find such people, be sure to tell them where they can go to find competent instruction. There are many teachers in the world today, and some are better (or worse) than others. Know some places where people can go to find a reliable source of solid computer training. It is the author's hope that Research Technology Associates, the sponsoring non-profit organization for this course, would be such a provider of quality training. However, you should know of several good trainers in your area where people can find help.

Finally, help users to know that if they do stupid things, you cannot be responsible for their loss of data, services or time. If the person knows what is right to do, and then does the wrong things anyway, you cannot be held responsible for the consequences.

For example, I once helped a student to repair a computer for one of her friends. However, the owner of the computer put a password into the CMOS Setup program that prevented us from changing the BIOS settings, or from booting the computer. Further, the owner forgot the password. Finally, the motherboard had a soldered-on type of battery that was not easily removable (to clear the CMOS settings), and there was no password reset jumper on the motherboard. Also, the CMOS chip was designed to prevent shorting-out as a method of resetting the chip.

I told the student that the best option for repair was to replace the motherboard. Well, the owner of the motherboard was very upset with me (and my student), because we couldn't fix the computer without buying a new motherboard. I had no pity on the owner, and instructed my student to have none as well. If the user couldn't remember the password, then he/she had no business putting one on the computer. Hopefully this makes my point sufficiently well.

Summary and Lab

The rest of this lecture and lab will be devoted to showing you various kinds of user-imposed problems ... we will show you some computers with various kinds of hardware and software problems, and show you how specific changes are likely to affect your system's performance. You will want to take notes of this session, or record the session if you wish.
An Overview of The Windows Registry

The Windows Registry provides a single, unified database for storing system and application configuration data in a hierarchical form. Because the Registry contains all the settings required to configure memory, hardware peripherals, and Windows-supplied network components, you may find that it is no longer necessary to configure settings in startup configuration files and initialization (.INI) files. Because settings are stored in a central location, you can provide both local and remote support for system configuration using Windows-based tools.

The Registry is similar to the INI files used under previous versions of Windows, with each key in the Registry similar to a bracketed heading in an INI file and with Registry values similar to entries under the INI headings. However, Registry keys can contain subkeys, while INI files do not support nested headings. Registry values can also consist of binary data, rather than the simple strings used in INI files.

Although Microsoft discourages using INI files in favor of Registry entries, some applications (particularly older 16-bit Windows-based applications) still use INI files. Windows supports INI files solely for compatibility with those applications and related tools (such as setup programs).

The Registry provides the following benefits in Windows:

A single source provides data for enumerating and configuring the hardware, applications, device drivers, and operating system control parameters. The configuration information can be recovered easily in the event of system failure. Users and administrators can configure computer options by using standard Control Panel tools and other administrative tools, reducing the likelihood of syntactic errors in configuration information.

A set of network-independent functions can be used to set and query configuration information, allowing system administrators to examine configuration data on remote networked computers. The operating system automatically backs up the last good configuration used to start the computer.

Because user-specific Registry information can be maintained on a central network server when user profiles are enabled, users can have access to personal desktop and network access preferences when logging on to any computer, and settings for multiple users can be maintained on a single computer. Also, system policies (called Group Policy Objects or GPOs) can be used to enforce certain Registry settings for individuals, workgroups, or all users.

Main Registry Components

There are several classes (or hives) of registries within the single Windows Registry. Each class deals with a specific aspect of how Windows associates files with applications, and configuration settings with users and hardware. Listed below are the major hive classes within the Windows Registry:

HKEY_CLASSES_ROOT, HKEY_CURRENT_USER, HKEY_LOCAL_MACHINE, HKEY_USERS, and HKEY_CURRENT_CONFIG.

The registry hive called HKEY_DYN_DATA exists only in Windows 9x.
What functions do these parts of the Registry perform?

**HKEY_CLASSES_ROOT**

This part of the Registry provides Windows with the information it needs to associate different types of files with the applications for which they belong. For example, .DLL files are called and used by application software, or can be downloaded from the Internet; .AVI files are video files that the Windows Media Player (MPLAYER.EXE) will display for you. If you double click on the icon for an .AVI file, MPLAYER would load automatically and play the file, because the Registry associates that file with that application.

**HKEY_CURRENT_USER**

This part of the Registry provides Windows with the "personal" desktop configuration information needed for the currently logged-in user of Windows. Windows gives you the ability to have multiple configurations of the same installation of Windows for different users of the same machine, so each person's desktop will be configured to their liking. This includes desktop schemes, sounds, colors, icons, keyboard layout, networking configuration, and available software.

**HKEY_LOCAL_MACHINE**

This part of the Registry provides Windows with the non-user-specific, hardware based aspects of the host (or current) computer. For example, the HARDWARE branch of this subtree is where Windows stores all of the information about Plug-and-Play based hardware in your computer. Your network hardware configuration, hardware requirements of application software, audio and video controls, drive controller and video card configuration, and your PCI bus configuration information is all included in this part of the Registry.

**HKEY_USERS**

This part of the Registry provides Windows with the list and configuration information for all registered users of Windows on that PC. In this instance, registered means anyone who has logged into the PC (NOT necessarily onto the network) and has done anything under the desktop interface. The same kinds of information found in HKEY_CURRENT_USER will be found for all recognized users under the HKEY_USERS subtree.

**HKEY_CURRENT_CONFIG**

This part of the Registry provides Windows with the current machine's hardware and Plug-and-Play configuration. This is set (or reconfigured) through the use of .INF (information) files used when Windows installs new devices into the PC. The Windows configuration manager is primarily responsible for controlling this aspect of the Registry, working together with the Plug-and-Play BIOS, the device drivers and VxDs (virtual device drivers), the software enumerators that poll each Plug-and-Play device, any resource arbitrators on the system board, and the application programming interfaces (APIs) that allow software to interface with the hardware.

**HKEY_DYN_DATA [ Exists ONLY in Windows 9x ]**

This part of the Registry provides Windows with the information it needs to use dynamic (virtual) device drivers, or VxDs. Dynamic drivers are loaded only when an application calls to a specific resource on your PC (modem, sound card, etc.); these drivers may not necessarily be loaded when Windows boots up. The VXDLDR module of Windows handles the loading of VxDs when needed by the operating system and/or the specific device. Also, this part of the Registry keeps track of information on the kernel of Windows that has been loaded into RAM, the Virtual FAT that has been loaded into RAM, and the Virtual Memory Manager module of Windows.
Restoring the Registry Files in Windows 2000 and XP / Vista / Windows 7

This section describes how to back up, edit, and restore the registry. Microsoft recommends that before you edit the registry, you back up the registry and understand how to restore it if a problem occurs.

How to Back Up the Windows 2000 Registry

Before you edit the registry, export the keys in the registry that you plan to edit, or back up the whole registry. If a problem occurs, you can then follow the steps shown below to restore the registry to its previous state.

Exporting Registry Keys

You can follow these steps to export a registry key before you edit it:

NOTE: Do not follow these steps to export a whole registry hive (for example, HKEY_CURRENT_USER). If you must back up whole registry hives, back up the whole registry instead.

• Click Start, and then click Run.
• In the Open box, type regedt32, and then click OK.
• Locate and then click the key that contains the values that you want to edit.
• On the Registry menu, click Save Key.
• In the Save inbox, select a location in which to save the .reg file, type a file name in the File name box, and then click Save.

How to Back Up the Entire Windows Registry

Follow these steps to export the entire Registry to a .REG file:

• Click Start, and then click Run.
• In the Open box, type regedit, and then click OK.
• Make sure that My Computer is highlighted in the Registry editor.
• Click on the File drop-down menu, and click the Export option.
• In the Save inbox, select a location in which to save the .reg file, type a file name in the File name box, and then click Save.

NOTE: this procedure actually works in ALL Windows versions.

To back up the whole registry, you also can use the Microsoft Backup utility to create an Emergency Repair Disk (ERD), or back up the System State (which includes the registry, the COM+ Class Registration database, and your boot files).

For additional information about using the Backup utility to create an ERD, refer to the following article number to view the article in the Microsoft Knowledge Base: 231777

( http://support.microsoft.com/kb/231777/ ) How to create an emergency repair disk in Windows 2000

For additional information about using the Backup utility to back up the system state, refer to the following article number to view the article in the Microsoft Knowledge Base: 240363

( http://support.microsoft.com/kb/240363/ ) How to use the Backup program to back up and restore the system state in Windows 2000
How to Back Up the Windows XP / Vista / Windows 7 Registry

- Use the System Restore utility from the Start menu. Click on Start, then click on Programs (or All Programs) / Accessories/ System Tools, and select System Restore.
- (You also can click on Start, then Run, and type %SystemRoot%\system32\restore\rstrui.exe, and then click OK.)
- On the Welcome to System Restore page, click Create a restore point, and then click Next.
- On the Create a Restore Point page, type a name for the restore point and then click Create.
- After the restore point has been created, click Close.
- Note: If System Restore is turned off, you will receive a message that asks whether you want to turn on System Restore now. Click Yes. Then, in the System Properties dialog box, click to clear the Turn off System Restore check box, click OK, and then repeat this step.

To Restore the Windows XP / Vista / Windows 7 Registry

- You can use System Restore to undo registry changes in Windows XP, Windows Vista or Windows 7
- Click on Start, then click on Programs (or All Programs) / Accessories/ System Tools, and select System Restore.
- (You also can click on Start, then Run, and type %SystemRoot%\System32\Restore\Rstrui.exe, and then click OK.)
- On the Welcome to System Restore page, click Restore my computer to an earlier time (if it is not already selected), and then click Next.
- On the Select a Restore Point page, click the system checkpoint. In the On this list select the restore point area, click an entry that is named "Guided Help (Registry Backup)," and then click Next. If a System Restore message appears that lists configuration changes that System Restore will make, click OK.
- On the Confirm Restore Point Selection page, click Next. System Restore restores the previous Windows configuration and then restarts the computer.
- Log on to the computer. When the System Restore confirmation page appears, click OK.

Using Regedit to Edit Your Registry

Windows comes with a Registry editing tool that can help you to repair or edit a faulty registry. The program is called REGEDIT.EXE. It is a fairly simple database editor, and it lets you search the Registry for specific text strings (by pressing Ctrl - F). For example: if Windows gives you error messages that certain .DLL files could not be found on your PC, you can use REGEDIT to go into the Registry and delete out all mentions of that now-missing VxD file, thereby eliminating the error messages at system boot-up time.

Another Windows Registry editor, REGEDT32.EXE, is available to modify the Registry manually. It displays the Registry hives as a series of folders. You can use either registry editor, but Microsoft (and the author) recommend using REGEDIT.EXE.

BE CAREFUL, HOWEVER, WHEN RUNNING REGEDIT ... even the experts at Microsoft recommend that you not use Regedit unless you know exactly what you are doing. Usually, it's better to reinstall the missing software, or uninstall the errant software, rather than messing around with the Registry. When you uninstall a software application, the uninstaller edits the Registry for you, removing all mentions of any VxDs or drivers that will no longer be needed. It's much better to let the software developer's uninstaller change the Registry, rather than you, especially since they know what Registry entries were made in the first place.

Please use this guide when editing a Registry, and don't add or delete anything unless you are absolutely sure that it's the right thing to do.

For the A+ examination, you will need to know what the Windows Registry is, what are the major classes (or hives) within the Registry, how to edit the Registry (use Regedit), and how to restore your backup registry in the case of emergency.
Re-Registering Programs Using Windows Explorer and .REG Files

From time to time, you may find that certain programs will begin to malfunction because the Registry entries for that program have become corrupt. The corruption may come from a virus, from another installed program with competing Registry values (i.e., Internet Explorer vs. Firefox), from user error, or from other miscellaneous problems (disk space corruption, installer failure, etc.). When this occurs, there is a process you can use to re-register a program in the Windows Registry without forcing a reload of the operating system. This process should restore a program to normal operation.

To re-register a program in Windows, right-click on Start, then launch Windows Explorer. Select Tools from the menu bar, then select Find, then select Files/Folders, and then search for any files on the hard disk that end in .REG. Find the .REG file that correlates to the affected program, and then re-register affected program by double-clicking on the selected .REG file. This should restore the program to normal operation. If it does not, contact the program's technical support staff for assistance.

Online Registry Resources

Several websites are available online that provide information on how to edit the Windows registry, specifically to fix specific problems or to enhance the way Windows operates. The best known site is www.regedit.com, which has information broken down into specific categories (such as Hardware, Network, and Tips and Tricks). Another websites, www.annoyances.org, has a great deal of helpful information. Microsoft’s website does have some information on how to edit the registry, along with specific fixes that will resolve identified consumer problems. If you encounter registry problems, you will find that the Internet is full of people who have been in your situation before, and may have an answer to fix your particular problem.

Summary and Lab

The rest of this lecture and lab will be devoted to showing you various kinds of registry problems ... we will show you some computers with various kinds of hardware and software problems, and show you how specific changes are likely to affect your system’s performance. You will want to take notes of this session, or record the session if you wish.

NOTES
AN OVERVIEW OF LINUX OPERATING SYSTEMS

What is Linux?

Linux is a generic term referring to Unix-like computer operating systems based on the Linux kernel. Their development is one of the most prominent examples of free and open source software collaboration; typically all the underlying source code can be used, freely modified, and redistributed, both commercially and non-commercially, by anyone under licenses such as the GNU General Public License.

Linux can be installed on a wide variety of computer hardware, ranging from embedded devices such as mobile phones, smartphones and wristwatches to mainframes and supercomputers. Linux is predominantly known for its use in servers; in 2007 Linux's overall share of the server market was estimated at 12.7%, while a 2008 estimate suggested that 60% of all web servers ran Linux. Most desktop computers run either Mac OS X or Microsoft Windows, with Linux having only 1–2% of the desktop market. However, desktop use of Linux has become increasingly popular in recent years, partly owing to the popular Ubuntu distribution and the emergence of netbooks and smartbooks.

Typically Linux is packaged in a format known as a Linux distribution for desktop and server use. Linux distributions include the Linux kernel and all of the supporting software required to run a complete system, such as utilities and libraries, the X Window System, the GNOME and KDE desktop environments, and the Apache HTTP Server. Commonly-used applications with desktop Linux systems include the Mozilla Firefox web-browser, the OpenOffice.org office application suite and the GIMP image editor.

The name "Linux" comes from the Linux kernel, originally written in 1991 by Linus Torvalds. The main supporting Userland in the form of system tools and libraries from the GNU Project (announced in 1983 by Richard Stallman) is the basis for the Free Software Foundation's preferred name GNU/Linux.

Differences Between Linux and Microsoft-Based Operating Systems

The primary difference between Linux and many other popular contemporary operating systems is that the Linux kernel and other components are free and open source software. Linux is not the only such operating system, although it is by far the most widely used. Some free and open source software licenses are based on the principle of copyleft, a kind of reciprocity: any work derived from a copyleft piece of software must also be copyleft itself. The most common free software license, the GNU GPL, is a form of copyleft, and is used for the Linux kernel and many of the components from the GNU project.

Linux based distributions are intended by developers for interoperability with other operating systems and established computing standards. Linux systems adhere to POSIX, SUS, ISO, and ANSI standards where possible, although to date only one Linux distribution has been POSIX.1 certified, Linux-FT.

Free software projects, although developed in a collaborative fashion, are often produced independently of each other. The fact that the software licenses explicitly permit redistribution, however, provides a basis for larger scale projects that collect the software produced by stand-alone projects and make it available all at once in the form of a Linux distribution.

A Linux distribution, commonly called a "distro", is a project that manages a remote collection of system software and application software packages available for download and installation through a network connection. This allows the user to adapt the operating system to his/her specific needs. Distributions are maintained by individuals, loose-knit teams, volunteer organizations, and commercial entities. A distribution is responsible for the default configuration of the installed Linux kernel, general system security, and integration of the different software packages into a coherent whole. Distributions typically use an installation package manager to install, remove and update all of a system's software from one central location.
A distribution is largely driven by its developer and user communities. Some vendors develop and fund their distributions on a volunteer basis, Debian being a well-known example. Others maintain a community version of their commercial distributions, as Red Hat does with Fedora.

In many cities and regions, local associations known as Linux Users Groups (LUGs) seek to promote their preferred distribution and by extension free software. They hold meetings and provide free demonstrations, training, technical support, and operating system installation to new users. Many Internet communities also provide support to Linux users and developers. Most distributions and free software / open source projects have IRC chatrooms or newsgroups. Online forums are another means for support, with notable examples being LinuxQuestions.org and the Gentoo forums. Linux distributions host mailing lists; commonly there will be a specific topic such as usage or development for a given list.

There are several technology websites with a Linux focus. Print magazines on Linux often include cover disks including software or even complete Linux distributions.

Although Linux distributions are generally available without charge, several large corporations sell, support, and contribute to the development of the components of the system and of free software. An analysis of Linux showed 75 percent of the code from December 2008 to January 2010 was developed by programmers working for corporations, leaving about 18 percent to the traditional, open source community. Some of the major corporations that contribute include Dell, IBM, HP, Oracle, Sun Microsystems, Novell, Nokia. A number of corporations, notably Red Hat, have built their entire business around Linux distributions.

The free software licenses, on which the various software packages of a distribution built on the Linux kernel are based, explicitly accommodate and encourage commercialization; the relationship between a Linux distribution as a whole and individual vendors may be seen as symbiotic. One common business model of commercial suppliers is charging for support, especially for business users. A number of companies also offer a specialized business version of their distribution, which adds proprietary support packages and tools to administer higher numbers of installations or to simplify administrative tasks. Another business model is to give away the software in order to sell hardware.

The popularity of Linux on standard desktops (and laptops) has been increasing over the years. Currently most distributions include a graphical user environment. The two most popular such environments are GNOME and KDE, both of which are mature and support a wide variety of languages.

Advantages To Linux Over Windows Operating Systems

- Greater stability for the core operating system
- Nearly impervious to viruses and spyware
- Superior security in the file system, as compared to NTFS
- Fully capable of working in networked and Internet-connected environments
- Broad range of applications available, most as open-source programs / suites
- Developers can build applications and port the operating system to meet specific needs
- Zero cost-basis to obtain the operating system

Available Applications in the Linux Environment

Many types of applications available for Microsoft Windows and Mac OS X are also available for Linux. Commonly, either a free software application will exist which does the functions of an application found on another operating systems, or that application will have a version that works on Linux (such as Skype). Furthermore, the Wine project provides a Windows compatibility layer to run unmodified Windows applications on Linux. CrossOver is a proprietary solution based on the open source Wine project that supports running Windows versions of Microsoft Office, Intuit applications such as Quicken and QuickBooks, Adobe Photoshop versions through CS2, and many popular games such as World of Warcraft and Team Fortress 2. In other cases, where there is no Linux port of some software in areas such as desktop publishing and professional audio, there is equivalent software available on Linux.
Many popular applications are available for a wide variety of operating systems. For example Mozilla Firefox, Corel WordPerfect Suite and OpenOffice.org have downloadable versions for all major operating systems. Furthermore, some applications were initially developed for Linux (such as Pidgin, and GIMP) and, due to their popularity, were ported to other operating systems (including Windows and Mac OS X).

A growing number of proprietary desktop applications are also supported on Linux. In the field of animation and visual effects, most high end software, such as AutoDesk Maya, Softimage XSI and Apple Shake, is available for Linux, Windows and/or Mac OS X.

The collaborative nature of free software development allows distributed teams to localize Linux distributions for use in locales where localizing proprietary systems would not be cost-effective. For example the Sinhalese language version of the Knoppix distribution was available significantly before Microsoft Windows XP was translated to Sinhalese. In this case the Lanka Linux User Group played a major part in developing the localized system by combining the knowledge of university professors, linguists, and local developers.

To install new software in Windows, users either download a digital distribution and double-click to install it or use a traditional installation medium (such as CD-ROM). Both of these methods usually provide a "Software Installation Wizard" to guide the user through the setup. On most Linux distributions, there are utilities for browsing a list of thousands of applications installed with a single click. Some of these programs are the Synaptic Package Manager, PackageKit, and Yum Extender. However, installing software not in the official repositories is not always as easy - especially for users new to Linux - and sometimes the only option is to compile from source.

**Hardware Drivers for Linux Operating Systems**

For the most part, unless you have a super-brand-new PC or laptop with cutting-edge technology, Linux will have the necessary drivers to run all of your hardware devices. There will be cases where you may have to do some in-depth searching to locate these drivers. Manufacturers like Dell, HP/Compaq and Lenovo provide hardware drivers for Linux operating systems on their support websites. Some Linux distributions like Ubuntu provide proprietary hardware drivers on the installation CD, in the same way that Microsoft does for Windows. Other manufacturers (like Acer, Toshiba and Gateway) provide poor support for Linux. In these cases, you may have to do some Web searching for a person or a developer that has taken it upon themselves to develop the proper driver. In any situation where you need a hardware driver for a Linux installation, you should contact the Linux distributor and/or the hardware manufacturer with questions.

**Online Resources for Information and Applications for Linux**

The Internet has hundreds of websites that will provide you with different versions of the Linux operating system. For example, [www.ubuntu.com](http://www.ubuntu.com) will link you to downloadable versions of the operating system, technical support, and pointers to open-source applications. Listed below are several websites that provide helpful information and software related to Linux operating systems:

http://www.linuxberg.com  
http://www.linux.org  
http://freshmeat.net  
http://www.redhat.com  
http://linuxresources.us

Search engines like Google, Yahoo and Bing will point you towards any number of informational and downloadable resources for Linux-based operating systems.
Summary and Lab

In this course, we will demonstrate how to install and use Ubuntu Linux on a typical desktop (or laptop) PC. The instructor will provide to students a current copy of the Ubuntu installation CD/DVD, for you to keep and install on your home PC, or a development PC. Through the process of installing and using Linux, it is hoped that the student will become familiar with the operating system and understand the strengths of Linux as compared with Microsoft-based operating systems. The expectation is that the student will install Linux on a PC and then attempt to use the PC to perform typical operations that could otherwise be done on a PC with a Windows-based operating system.

If you need to obtain a PC to use in experimenting with Linux, please see the instructor.
OVERVIEW OF RESIDENTIAL AND COMMERCIAL BROADBAND INTERNET SYSTEMS

A residential gateway is a home networking device, used as a gateway to connect devices in the home to the Internet or other WAN.

It is an umbrella term, used to cover multi-function networking computer appliances used in homes, which may combine a DSL modem or cable modem, a network switch, providing LAN switching, a consumer-grade router, and a wireless access point. In the past, such functions were provided by separate devices, but by technological convergence, they have often merged into a single device.

There are multiple devices that have been described as "residential gateways" each with a different function. Each type of device allows the connection of a LAN (used in the home) to a WAN. The WAN can be often the Internet or can merely be a larger LAN of which the home is a part (such as a municipal WAN that provides connectivity to the residences within the municipality). WAN connectivity may be provided through DSL, cable modem, a broadband mobile phone network, or other connections.

The term "residential gateway" was originally used to distinguish the inexpensive networking devices designated for use in the home from similar devices used in corporate LAN environments (which generally offered a greater array of capabilities). In recent years, however, the less expensive "residential gateways" have gained many of the capabilities of corporate gateways and the distinctions are fewer. Many home LANs now are able to provide most of the functions of small corporate LANs.

Therefore the term "residential gateway" was becoming obsolete and merely implies a less expensive, lower capability networking device.

Nowadays, the home gateway tends to have abundant interfaces, powerful functions and a more user-friendly interface. It is a manageable terminal with auto-configuration, multiple interfaces, and multi-service perceiving and bearing. The home gateway provides Quality of Service to bear services of different types at the same time. As a part of the carrier network, the home gateway shall support remote control, detection and configuration.

Devices

Multiple devices have been described as "residential gateways":

- Cable modem
- DSL or ADSL modem
- Network modem
- Router or Wireless router
- Network switch
- VoIP ATA
- Wireless access point
- or any combination of the above.

A typical router provides:

- IP address routing
- network address translation (NAT)
- DHCP functions
- firewall functions
- LAN connectivity like a Network switch
Most routers are self-contained components, using internally-stored firmware. They are generally OS-independent (i.e. can be used with any operating system). Most also have a firewall application built into them, giving the users additional protection from hackers.

Wireless routers perform the same functions as a router, but also allows connectivity for wireless devices with the LAN, or between the wireless router and another wireless router. (The wireless router-wireless router connection can be within the LAN or can be between the LAN and a WAN.)

A modem (e.g. DSL modem, Cable modem) provides none of the functions of a router. It merely allows Ethernet traffic to be transmitted across telephone lines, cable wires, optical fibers, or wireless radio frequencies. On the receiving end is another modem that re-converts the transmission format back into digital data packets.

This allows network bridging using telephone, cable, optical, and radio connection methods. The modem also provides handshake protocols, so that the devices on each end of the connection are able to recognize each other. However, a modem generally provides few other network functions.

- A USB modem plugs into a single PC and allow connection of that single PC to a WAN. If properly configured, the PC can also function as the router for a home LAN.
- An internal modem can be installed on a single PC (e.g. on a PCI card), also allowing that single PC to connect to a WAN. Again, the PC can be configured to function as a router for a home LAN.

A wireless access point can function in a similar fashion to a modem. It can allow a direct connection from a home LAN to a WAN, if a wireless router or access point is present on the WAN as well.

Features

Beyond basic connectivity and routing, residential gateways can provide addition features, such as:

- Configuration via a web interface (by browsing to 192.168.1.1)
- Dynamic DNS, which is a A service that lets anyone on the Internet gain access to resources on a local network when the Internet address of that network is constantly changing. Such resources are typically a Web server, webcam or a PC for remote control operation.

Manufacturers

There are a number of manufacturers of networking devices that have been used as residential gateways Here is a list of some of the more well-recognized manufacturers:

- 3Com
- Siemens AG
- Allied Telesis
- SMC Networks
- Apple Inc. (termed AirPort Base Stations
- U.S. Robotics
- Asus
- Verizon
- Belkin
- Westell Technologies, Inc.
- Check Point
- Zoom Telephonics
- D-Link
- ZyXEL
- Enterasys Networks
- Linksys
- Motorola
- NEC
- NETGEAR
Configuring Typical Residential / Small-Business Routers

Virtually all residential routers can be configured by using a browser such as Internet Explorer or Mozilla Firefox. By pointing to the internal IP address for the router and entering the username and password combination, one can access the router and setup various features, such as:

- WPA and/or WEP encryption
- MAC address filtering
- NAT translation
- Opening or closing TCP/IP ports that are used by devices such as an Xbox, PlayStation 3, or a smartphone (such as a BlackBerry, iPhone or Droid)
- Setting the channel frequency for the wireless router (to prevent conflicts with cordless phones)
- Lease times for private IP addresses
- Public DNS and WINS server addresses
- Cloning a PC’s MAC address (primarily required on Comcast systems)

Most routers have their private IP address set to **192.168.1.1**; some will be set at **192.168.0.1**. To access the router, launch your browser application, and instead of entering a typical URL (like www.bbcnews.com), enter the IP address for the router. An authentication window will appear; enter the router’s administrator username and password combination. Here are some typical combinations to use:

**Linksys and Westell**: username is blank, and password is admin (lowercase)

**D-Link and Belkin**: username is Admin (case-sensitive), and password is password (lowercase)

**Other brands**: try the username of admin (lowercase) and a password of admin or password (lowercase)

If the router has a username and password combination that is unknown, there is a reset button at the back of the unit that can be used to clear the passwords and reset the router to default settings. Press the button with a paperclip or very small screwdriver. Pressing the reset button while the unit is powered will perform a “warm boot” that will restart the router, but not clear the password or other settings. Removing power from the router, holding in the reset button and then restoring power to the router will force a “cold boot” reset of the unit. Hold the button in for several seconds after restoring power, and then release the button. The router will then revert back to the out-of-box default settings. Refer to the manufacturer’s instructions when working with your router.

If the user wishes to enable the WPA (Wi-fi Protected Access) or WEP (wired equivalent privacy) protocols, you will need to develop a “pass-phrase” password that can be remembered and provided to any wireless devices attempting to connect to the router. Here are the key differences between WEP and WPA:

WEP aims to provide security by encrypting data over radio waves so that it is protected as it is transmitted from one end point to another. However, it has been found that WEP is not as secure as once believed. WEP is used at the two lowest layers of the OSI model - the data link and physical layers; it therefore does not offer end-to-end security.

WPA technology is designed to work with existing Wi-Fi products that have been enabled with WEP (i.e., as a software upgrade to existing hardware), but the technology includes two improvements over WEP:

- Improved data encryption through the temporal key integrity protocol (TKIP). TKIP scrambles the keys using a hashing algorithm and, by adding an integrity-checking feature, ensures that the keys haven’t been tampered with.
- User authentication, which is generally missing in WEP, through the extensible authentication protocol (EAP). WEP regulates access to a wireless network based on a computer’s hardware-specific MAC address, which is relatively simple to be sniffed out and stolen. EAP is built on a more secure public-key encryption system to ensure that only authorized network users can access the network.

It should be noted that WPA is an interim standard that will be replaced with the IEEE’s 802.11i standard upon its completion.
When developing a WEP or WPA pass-phrase, you will need to create a password that has a combination of numbers, letters and special characters. In this way you can be assured that the password is sufficiently complex and will prevent hackers from easily obtaining access to the wireless router. You should connect a PC to the router via the **wired connections** at the back of the device when setting the WPA or WEP pass-phrase. That way, you won’t lose the connection to the router when the pass-phrase initially is established. Write down the pass-phrase, and keep it in a secure location. You can view the pass-phrase in the router’s configuration program from a PC connected via a hard-wired connection, but not while connected wirelessly.

**Comcast Systems and Cloning PC MAC Addresses**

Comcast has a business practice of allowing only ONE computer per household to be connected to their cable modem systems at a time. Comcast records the Media Access Control (MAC) address from the “authorized” PC’s network card, and only allows that one MAC address to interact with their system. Most residential routers now are designed to overcome this problem by “cloning” the MAC address of the authorized wired PC. This will allow multiple PCs to connect simultaneously to the Internet on a Comcast system.

To accomplish this, start by connect the PC directly to the cable modem, and run the Comcast Internet configuration software application. Once that PC is running properly on the system, disconnect the PC from the cable modem. Attach the cable modem to the “Internet” jack on the router, and connect a PC to the router with a CAT-5 network cable. Access the router’s configuration page with your browser software, and navigate to the “Clone PC MAC address” menu option. Clone the PC’s MAC address, save the settings, and allow the router to restart. You may also need to reboot the PC for the changes to take effect.

If you have difficulty with this process, contact the router manufacturer, rather than Comcast technical support. Most router manufacturers are familiar with this procedure, and they can step you through the process.

**Router Failures**

Like any other electronic device, routers and cable modems will fail or become defective. A number of reasons can account for this problem:

- Overheating (most routers are not heat-sinked, and do not have cooling fans)
- Electrical damage from surges (from the AC line or the incoming phone/cable line)
- AC adapter failure
- Hacking (some hackers are bright enough to know how to wipe the router ROM BIOS)
- Breakage from falls
- Other forms of consumer abuse (spilling liquids, rough treatment, etc.)

If a residential or small-office router fails, the best and simplest solution is to replace the unit. The cost of residential routers continue to drop, even as performance on newer routers increases. If you have performed a warm and/or cold-boot to a router and it fails to connect properly, and you know the incoming Internet connection is live (because you connected a PC or laptop directly to the incoming cable and got onto the Internet), purchase a new router and replace the old one.

**Differences between 802.11b, 802.11g and 802.11n Wireless Connections**

There are three different wireless transmission protocols in use today: 802.11b, 802.11g, and 802.11n. Each of these protocols have different transmission speeds and security characteristics. These protocols are described starting on the next page:
802.11b

Also referred to as 802.11 High Rate or Wi-Fi, the 802.11b protocol is an extension to the original 802.11 specification developed by the IEEE for wireless LAN (WLAN) technology that applies to wireless LANs. It provides 11 Mbps transmission (with a fallback to 5.5, 2 and 1 Mbps) in the 2.4 GHz band. 802.11b uses only direct-sequence spread spectrum (DSSS), which is a transmission technology where a data signal at the sending station is combined with a higher data rate bit sequence, or chipping code, that divides the user data according to a spreading ratio. If one or more bits in the pattern are damaged during transmission, the original data can be recovered due to the redundancy of the transmission. 802.11b was a 1999 ratification to the original 802.11 standard, allowing wireless functionality comparable to Ethernet.

802.11g

802.11g is an extension to 802.11 specification developed by the IEEE for wireless LAN (WLAN) technology that is used for transmission over short distances at up to 54-Mbps in the 2.4 GHz bands. 802.11g routers typically have greater data transmission ranges than do 802.11b routers, usually in the range of 200 - 250 feet from the source.

802.11n

802.11n is an extension to 802.11 specification developed by the IEEE for wireless LAN (WLAN) technology. 802.11n builds upon previous 802.11 standards by adding multiple-input multiple-output (MIMO). The additional transmitter and receiver antennas allow for increased data throughput through spatial multiplexing and increased range by exploiting the spatial diversity through coding schemes like Alamouti coding. The data transmission speed is 100 Mbit/s (even 250 Mbit/s in PHY level), and so up to 4-5 times faster than 802.11g. 802.11n also offers a better operating distance than current networks.

Compatibility Issues

An 802.11n router typically will be backwardly compatible with 802.11b and 802.11g devices; 802.11g routers will recognize 802.11b devices, but not the newer 802.11n interface cards. When selecting a new router, try to purchase one that has the highest and best data transmission capabilities. This will provide the consumer with the most satisfactory wireless online experience. When working with an existing router, examine the unit or access the configuration page to determine which of these three protocols are supported.

Residential Wireless Routers and Residential Cordless Phones

One of the biggest reported problems with residential wireless routers is that the connections will sporadically terminate for what appears to be no reason. In fact, there is a very simple reason: wireless routers transmit data at the same frequency spectrum as residential cordless phones. These devices work at the 2.4GHz and/or 5.8GHz frequency bands, and each bandspread has 11 separate channels. If your cordless phone is operating at the same frequency and channel as your wireless router, you will suffer a disconnection from the router whenever the telephone rings.

The solution to this problem is quite simple: change the channel. Cordless phones have a “channel” button that will rotate the phone to an alternate channel within the spectrum. Simply press the channel button once, and your phone will now be at a different frequency than your router. However, if your neighbor is the person with the cordless phone at the offending frequency, you will have to change channels on the router. Access the router configuration page, and navigate to the options to change the channel frequency. The router typically will restart after such a change, and you may need to reboot the PC or laptop to re-establish the wireless connection.

This problem even has been reported with some models of garage-door opener units. The fix for this problem is the same as with a cordless phone: change the radio channel of one of these devices, and the issue will be resolved.
Mobile Broadband and 3G / EV-DO Wireless Internet Access

Evolution-Data Optimized (EV-DO) is a fast wireless broadband access (3G) technology, where you are the hotspot (meaning you don't need a Wi-Fi hotspot to have the Internet access). Your PC or laptop requires an EV-DO PC card for connection. EV-DO supports an "always-on" connection, similar to DSL. EV-DO is the wireless broadband standard that has been adopted by many CDMA mobile phone service providers, such as Cricket, Verizon, and Sprint/Nextel. AT&T and T-Mobile have similar products that work in the GSM cellular radio frequencies.

Mobile broadband adapters essentially are cellular phones that only permit data access to the provider’s network resources. So long as there is a cell tower within range, the customer can access the Internet at speeds that come close to residential-based wired Internet systems. Adapters can be purchased from the cellular carriers for existing PCs and laptops, along with monthly or contract-based access plans. Many new laptops and netbook PCs have 3G and/or EV-DO adapters pre-installed in them.

Some providers (Sprint, for example) have created mobile wi-fi hotspots that essentially are EV-DO modems which permit up to five PCs or laptops to connect to the mobile broadband connection. So long as the laptop or other device has traditional wi-fi capabilities, these devices can tap into the bandwidth available on the mobile hotspot’s EV-DO modem.

WiMAX and 4G Mobile Broadband Internet Access

WiMAX is the next-generation of wireless technology designed to enable pervasive, high-speed mobile Internet access to the widest array of devices including notebook PCs, handsets, smartphones, and consumer electronics such as gaming devices, cameras, camcorders, music players, and more. As the fourth generation (4G) of wireless technology, WiMAX delivers low-cost, open networks and is the first all IP mobile Internet solution enabling efficient and scalable networks for data, video, and voice. As a major driver in the support and development of WiMAX, Intel has designed embedded WiMAX solutions for a variety of mobile devices supporting the future of high-speed broadband on-the-go.

WiMAX is based upon the IEEE 802.16e standard enabling the delivery of wireless broadband services anytime, anywhere. WiMAX products can accommodate fixed and mobile usage models. The IEEE 802.16e standard was developed to deliver non-line-of-sight (LoS) connectivity between a subscriber station and base station with typical cell radius of three to ten kilometers.

WiMAX technology utilizes Orthogonal Frequency-Division Multiplexing (OFDM) over EDGE, GPRS, and HSPA cellular frequencies to deliver higher bandwidth efficiency and therefore higher data throughput, with more than one Mbps downstream and higher data rates. This allows more than one frequency at a time to be used in delivering data streams over the wireless/cellular spectrum to the customer. Adaptive modulation also increases link reliability for carrier-class operation and the possibility to keep higher order modulation at wider distance extend full capacity over longer distances.

As of May 2009, the WiMAX Forum is tracking 475 network deployments in 140 countries. You can visit WiMAX Maps at [www.wimaxmaps.org](http://www.wimaxmaps.org) to see where these systems are being deployed. WiMAX Maps is an interactive WiMAX deployment mapping database provided by WiMAX Forum and powered by Informa Telecoms & Media’s World Cellular Information Service (WCIS) using the familiar Google Maps API.
Summary and Lab

In this course, we will demonstrate how to install and configure residential and commercial broadband network and Internet services. The instructor recommends that the student obtain a router and several computers (PCs or laptops) that could be used to build their own testing network, that can be used to learn and reinforce the concepts described in this chapter.

The next section of this text, Overview of Small Office and Home Office Networking Systems, provides further details and a roadmap on how to setup residential and small-office networks.

If you need to obtain equipment to use in experimenting with networks, please see the instructor.
OVERVIEW OF SMALL-OFFICE AND HOME-OFFICE (SOHO) NETWORKING SYSTEMS

Many families and small offices have more than one PCs. You should set up a small network to better utilize the computing power and resources in PCs. Also, by setting up a network, you can share an internet connection. No more fighting on who can surf the internet.

There are basically two type of networking: peer-to-peer networking and server-based networking.

Peer-to-peer networking

This type of network is easy to configure, inexpensive and ideal for home and small offices. In a peer-to-peer network, each computer shares information stored on it with other computers or peers, on the network. Peripheral devices such as printers and scanners can be shared as well. The disadvantage of peer-to-peer networking is that it's relatively insecure. Everyone on the network can access the files you've designated to share. However, there are measures you can implement to remedy this issue.

Server-based networking

Server-based networks are built around a centralized computer called a server. This type of networking is also referred to as server-client network. The server holds all the network's shared information which the client computers can access. The server-base network is popular with the business world because it's easier to manage and offers a better security for the information stored on the server.

However, server-based networks are more expensive to set up and maintain. At least one dedicated computer is needed to act as a server. A more expensive operating system specifically designed to run on a server computer is also needed. In addition, a knowledgeable network administrator is needed to manage the server. As you can see, server-based networking is not necessary for home use.

After you have decided which networking scheme meets your need, you then need to to decide how you want to physically connect the network. There are generally two choices you can pick: cabled networks and wireless networks.

Cabled networks

Until recently, almost all networks are connected by network cables and network devices such as hubs and switches. This type of connection is fast, reliable and relatively inexpensive. It's also more secure than wireless network. However, there are drawbacks with network cable in SOHO setting. You need to connect each computer with a network cable which is difficult to do, especially if you live in a multi-story house and the computers are not close to each other. Fortunately, to avoid hole drilling and tangling layout of network cables, wireless networking provides a more elegant solution.

Wireless networks

Wireless networks are getting more and more popular with the home networking market. This type of networking offers much greater flexibility and freedom. Instead of connecting PCs using cables and switches, wireless networking uses wireless access points, routers and wireless NIC cards.

However, there are drawbacks with wireless networking as well. Wireless networks can be up to ten times slower than cabled networks. Wireless networks can be less secure than wired networks, due to the fact that signals are broadcast in the air for up to 800 feet. Fortunately, there are security measures you can implement to minimize the risk.
Setting Up A Small Office / Home Office (SOHO) Network

Many people are unaware of how easy and inexpensive it is to interconnect existing computers to form a small Local Area Network (LAN). If you are using Windows, no additional software is required to enjoy basic network functions such as shared use of directories, drives, or printers and the hardware costs are minimal. A network can substantially simplify internet access for two or more people. Of course another reason for setting up a network is to play multiplayer games such as World of Warcraft or use “groupware” applications such as shared calendars, contact lists, to-do lists, etc.

Configuring and connecting networking hardware

The standard networking technology used today is Ethernet. Ethernet works by means of adapters known as Network Interface Cards (NICs) in each computer. The NICs are connected with cables which vary depending on the cabling option chosen. Many recent computers have built-in network capability on the motherboard.

Ethernet comes in two flavors. Fast Ethernet operates at 100 or 1000 Megabits per second (Mbps) and is overkill for a SOHO. Regular or original Ethernet operates at 10 Mbps which is fast enough for a small LAN. NICs can be purchased to fit into a PCI slot or USB port, and can also be found to fit a laptop PCMCIA slot or USB port.

There are two different Ethernet cabling options one of which will be usually used in any given LAN. NICs can be purchased with any of these interface connectors or even with two connectors. If the NIC has more than one connector a jumper plug or software configuration is usually used to select which connector is in use. Internal PCI or external USB NICs cost as little as $20 each.

The older coaxial interface, also known as 10-base-2, or "thin", or "BNC" Ethernet works with a coaxial bayonet "BNC" connector on the NIC. Computers are connected together in a "daisy chain" using BNC "T" adapters plugged into each NIC. A coaxial 50 ohm cable connects each "T" to the "T" on the next computer. The first and last computers will have a terminator resistor plugged into the unoccupied arm of the "T". Coaxial typically is only available at the 10 megabit speed. Hubs and NICs that provide coaxial connectivity are much harder to find nowadays.

The twisted pair interface, also known as "UTP" or 10-base-T or "RJ-45" has an RJ-45 jack on the NIC. The RJ-45 connectors look similar to the standard telephone RJ-11 jack (but are somewhat larger) and are used with cables that look similar to standard telephone twisted pair cables to connect the NICs to a "hub", high speed modem, or router.

The hub has between 4 and 32 RJ-45 jacks. New office buildings are sometimes wired with RJ-45 jacks in the walls to facilitate setting up 10-base-T LANs. Hubs plug into a power line and cost $25 and up. Some hubs provide a BNC connector as well as the RJ-45 jacks. Motels are increasingly providing RJ-45 connections for laptops.

You will need to use a residential router (like a Linksys, Belkin or D-Link) to establish IP addresses for each computer in the network. Even wireless routers will have 3 or 4 wired RJ-45 jacks in the back of the unit. If you need only that many wired connections in your SOHO network, you will not need to use an additional hub. If you need more than 4 wired connections, connect a hub to your router using a cross-over RJ-45 network cable. This will allow the two devices to communicate properly one with another.

Setting up network software

Ethernet transmits data by means of data packets, and the network automatically adjusts to adding more computers to the environment. NICs all have a unique MAC address built in at the factory to facilitate this. After you physically install your NIC you will need to install the driver for the NIC using Windows installation procedures and disk supplied by your NIC manufacturer. Usually, diagnostic software and software to set up the NIC regarding which connector to use (if it has more than one) is also supplied.
Once you install the NIC driver, go to the Windows Control Panel and select the Network Connections application. Right-click on the particular network connection, and then select the “Properties” option. Make sure that client for Microsoft networks, your adapter driver, the TCP/IP protocol, and Microsoft file and printer sharing for Microsoft networks service are installed. This is the default situation for a typical Windows installation. Under file and print sharing check "give others access to my file" and "give others access to my printers" to enable both file and printer sharing.

When the network is completed you can specify specific drives or directories to be shared with other computers on your LAN. You can right-click on a drive shown in My Computer, and select the “Sharing and security” option to enable file sharing. You can share individual directories or entire drives for read-only access or access with a password. You can also specify printers to be shared. When directories, drives, or devices are shared you will see a hand symbol attached to the icon for that item.

**Groupware**

Although you can share files so that any computer on the LAN can open the same file on the same drive, there is a complication. If more than one computer could open and change the same file simultaneously, the changes from one person will be lost. Many applications such as Microsoft Word will not open a file that is already open on someone else’s computer. Applications specifically designed for collaboration ("groupware" or "work group applications") avoid this problem.

**Peer and Server Networks**

Networks of computers all of which are used as work stations are commonly known as "peer-to-peer" networks. A server network requires an additional dedicated server machine, usually running expensive server operating system software, and therefore may be less attractive in a SOHO context. When investigating groupware applications make sure to understand if a server and specific server software is required or if the application can run on a peer network.

**How to set up a TCP/IP network**

TCP/IP (or IP for short) is the de facto protocol standard for any kind of small or large network. Further, it is the protocol used when connecting to the Internet. Each computer on the LAN needs to have its own IP address. Your router will assign IP addresses to each PC automatically using DHCP (Dynamic Host Configuration Protocol). You could assign IP addresses manually, but there is no significant benefit to doing so. Manually assigned “static” IP addresses (ones that do not change) are only needed for IP-based printers, or if you are running a public Internet website to which a URL (like www.cnn.com) is tied to that unchanging IP address.

**Connecting your Local Network to the Internet**

You can connect your router directly to the public Internet connection provided by your Internet Service Provider (ISP), such as Verizon or Comcast. The router will manage the data transmissions from all of your privately-addressed computers on your network (with IP addresses beginning with 192.168) to the Internet, and vice versa.

ISPs generally provide a single public Internet Protocol (IP) address to their customers. This IP address is usually assigned dynamically at logon time, so that it can be reassigned to someone else when you log off. All of the PCs on your private network will appear to the Internet to have the public IP address provided by your ISP. Your router will handle all of the connectivity issues so that two or more people can have simultaneous Internet access.

Depending on your situation, your public Internet connection will connect to a cable or DSL modem, and your network’s router will connect to the DSL/cable modem. Newer routers have both of these functions built into a single component, making connections easier to manage.
Voice Over IP Services

Inexpensive router boxes are now available to support voice over IP (VoIP) services provided by Vonage or other Internet based telephone services. These units connect to the Internet via RJ-45 cable connecting to your cable/DSL modem or router, and typically provide two RJ-11 phone connectors and three RJ-45 ethernet connectors. The ethernet connectors can be connected directly to up to three computers. The phone connectors can be connected to ordinary phones or fax machines to provide up to two lines of phone service.

The phone lines can be routed to many phones via standard building phone lines. However, these small VoIP boxes may not be able to drive as many telephones or phone-connected devices as a typical telephone company line. If you are using more than one phone or fax machine on each line, check with the box vendor to see how many devices each line can handle.

The quality of the VoIP service is mostly dependent on the quality of the underlying Internet service. For example: if you are having problems with Vonage, it is quite likely that the actual problem is the quality of the connection provided by your cable or DSL supplier. If you are using a wired or wireless router, the VoIP box should be connected to the DSL/cable modem, and the router then should be connected to the VoIP box. In this way the VoIP box will have priority over the computer's access, and voice quality will be better during times when your computers are accessing the Internet.

Be advised that fax machines can have problems with VoIP systems. This is because any momentary delay, slowdown, or dropping of data packets can interfere with the operation of the analog modem in the fax, which can cause a dropped fax error. If you are having problems faxing, try setting the fax's modem to operate at a slower speed (9600 bps) instead of the normal 14,400 bps. Refer to the fax's instruction manual for directions on how to modify this setting.

Also, Internet-based applications like Skype and ooVoo allow you to make VoIP calls between PCs, as well as to cellular and land-line phones. Calls between PCs anywhere in the world are free, and calls from a PC to a cellular or land-line phone cost approximately $0.02 per minute. These companies have monthly or pay-as-you-go plans, plans that provide you with a traditional telephone number, and a full range of calling services (like caller ID, automatic redial, call forwarding, voice mail, and so forth). Visit these companies' websites for additional information on the programs and available plans and features.

Managing Modems and Routers

Cable modems, DSL modems, and routers typically have a built-in web server that displays configuration pages. By entering the IP address of the device in your browser (usually 192.168.1.1), you can browse to the device's configuration page and setup the various operating parameters of the device. Also, your ISP can browse to your router and assist you whenever you have connectivity problems.

Fiber Optic Services (FiOS)

Verizon is now offering high-speed fiber optic Internet services to their customers. Comcast, Cox, and other ISPs nationally are working to provide the same service. Fiber-optic cable provides extremely high bandwidth and simultaneously can carry cable TV services, voice phone service, and high speed Internet on a single fiber. The fiber comes to your house and connects to a box usually located inside the house, near where the outside telephone interface box is located. If you sign up for fiber-optic Internet service, Verizon will convert your phone service to fiber as well. Companies like Verizon want you to switch because fiber is easier to maintain than the existing copper wires, and they will have to maintain the fiber-optic service anyhow.

The FiOS interface box has an UPS with a battery backup connected to it, so that telephone service can be provided in event of a power failure. The batteries in these UPS systems reportedly only last for a few hours, so you may want to have other telephone services available (like a cell phone) if you tend to have long power outages.
COMPARING WINDOWS 7 TO WINDOWS VISTA AND WINDOWS XP

When buying a new, upgraded operating system for your PC, the first thing to ask is -

**What will this new operating system do that my old one will not do?**

Why does someone need to upgrade their operating system on a PC? First, if the operating system is no longer supported by Microsoft, you may encounter problems and have no avenue for advice and patches from the manufacturer. In addition, security updates that can protect your system from hackers and malicious software may no longer be available. Next, the operating system you currently use may lack features and applications available in the newer versions. Also, newer hardware devices may require a specific (or newer) operating system to support the necessary drivers.

Before you upgrade from an exiting operating system to a new one, several questions have to be answered:

**Will My PC or Laptop Accept the New Operating System?**

Generally a newer operating system will require you to inspect the PC or laptop to determine the following -

- Do I have enough RAM to accommodate the new O/S?
- Do I have enough free hard disk space to load the new O/S?
- Is my video card up to the processing capabilities for the new O/S?
- Do I have all of the hardware drivers FOR THE NEW O/S available for my PC or laptop?
- Is my CPU fast enough to handle the added overhead for the new O/S?
- Was my PC or laptop designed or intended to run this level of O/S?
- How much will any hardware upgrades run, in addition to the cost of the new O/S?
- Will my primary applications run under the new O/S, or will I need updated versions?
- Have there been reports of problems with this new O/S running on systems like mine?

Running to the store and just buying and installing an updated operating system is a TERRIBLE idea. The questions listed above must be asked and answered fully before making a potential mistake. Most brand-name PCs and laptops have a sticker on them that indicates the operating system they were designed to use. Going above and beyond the operating system design specifications for that computer could leave you with a system that is sluggish, non-responsive, and in need of significant repair time.

Typically, you should plan on having double the amount of RAM currently in the computer to run the newer operating system. You also should plan to have at least 40GB of free hard disk space available to install an updated operating system. The hard drive should be checked with the Scandisk tool in Windows, and have a thorough anti-virus and anti-spyware check performed prior to the installation. Temporary files and any unnecessary files on the PC should be removed with a utility program such as CCleaner. Defragmentation of the hard drive is not necessary, but it is not a bad idea to do.

Then, before the installation takes place, obtain from the hardware manufacturer any updated hardware device drivers for your PC or laptop. Just because the current drivers work with the current operating system does NOT mean that they will work with the new version. Drivers are specific to the hardware they support AND the operating systems they run upon. Having these drivers will ensure your computer operates as expected at the end of the upgrade process.

Make sure that your primary applications will work correctly with the upgraded operating system. There are cases where an O/S upgrade will “break” an application or office suite. If your key programs will not operate in the new environment, you must choose either to purchase the upgraded application, or choose not to perform the O/S upgrade.
What New Features Does This Operating System Upgrade Provide?

Newer operating systems have been redesigned to make synchronization with other electronic devices easier. Digital cameras, smart phones, personal digital assistants (PDAs) and other similar devices are recognized by Windows Vista and Windows 7 far better than in Windows XP or 2000. Access to multimedia content, such as music files, web-based video, and DVD playback are easier in the newer operating systems. The ability to create content such as personally-edited movies, and music play lists and burn them to CDs or DVDs has improved greatly over the years. Finally, the newer operating systems have a redesigned user interface that (supposedly) is easier for the customer to use; always remember that ease of use is a function of both design and familiarity.

But what if you don’t need all these bells and whistles? If all you need a PC or laptop to do is connect to the Internet, read email and generally surf the Web, you may not have any interest or need in these newer or enhanced features. The advice that your mother gave you as a child sometimes applies in this situation: “If it isn’t broken, don’t fix it.” If you do require the upgraded features that come with the upgraded operating system, feel good in obtaining and installing it. If this is not the case, perhaps you are better off by leaving things as they are.

Does the New Operating System Break My Old Software?

As mentioned on the previous page, newer operating systems can render certain applications inoperable. On the flip side, there may be some applications that require a newer operating system to launch properly. You should do some research on the Internet or in computer trade magazines (like PC Week or PC World) to investigate this issue before making the leap into an operating system upgrade.

What Will This Upgrade Cost Me?

Cost should always be a key determining factor in deciding to upgrade a computer, whether it’s an operating system upgrade or just for the sake of enhancement. The operating system upgrade itself can range from around $100.00 to as much as $400.00. Components like additional RAM, a better video card and a bigger hard drive can cost several hundred more dollars. By the time that all of the upgrades are completed, it might be cheaper to purchase an entire new computer or laptop. Not every upgrade situation will look like this, but the likelihood of having to do several kinds of upgrades to accommodate a new operating system is somewhat high. Plan on an O/S upgrade costing an average of $200.00 per computer, and at least 4 - 5 hours of time invested in making the necessary changes.

Differences Between the Various Windows Operating Systems

If you listen solely to Microsoft for information on the differences between operating systems, you may only get a portion of the story. For example, Microsoft has information and charts on their website that contrasts Windows XP, Vista, and Windows 7. A link to that chart is shown below:


Of course, Microsoft says the newest version of Windows is CLEARLY superior to the previous versions. I would recommend doing a Google, Yahoo or Bing search on the phrase “comparing Windows 7, Vista and XP.” This will yield hundreds of results from various sources that will give you a more well-rounded presentation.

But how can you determine for yourself the differences between the various Windows operating systems? In the course, we will take three identical computers and install Windows on each of them. Then, we will perform identical tasks on all three computers, to see how each performs in real time. Once this is done, we will perform upgrades on the designated Windows Vista and Windows 7 computers, to see what is required to bring them up to an acceptable performance level.
Minimum Installation Specifications for Windows Operating Systems

Microsoft provides on their website the minimum hardware specifications needed to install and run a given Windows operating system version. Below are the MINIMUM specifications needed to run Windows XP, Windows Vista, and Windows 7:

Windows XP (Home and Professional)

• PC with 300 megahertz or higher processor clock speed recommended; 233 MHz minimum required (single or dual processor system);* Intel Pentium/Celeron family, or AMD K6/Athlon/Duron family, or compatible processor recommended
• 128 megabytes (MB) of RAM or higher recommended (64 MB minimum supported; may limit performance and some features)
• 1.5 gigabytes (GB) of available hard disk space*
• Super VGA (800 x 600) or higher-resolution video adapter and monitor
• CD-ROM or DVD drive
• Keyboard and Microsoft Mouse or compatible pointing device

NOTE: XP Home / Professional runs best with at least 512MB of RAM and at least a 1.0GHz CPU.

Windows Vista Home Basic

• 1 GHz 32-bit (x86) or 64-bit (x64) processor
• 512 MB of system memory
• 20 GB hard drive with at least 15 GB of available space
• Support for DirectX 9 graphics and 32 MB of graphics memory
• DVD-ROM drive
• Audio Output
• Internet access (fees may apply)

NOTE: Vista Home Basic runs best with at least 1.5GB of RAM and at least a 1.5GHz CPU.

Windows Vista Home Premium / Business / Ultimate

• 1 GHz 32-bit (x86) or 64-bit (x64) processor
• 1 GB of system memory
• 40 GB hard drive with at least 15 GB of available space
• Support for DirectX 9 graphics with:
  WDDM Driver
  128 MB of graphics memory (minimum)
  Pixel Shader 2.0 in hardware
  32 bits per pixel
• DVD-ROM drive
• Audio Output
• Internet access (fees may apply)

NOTE: Vista Home Premium / Business / Ultimate runs best with at least 2GB of RAM and at least a 1.8GHz CPU.
Windows 7 (all versions)

- 1 gigahertz (GHz) or faster 32-bit (x86) or 64-bit (x64) processor
- 1 gigabyte (GB) RAM (32-bit) or 2 GB RAM (64-bit)
- 16 GB available hard disk space (32-bit) or 20 GB (64-bit)
- DirectX 9 graphics device with WDDM 1.0 or higher driver

Additional requirements to use certain features:
- Internet access (fees may apply)
- Depending on resolution, video playback may require additional memory and advanced graphics hardware
- For some Windows Media Center functionality a TV tuner and additional hardware may be required
- Windows Touch and Tablet PCs require specific hardware
- HomeGroup requires a network and PCs running Windows 7
- DVD/CD authoring requires a compatible optical drive
- BitLocker requires Trusted Platform Module (TPM) 1.2
- BitLocker To Go requires a USB flash drive
- Windows XP Mode requires an additional 1 GB of RAM, an additional 15 GB of available hard disk space, and a processor capable of hardware virtualization with Intel VT or AMD-V turned on
- Music and sound require audio output

Product functionality and graphics may vary based on your system configuration. Some features may require advanced or additional hardware.

NOTE: Windows 7 runs best with at least 2GB of RAM and at least a 2.0GHz CPU.

Microsoft does make available at no charge from their website the Windows Vista and Windows 7 Upgrade Advisor applications. These Upgrade Advisors will give you a more detailed understanding of whether your PC can run Windows 7 or Windows Vista. The author strongly recommends that you run these Upgrade Advisor applications BEFORE following through with an operating system upgrade.

Service Packs from Microsoft

Instead of issuing revised versions of Windows (or other application programs), Microsoft made available to the customer via their web site programs called service packs, which when run will update Windows with revised versions of specific files that have had reported problems.

These service packs are available from Microsoft at no charge for Windows XP, Vista, and for the Microsoft Office XP/2003/2007 suites. Service packs for older operating systems and application suites are still available on the Internet, but Microsoft no longer makes these resources available on their website.

These files are self-extracting archive files that will automatically unpack and then install the proper components on your PC. If you encounter unusual problems on your PC, it is possible that running a service pack upgrade may fix the problem. Usually service pack upgrades do not create the kinds of problems encountered with version-to-version operating system upgrades.

Visit the Microsoft web site at http://www.microsoft.com for more details.
OVERVIEW OF CONNECTED PERSONAL DIGITAL ASSISTANTS (PDAs)

Palm Operating System Devices

Palm OS (also known as Garnet OS) is a mobile operating system initially developed by Palm, Inc. for personal digital assistants (PDAs) in 1996. Palm OS is designed for ease of use with a touchscreen-based graphical user interface. It is provided with a suite of basic applications for personal information management. Later versions of the OS have been extended to support smartphones. Several other licensees have manufactured devices powered by Palm OS.

Following Palm's purchase of the Palm trademark, the currently licensed version from ACCESS was renamed Garnet OS. In 2007, ACCESS introduced the successor to Garnet OS, called Access Linux Platform and in 2009, the main licensee of Palm OS, Palm, Inc., switched from Palm OS to webOS for their forthcoming devices.

The Palm Pilot was the name of the first generation of personal digital assistants manufactured by Palm Computing in 1996 (then a division of U.S. Robotics).

The first two generations of PDAs from Palm were referred to as "PalmPilots". Due to a trademark infringement lawsuit brought by the Pilot Pen Corporation, since 1998 handheld devices from Palm have been known as Palm Connected Organizers or more commonly as "Palms". "PalmPilot" has entered the vernacular as a synonym for PDAs, regardless of the brand.

The first Palms, the Pilot 1000 and Pilot 5000, had no infrared port, backlight, or flash memory, but did have a serial communications port. Their RAM size was 128 kB and 512 kB respectively, and they used version 1 of Palm OS. Later, it became possible to upgrade the Pilot 1000 or 5000's internals to up to 1 MB of internal RAM. This was done with the purchase of an upgrade module sold by Palm, and the replacement of some internal hardware components. Originally, it was conceived that all Palm PDAs were to be hardware-upgradeable to an extent, but ultimately, this capability gave way to external memory slots and firmware-upgradeable flash memory after the Palm III series.

The next couple of Palms, called PalmPilot Personal and PalmPilot Professional, had a backlight, but still no infrared port or flash memory. Their RAM size was 512 kB and 1024 kB respectively. They used the more advanced version 2 of the Palm OS.

Palm III, and all the following Palms, did not have the word "Pilot" in their name due to legal disputes. ("Pilot" was, and still is, a registered trademark for pens.) Palm III had an IR port, backlight, and flash memory. The latter allowed to upgrade Palm OS, or, with some external applications, to store programs or data in flash memory. It ran on two standard AAA batteries. It was able to retain enough energy for 10–15 minutes to prevent data erasure during battery replacement. It had 2 Megabytes of memory, large at the time, and used Palm OS 3. (Palm also produced an upgrade card for the Pilot series, which made them functionally equivalent to a Palm III.)

Meanwhile, with Palm Computing now a subsidiary of 3Com, the founders felt they had insufficient control over the development of the Palm product. As a result, they left 3Com and founded Handspring in June 1998. When they left Palm, Jeff Hawkins (one of the inventors of the Palm) secured a license for the Palm OS for Handspring, and the company became the first Palm OS licensee. Handspring went on to produce the Handspring Visor, a clone of the Palm handhelds that included a hardware expansion slot (early Palm devices also had a hardware expansion slot, however this was for device upgrade purposes, not peripherals) and used slightly modified software.

The next versions of Palm used Palm OS 3.1. These included Palm IIIx with 4 Megabytes of memory, Palm IIIe without flash memory or hardware expansion slot (and available for cheaper price), Palm V with 2 Megabytes of memory, and Palm Vx with 8 Megabytes of memory.
Palm VII had wireless connection to some Internet services, but this connection worked only within USA. It used Palm OS 3.2.

Palm IIIc was the first Palm handheld with color screen. It used Palm OS 3.5 which provided extensive tools for writing color applications.

Some of these newer handhelds, for example Palm V, used internal rechargeable batteries. Later this feature became standard for all Palms.

Palm handhelds initially ran on the popular DragonBall processors, a Motorola 68000 derivate. More recent models are using a variation of the popular ARM architecture (usually referred to by the Intel Xscale brand name). This is a class of RISC microprocessors that is widely used in mobile devices and embedded systems, and its design was influenced strongly by a popular 1970s/1980s CPU, the MOS Technology 6502.[citation needed]

Palm Computing was spun off into its own company (called Palm Incorporated) in 2000. Handspring later merged with Palm to form palmOne in 2003 when Palm Inc. split into companies based upon selling hardware (palmOne) and the software (PalmSource). In 2005, palmOne acquired the full rights to the Palm name by purchasing the shared rights PalmSource owned and changed names back to Palm again. PalmSource was acquired by ACCESS Systems in 2005, which subsequently sold the Palm OS source code back to Palm, Inc. in December, 2006.

Palm handhelds continue to advance, including the ability to access hard drives on computers via USB cables, and are beginning to merge with smartphones. The "Treo 700w" is one of the latest offering that combines a Palm handheld with mobile phone, e-mail, SMS, and instant messaging. It is the first Palm device to use Windows Mobile instead of Palm OS.

It is widely expected that Palm handhelds as a PDA-only device will disappear as multi-function Palm handhelds like the Treo 650 decline in price. Multi function devices include several different abilities in the same package such as: an MP3 player, a camera, Wi-Fi, Bluetooth, or several other options. The Treo 650+ series is a multi-functioning series, packing in a camera, MP3, Bluetooth, and a phone. The Zire 71 and 72 are examples of this also.

In 2007 Palm released the Palm Centro, a consumer-oriented smartphone running the Palm OS. It took a step away from the familiar Treo smartphone by making it thinner and changing the overall appearance of it. The Centro is a very successful smartphone as it combines many features with a lower price. Since then, Palm has also released the Palm Treo 500v, a similar device to the Centro which is also directed at the consumer market. Palm's newest offering, the "Foleo", was cancelled before being publicly available.

The Palm Pre is a multimedia smartphone designed and marketed by Palm with a multi-touch screen and a sliding keyboard. The smartphone was the first to use Palm's new operating system, webOS (currently version 1.4.0), which is based on Linux. The Pre functions as a camera phone, a portable media player, and has location and navigation capabilities. The Pre also serves as a personal information manager, has a number of communication and collaboration applications, and has Bluetooth and Wi-Fi connectivity built-in.

The Pre was launched in June 2009 with Sprint, and later also went on sale in Canada with Bell Mobility. A GSM version of the original Pre was launched later in 2009 on a number of networks in Europe and in Mexico. A revised model, the Palm Pre Plus, which doubled the available memory and internal storage, was launched in January 2010 for Verizon Wireless. Smart phones like the Pre and the Pre Pixi are looking to take back some of the market share that has been lost over the years to competing phone and PDA providers.
Microsoft Windows Mobile Devices

Windows Mobile is a compact mobile operating system developed by Microsoft, and designed for use in smartphones and mobile devices.

The current version is called 'Windows Mobile 6.5'. It is based on the Windows CE 5.2 kernel, and features a suite of basic applications developed using the Microsoft Windows API. It is designed to be somewhat similar to desktop versions of Windows, feature-wise and aesthetically. Additionally, third-party software development is available for Windows Mobile, and software can be purchased via the Windows Marketplace for Mobile.

Originally appearing as the Pocket PC 2000 operating system, most Windows Mobile devices come with a stylus pen, which is used to enter commands by tapping it on the screen. Microsoft announced a completely new phone platform, Windows Phone 7, at the Mobile World Congress in Barcelona on February 15, 2010. Phones running Windows Mobile 6.x will not be upgradeable to version 7.

Windows Mobile's share of the Smartphone market has fallen year-on-year, decreasing 20% in Q3 2009. It is the 5th most popular smartphone operating system, with a 2% share of the worldwide smartphone market (after Symbian, BlackBerry OS, Android and iPhone OS). In the United States, it is the 3rd most popular smartphone operating system for business use (after BlackBerry OS and iPhone OS), with a 24% share among enterprise users.

The original Pocket PC 2000 was released in April 2000, and was based on Windows CE 3.0. It was the debut of what was later dubbed the Windows Mobile operating system, and meant to be a successor to the operating system aboard Palm-Size PCs. Backwards compatibility was retained with such Palm-Size PC applications. Pocket PC 2000 was intended mainly for Pocket PC devices, however several Palm-Size PC devices had the ability to be updated as well.

In addition, several Pocket PC 2000 phones were released, however Microsoft's "Smartphone" hardware platform was not yet created. The only resolution supported by this release was 240 x 320 (QVGA). Removable storage card formats that were supported were CompactFlash and MultiMediaCard. At this time Pocket PC devices had not been standardized with a specific CPU architecture. As a result, Pocket PC 2000 was released on multiple CPU architectures; SH-3, MIPS, and ARM.

Aesthetically, the original Pocket PC operating system was similar to Windows 98, Windows Me, and Windows 2000 operating systems.

Features/built-in applications for Pocket PC 2000 included the following:

- Pocket Office
- Pocket Word
- Pocket Excel
- Pocket Outlook
- Pocket Internet Explorer
- Windows Media Player
- Microsoft Reader
- Microsoft Money
- Notes, a note taking application
- Character recognition support
- Infrared (IR) File beaming capability

Pocket PC 2002 was released in October 2001. Like Pocket PC 2000, it was powered by Windows CE 3.0. Although targeted mainly for 240 × 320 (QVGA) Pocket PC devices, Pocket PC 2002 was also used for Pocket PC phones, and for the first time, Smartphones.

These Pocket PC 2002 Smartphones were mainly GSM devices.
With future releases, the Pocket PC and Smartphone lines would increasingly collide as the licensing terms were relaxed allowing OEMs to take advantage of more innovative, individual design ideas. Aesthetically, Pocket PC 2002 was meant to be similar in design to the then newly released Windows XP.

New features/built-in applications included the following:

- Enhanced UI with theme support
- Spell checker and Word count tool in Pocket Word
- Savable downloads and WAP in Pocket Internet Explorer
- Virtual Private Networking support
- Synchronization of folders
- MSN Messenger
- Terminal Services
- Windows Media Player 8 with streaming capability
- Microsoft Reader 2
- Palm OS support for file beaming
- Improved Pocket Outlook
- Digital rights management (DRM) support in Microsoft Reader


The last was designed especially for Pocket PCs which include phone functionalities.

The Professional Edition was used in Pocket PC budget models. It lacked a number of features that were in the Premium Edition, such as a client for L2TP/IPsec VPNs. Windows Mobile 2003 was powered by Windows CE 4.20.

New features/built-in applications included the following:

- Support for add-on keyboards
- Enhanced communications interface with Bluetooth device management
- Bluetooth file beaming support
- Bluetooth headset support
- Pictures application with viewing, cropping, e-mail, and beaming support
- Jawbreaker game
- Enhanced Pocket Outlook with vCard and vCal support
- Improved Pocket Internet Explorer
- Windows Media Player 9.0 with streaming optimization
- SMS reply options for Phone Edition
- MIDI file support as ringtones in Phone Edition

**Windows Mobile 5.0** was released at Microsoft's Mobile and Embedded Developers Conference 2005 in Las Vegas, May 9–May 12, 2005. Microsoft plans to offer mainstream support for Windows Mobile 5 through October 12, 2010, and extended support through October 2015. It used the .NET Compact Framework 1.0 SP3 — an environment for programs based on .NET.

Windows Mobile 5.0 included Microsoft Exchange Server "push" functionality improvements that worked with Exchange 2003 SP2. The "push" functionality also required vendor/device support. With AKU2 software upgrades all WM 5.0 devices supported DirectPush.
Windows Mobile 5.0 featured increased battery life due to Persistent storage capability. Previously up to 50% (enough for 72 hours of storage) of battery power was reserved just to maintain data in volatile RAM. This continued the trend of Windows-based devices moving from using RAM as their primary storage medium to the use of a combination of RAM and flash memory (in use, there's no distinction between the two apparent to the user).

Programs and frequently accessed data run in RAM, while most storage is in the flash memory. The OS seamlessly moves data between the two as needed. Everything is backed up in the flash memory, so unlike previous devices, WM5 devices do not lose any data if power is lost.

With Windows Mobile 5.0, OS updates were released as Adaptation kit upgrades, or AKUs. AKU 3.5 is the most recent release for WM 5.0.

Further new features and built-in applications included:

- New version of Office called "Office Mobile"
- PowerPoint Mobile
- Graphing capability in Excel Mobile
- Tables and graphics insertion in Word Mobile
- Windows Media Player 10 Mobile
- Photo Caller ID
- DirectShow support
- Picture and Video package, which converged the management of videos and pictures
- Enhanced Bluetooth support
- Global Positioning System (GPS) management interface
- Default QWERTY keyboard-support
- Error reporting facility similar to that present in desktop and server Windows systems
- ActiveSync 4.2 with 15% increased synchronization speed

**Windows Mobile 6** was released in February 2007 at the 3GSM World Congress 2007. It comes in three different versions: "Windows Mobile 6 Standard" for Smartphones (phones without touchscreens), "Windows Mobile 6 Professional" for Pocket PCs with phone functionality, and "Windows Mobile 6 Classic" for Pocket PCs without cellular radios.

Windows Mobile 6 is powered by Windows CE 5.0 (version 5.2) and is strongly linked to Windows Live and Exchange 2007 products. Aesthetically, Windows Mobile 6 was meant to be similar in design to the then newly released Windows Vista. Functionally, it works much like Windows Mobile 5, but with much better stability.

New features/built-in applications include the following:

- 320x320 and 800x480 (WVGA) screen resolution support
- Office Mobile support for Smartphones
- Operating System Live Update
- Improved Remote Desktop access (Available for only certain Pocket PCs)
- VoIP (Internet calling) support with AEC (Acoustic Echo Cancelling) and MSRT Audio Codec
- Windows Live for Windows Mobile
- Customer Feedback option
- Enhanced Microsoft Bluetooth Stack
- Storage Card Encryption (encryption keys are lost if device is cold-booted).
- Smartfilter for searching within programs
- Improved Internet Sharing
- HTML email support in Outlook Mobile
- Search ability for contacts in an Exchange Server Address Book
- AJAX, JavaScript, and XMLDOM support on Internet Explorer Mobile
- Out of Office Replies with Microsoft Exchange 2007
• Unlicensed Mobile Access (UMA) support for select operators
• Server Search on Microsoft Exchange 2007
• .NET Compact Framework v2 SP2 Preinstalled in ROM
• Microsoft SQL Server 2005 Compact Edition Preinstalled in ROM
• OneNote Mobile as a companion to Microsoft Office OneNote
• Office Mobile 6.1 announced with support for Office 2007 document formats (pptx, docx, xlsx).

Finally, Windows Phone 7 is an upcoming version of the Windows Mobile operating system developed by
Microsoft. It is planned for release by "holiday" 2010.

Windows Phone 7 was initially intended to be released during 2009, but several delays prompted Microsoft to
develop Windows Mobile 6.5 as an interim release. During the Mobile World Congress 2010 in Barcelona,
Microsoft revealed details of Windows Phone 7, which features a new operating system and integration with
Xbox Live and Zune services.

Phones running Windows Mobile 6.x will not be upgradeable to Windows Phone 7.
RIM BlackBerry Devices

BlackBerry is a line of mobile e-mail and smartphone devices developed by Canadian company Research In Motion (RIM). While including typical smartphone applications (address book, calendar, to-do lists, etc, as well as telephone capabilities on newer models), the BlackBerry is primarily known for its ability to send and receive Internet e-mail wherever it can access a mobile network of certain cellular phone carriers. It commands a 20.8% share of worldwide smartphone sales, making it the second most popular platform after Nokia's Symbian OS, and is the most popular smartphone among U.S. business users. The service is available in North America and in most European countries.

The first BlackBerry device was introduced in 1999 as a two-way pager. In 2002, the more commonly known smartphone BlackBerry was released, which supports push e-mail, mobile telephone, text messaging, Internet faxing, Web browsing and other wireless information services. It is an example of a convergent device.

BlackBerry first made headway in the marketplace by concentrating on e-mail. RIM currently offers BlackBerry e-mail service to non-BlackBerry devices, such as the Palm Treo, through the BlackBerry Connect software. The original BlackBerry device had a monochrome display, but all current models have color displays.

Most current BlackBerry models have a built-in QWERTY keyboard, optimized for "thumbing", the use of only the thumbs to type, and there are also several models that include a SureType keypad for typing, and two models that are full touch-screen devices with no physical keyboard. System navigation is primarily accomplished by a scroll ball, or "trackball" in the middle of the device, older devices used a track wheel on the side and newer devices like the Blackberry Bold 9700 or Curve 8520/8530 use a small pad for navigation "trackpad" instead of a trackball. Some models (currently, those manufactured for use with iDEN networks such as Nextel and Mike) also incorporate a Push-to-Talk (PTT) feature, similar to a two-way radio.

Modern GSM-based BlackBerry handhelds incorporate an ARM 7 or 9 processor, while older BlackBerry 950 and 957 handhelds used Intel 80386 processors. The latest GSM BlackBerry models (8100, 8300 and 8700 series) have an Intel PXA901 312 MHz processor, 64 MB flash memory and 16 MB SDRAM.[5] CDMA BlackBerry smartphones are based on Qualcomm MSM6x00 chipsets which also include the ARM 9-based processor and GSM 900/1800 roaming (as the case with the 8830 and 9500) and include up to 256MB flash memory.

BlackBerry devices are sold and supported by many major cellular carriers, including Verizon, AT&T, Sprint/Nextel, T-Mobile, Vodafone, and other international carriers.

BlackBerry Operating System

RIM provides a proprietary multi-tasking operating system (OS) for the BlackBerry, which makes heavy use of the many specialized input devices available on the phones, particularly the scroll wheel (1999–2006) or more recently the trackball (September 12 2006–present) and trackpad (September 2009-present). The OS provides support for Java MIDP 1.0 and WAP 1.2. Previous versions allowed wireless synchronization with Microsoft Exchange Server e-mail and calendar, as well as with Lotus Domino e-mail. The current OS 4 provides a subset of MIDP 2.0, and allows complete wireless activation and synchronization with Exchange e-mail, calendar, tasks, notes and contacts, and adds support for Novell GroupWise and Lotus Notes.

Third-party developers can write software using these APIs, and proprietary BlackBerry APIs as well, but any application that makes use of certain restricted functionality must be digitally signed so that it can be associated to a developer account at RIM. This signing procedure guarantees the authorship of an application, but does not guarantee the quality or security of the code.
BlackBerry Enterprise Server

BlackBerry handhelds are integrated into an organization's e-mail system through a software package called "BlackBerry Enterprise Server" (BES). Versions of BES are available for Microsoft Exchange, Lotus Domino and Novell GroupWise. Google has made a Connector for BES which makes BES available for Google Apps as well. While individual users may be able to use a wireless provider's e-mail services without having to install BES themselves, organizations with multiple users usually run BES on their own network. Some third-party companies provide hosted BES solutions. Every BlackBerry has an ID called BlackBerry PIN, which is used to identify the device to the BES.

BES can act as a sort of e-mail relay for corporate accounts so that users always have access to their e-mail. The software monitors the user's local "inbox", and when a new message comes in, it picks up the message and passes it to RIM's Network Operations Center (NOC). The messages are then relayed to the user's wireless provider, which in turn delivers them to the user's BlackBerry device.

This is called "push e-mail," because all new e-mails, contacts and calendar entries are "pushed" out to the BlackBerry device automatically, as opposed to the user synchronizing the data by hand or on a polling basis. BlackBerry also supports polling email, which is how it supports POP. Device storage also enables the mobile user to access all data off-line in areas without wireless service. As soon as the user connects again, the BES sends the latest data.

An included feature in the newer models of the BlackBerry is the ability for it to track your current location through trilateration. One can view the online maps on the phone and see current location denoted by a flashing dot. However, accuracy of BlackBerry trilateration is less than that of GPS due to a number of factors, including cell tower blockage by large buildings, mountains, or distance.

BES also provides handhelds with TCP/IP connectivity accessed through a component called "Mobile Data Service - Connection Service" (MDS-CS). This allows for custom application development using data streams on BlackBerry devices based on the Sun Microsystems Java ME platform.

In addition, BES provides network security, in the form of Triple DES or, more recently, AES encryption of all data (both e-mail and MDS traffic) that travels between the BlackBerry handheld and a BlackBerry Enterprise Server.

Most providers offer flat monthly pricing for unlimited data between BlackBerry units and BES. In addition to receiving e-mail, organizations can make intranets or custom internal applications with unmetered traffic.

With more recent versions of the BlackBerry platform, the MDS is no longer a requirement for wireless data access. Beginning with OS 3.8 or 4.0, BlackBerry handhelds can access the Internet (i.e. TCP/IP access) without an MDS - previously only e-mail and WAP access was possible without a BES/MDS. The BES/MDS is still required for secure e-mail, data access, and applications that require WAP from carriers that do not allow WAP access.

BlackBerry Internet Service

The primary alternative to using BlackBerry Enterprise Server is to use the BlackBerry Internet Service. It was developed primarily for the average consumer rather than for the business consumer. This service allows POP3 and IMAP email integration for the personal user. It allows up to 10 email accounts to be accessed, including many popular email accounts such as Gmail, Hotmail, Yahoo and AOL. There are also special bundles for just MySpace, Facebook, & MSN as well.
Apple iPhone and iPod Touch Devices

The iPhone is a line of Internet- and multimedia-enabled smartphones designed and marketed by Apple Inc. and released in 2007. An iPhone functions as a camera phone (also including text messaging and visual voicemail), a portable media player (equivalent to a video iPod), and an Internet client (with e-mail, web browsing, and Wi-Fi connectivity). The user interface is built around the device's multi-touch screen, including a virtual keyboard rather than a physical one.

Third-party applications are available from the App Store, which launched in mid-2008 and now has well over 100,000 "apps" approved by Apple. These apps have diverse functionalities, including games, reference, GPS navigation, social networking, and advertising for television shows, films, and celebrities.

Apple announced the iPhone in January 2007, after months of rumors and speculation. Retroactively labeled, the "original" iPhone was introduced in the United States in June 2007 before being marketed in Europe. It featured quad-band GSM with EDGE cellular transmission capabilities.

Released in July 2008, the iPhone 3G supports faster 3G data speeds via UMTS with 3.6 Mbps HSDPA, and assisted GPS. Apple released version 3.0 of the iPhone OS for the iPhone (and iPod Touch) in June 2009. The iPhone 3GS has improved performance, a camera with higher resolution and video capability, voice control, and support for 7.2 Mbps HSDPA downloading (but remains limited to 384 Kbps uploading as Apple has not implemented the HSPA protocol).

Interacting with the iPhone

The touchscreen is a 9 cm (3.5 in) liquid crystal display (320×480 px at 6.3 px/mm, 160 ppi, HVGA) with scratch-resistant glass, and 18-bit color (rendering 262,144 colors). The capacitive touchscreen is designed for a bare finger, or multiple fingers for multi-touch sensing. The touch and gesture features of the iPhone are based on technology originally developed by FingerWorks. Most gloves and styluses prevent the necessary electrical conductivity. The iPhone 3GS also features a fingerprint-resistant oleophobic coating.

The display responds to three sensors. A proximity sensor deactivates the display and touchscreen when the device is brought near the face during a call. This is done to save battery power and to prevent inadvertent inputs from the user's face and ears. An ambient light sensor adjusts the display brightness which in turn saves battery power. A 3-axis accelerometer senses the orientation of the phone and changes the screen accordingly, allowing the user to easily switch between portrait and landscape mode. Photo browsing, web browsing, and music playing support both upright and left or right widescreen orientations. Unlike the iPad, the iPhone does not rotate the screen when turned upside-down, with the Home button above the screen. The 3.0 update added landscape support for still other applications, such as email, and introduced shaking the unit as a form of input. The accelerometer can also be used to control third party apps, notably games.

Audio and Speakers

One loudspeaker is located above the screen as an earpiece, and another is located on the left side of the bottom of the unit, opposite a microphone on the bottom-right. Volume controls are located on the left side of the unit and as a slider in the iPod application. Both speakers are used for handsfree operations and media playback.

The 3.5 mm TRRS connector for the headphones is located on the top left corner of the device. The headphone socket on the original iPhone is recessed into the casing, making it incompatible with most headsets without the use of an adapter. The iPhone 3G eliminates the issue with a flush-mounted headphone socket. Cars equipped with an auxiliary jack allow for handsfree use of the iPhone while driving as a substitute for Bluetooth.
While the iPhone is compatible with normal headphones, Apple provides a headset with additional functionality. A multipurpose button near the microphone can be used to play or pause music, skip tracks, and answer or end phone calls without touching the iPhone. A small number of third-party headsets specifically designed for the iPhone also include the microphone and control button. Apple sells headsets with volume controls, but they are only compatible with the iPhone 3GS.

**Bluetooth Integration**

The built-in Bluetooth 2.0+EDR supports wireless earpieces and headphones, which requires the HSP profile. Stereo audio was added in the 3.0 update for hardware that supports A2DP. While non-sanctioned third-party solutions exist, the iPhone does not officially support the OBEX file transfer protocol. The lack of these profiles prevents iPhone users from exchanging multimedia files, such as pictures, music and videos, with other Bluetooth-enabled cell phones.

Composite or component video at up to 576i and stereo audio can be output from the dock connector using an adapter sold by Apple. Unlike many similar phones, the iPhone did not support voice recording until the 3.0 software update.

**Battery Life**

The iPhone features an internal rechargeable battery. Like an iPod but unlike most other cell phones, the battery is not user-replaceable. The iPhone can be charged when connected to a computer for syncing across the included USB to dock connector cable, similar to charging an iPod. Alternatively, a USB to AC adapter (or "wall charger," also included) can be connected to the cable to charge directly from an AC outlet. A number of third party accessories (stereos, car chargers, even solar chargers) are also available.

Apple runs tests on preproduction units to determine battery life. Apple's website says that the battery life "is designed to retain up to 80% of its original capacity after 400 full charge and discharge cycles", which is comparable to iPod batteries. The original iPhone's battery was stated to be capable of providing up to seven hours of video, six hours of web browsing, eight hours of talk time, 24 hours of music or up to 250 hours on standby. The iPhone 3G's battery is stated to be capable of providing up to seven hours of video, six hours of web browsing on Wi-Fi or five on 3G, ten hours of 2G talk time, or five on 3G, 24 hours of music, or 300 hours of standby. Apple claims that the 3GS can last for up to ten hours of video, nine hours of web browsing on Wi-Fi or five on 3G, twelve hours of 2G talk time, or five on 3G, 30 hours of music, or 300 hours of standby.

If the battery malfunctions or dies prematurely, the phone can be returned to Apple and replaced for free while still under warranty. The warranty lasts one year from purchase and can be extended to two years with AppleCare. Though the battery replacement service and its pricing was not made known to buyers until the day the product was launched, it is similar to how Apple (and third parties) replace batteries for iPods.

**Built-in Camera**

The iPhone and iPhone 3G feature a built-in Fixed focus 2.0 megapixel camera located on the back for still digital photos. It has no optical zoom, flash or autofocus, and does not support video recording, however jailbreaking allows users to do so.

Version 2.0 of iPhone OS introduced the capability to embed location data in the pictures, producing geocoded photographs. The iPhone 3GS has a 3.2 megapixel camera, manufactured by OmniVision, featuring autofocus, auto white balance, and auto macro (up to 10 cm). It is also capable of capturing 640x480 (VGA resolution) video at 30 frames per second, although compared to higher-end CCD based video cameras it does exhibit the rolling shutter effect. The video can then be cropped on the device itself and directly uploaded to YouTube, MobileMe, or other services.
Storage and SIM

The iPhone was initially released with two options for internal storage size: 4 GB or 8 GB. In September 2007, Apple discontinued the 4 GB models. On February 5, 2008, Apple added a 16 GB model. The iPhone 3G was available in 16 GB and is still available with 8 GB. The iPhone 3GS comes in 16 GB and 32 GB variants. All data is stored on the internal flash drive; the iPhone does not support expanded storage through a memory card slot, or the SIM card.

The items included with the iPhone 3G. From left to right: Top of box; iPhone 3G; package with cloth, documentation, and SIM eject tool; headphones, USB cable, and wall charger. The SIM card sits in a tray, which is inserted into a slot at the top of the device. The SIM tray can be ejected with a paperclip or the "SIM eject tool" (a simple piece of die-cut sheet metal) included with the iPhone 3G and 3GS.

In most countries, the iPhone is usually sold with a SIM lock, which prevents the iPhone from being used on a different mobile network.

Internet connectivity

Internet access is available when the iPhone is connected to a local area Wi-Fi or a wide area GSM or EDGE network, both second-generation (2G) wireless data standards. The iPhone 3G introduced support for third-generation UMTS and HSDPA 3.6, but not HSUPA networks, and only the iPhone 3GS supports HSDPA 7.2. Support for 802.1X, an authentication system commonly used by university and corporate Wi-Fi networks, was added in the 2.0 version update.

By default, the iPhone will ask to join newly discovered Wi-Fi networks and prompt for the password when required. Alternatively, it can join closed Wi-Fi networks manually. The iPhone will automatically choose the strongest network, connecting to Wi-Fi instead of EDGE when it is available. Similarly, the iPhone 3G and 3GS prefer 3G to 2G, and Wi-Fi to either. Wi-Fi, Bluetooth, and 3G (on the iPhone 3G and 3GS) can all be deactivated individually. Airplane Mode disables all wireless connections at once, overriding other preferences.

The iPhone 3G has a maximum download rate of 1.4 Mbps in the United States. Furthermore, files downloaded over cellular networks must be smaller than 10 MB. Larger files, often email attachments or podcasts, must be downloaded over Wi-Fi (which has no file size limits). If Wi-Fi is unavailable, one workaround is to open the files directly in Safari.

Safari is the iPhone's native web browser, and it displays pages similar to its Mac and Windows counterparts. Web pages may be viewed in portrait or landscape mode and supports automatic zooming by pinching together or spreading apart fingertips on the screen, or by double-tapping text or images. The iPhone supports neither Flash nor Java. The iPhone supports SVG, CSS, HTML Canvas, and Bonjour applications.

The maps application can access Google Maps in map, satellite, or hybrid form. It can also generate directions between two locations, while providing optional real-time traffic information. Support for walking directions, public transit, and street view was added in the version 2.2 software update, but no voice-guided navigation. The iPhone 3GS can orient the map with its digital compass. Apple also developed a separate application to view YouTube videos on the iPhone, which streams videos after encoding them using the H.264 codec. Simple weather and stock quotes applications also tap in to the Internet.

A software update in January 2008 allowed the first generation iPhone to use cell tower and Wi-Fi network locations trilateration, despite lacking GPS hardware. The iPhone 3G and iPhone 3GS employ A-GPS, and the iPhone 3GS also has a digital compass.

The iPhone has three physical switches on the sides: wake and sleep, volume up and down, and ringer on and off. These are made of plastic on the original iPhone and metal on all later models. A single "Home" hardware button below the display brings up the main menu. The touchscreen furnishes the remainder of the user interface.
The back of the original iPhone was made of aluminum with a black plastic accent. The iPhone 3G and 3GS feature a full plastic back to increase the strength of the GSM signal. The iPhone 3G is available in black with 8 GB of space, and the discontinued 16 GB model was sold in either black or white. The iPhone 3GS is available in both colors, regardless of storage capacity.

**User Interface**

The interface is based around the home screen, a graphical list of available applications. iPhone applications normally run one at a time, although most functionality is still available when making a call or listening to music. The home screen can be accessed at any time by a hardware button below the screen, closing the open application in the process.

By default, the Home screen contains the following icons:

- Messages (SMS and MMS messaging)
- Calendar
- Photos
- Camera
- YouTube
- Stocks
- Maps (Google Maps)
- Weather
- Voice Memos
- Notes
- Clock
- Calculator
- Settings
- iTunes (store)
- App Store, and
- Compass (on the iPhone 3GS only)

Docked at the base of the screen, four icons for Phone, Mail, Safari (Internet), and iPod (multimedia) delineate the iPhone's main purposes.

In January 2008, Apple released software update 1.1.3, allowing users to create "Web Clips", home screen icons that resemble apps that open a user-defined page in Safari. After the update, iPhone users can rearrange and place icons on up to nine other adjacent home screens, accessed by a horizontal swipe. Users can also add and delete icons from the dock, which is the same on every home screen. Each home screen holds up to sixteen icons, and the dock holds up to four icons. Users can delete Web Clips and third-party applications at any time, and may select only certain applications for transfer from iTunes. Apple’s default programs, however, may not be removed. The 3.0 update adds a system-wide search, known as Spotlight, to the left of the first home screen.

Almost all input is given through the touch screen, which understands complex gestures using multi-touch. The iPhone’s interaction techniques enable the user to move the content up or down by a touch-drag motion of the finger. For example, zooming in and out of web pages and photos is done by placing two fingers on the screen and spreading them farther apart or bringing them closer together, a gesture known as "pinching". Scrolling through a long list or menu is achieved by sliding a finger over the display from bottom to top, or vice versa to go back. In either case, the list moves as if it is pasted on the outer surface of a wheel, slowly decelerating as if affected by friction. In this way, the interface simulates the physics of a real object.

Other user-centered interactive effects include horizontally sliding sub-selection, the vertically sliding keyboard and bookmarks menu, and widgets that turn around to allow settings to be configured on the other side. Menu bars are found at the top and bottom of the screen when necessary. Their options vary by program, but always follow a consistent style motif. In menu hierarchies, a "back" button in the top-left corner of the screen displays the name of the parent folder.
Phone Capabilities

The iPhone allows audio conferencing, call holding, call merging, caller ID, and integration with other cellular network features and iPhone functions. For example, if a song is playing while a call is received, it gradually fades out, and fades back when the call has ended. The proximity sensor shuts off the screen and touch-sensitive circuitry when the iPhone is brought close to the face, both to save battery and prevent unintentional touches.

The iPhone does not support video calling or videoconferencing because the camera and screen are on opposite sides of the device. The first two models only support voice dialing through third party applications. Voice control, available only on the iPhone 3GS, allows users to say a contact's name or number and the iPhone will dial.

The iPhone includes a visual voicemail (in some countries) feature allowing users to view a list of current voicemail messages on-screen without having to call into their voicemail. Unlike most other systems, messages can be listened to and deleted in a non-chronological order by choosing any message from an on-screen list.

A music ringtone feature was introduced in the United States on September 5, 2007. Users can create custom ringtones from songs purchased from the iTunes Store for a small additional fee. The ringtones can be 3 to 30 seconds long from any part of a song, can fade in and out, pause from half a second to five seconds when looped, or loop continuously. All customizing can be done in iTunes, or alternatively with Apple's GarageBand software 4.1.1 or later (available only on Mac OS X) or third-party tools.
Google Android Devices

Android is a software stack for mobile devices that includes an operating system, middleware and key applications, that uses a modified version of the Linux kernel. It was initially developed by Android Inc., a firm later purchased by Google, and lately by the Open Handset Alliance. It allows developers to write managed code in the Java language, controlling the device via Google-developed Java libraries.

The unveiling of the Android distribution in November 2007 was announced with the founding of the Open Handset Alliance, a consortium of 47 hardware, software, and telecom companies devoted to advancing open standards for mobile devices. Google released most of the Android code under the Apache License, a free software and open source license.

The first phone to run the Android operating system was the HTC Dream, released on 22 October 2008.

By the end of 2009 there will be at least 18 phone models using Android worldwide, according to Google. In addition to the mobile devices that ship with Android, some users have been able (with some amount of hacking, and with limited functionality) to install it on mobile devices shipped with other operating systems.

In February 2010, Google announced that 60,000 cell phones with Android are shipping every day.

Google has also participated in the Android Market by offering several applications for its services. These applications include Google Voice for the Google Voice service, Sky Map for watching stars, Finance for their finance service, Maps Editor for their MyMaps service, Places Directory for their Local Search, Google Goggles that searches by image, Google Translate, Listen for podcasts and My Tracks, a jogging application.

With the growing number of Android handsets, there has also been a growing interest by third party developers to port their applications to the Android operating system.

Famous applications that have been converted to the Android operating system include Shazam, Backgrounds, and WeatherBug.

The Android operating system has also been considered important enough by a lot of the most popular internet sites and services to create native android applications. These include MySpace and Facebook.

The release of Mozilla Firefox browser for Android is planned for late 2010. According to an interview with Mozilla's vice president of mobile, Jay Sullivan, part of the delay with the porting of Firefox over to Android has been because Firefox Mobile is built on C and C++ code, but that the new Native Development Kit makes it easier to port Firefox Mobile

Devices From Other Manufacturers

There are a number of other manufacturers that make smartphones and PDA devices. These companies include:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Website address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorola</td>
<td><a href="http://www.motorola.com/Consumers/US-EN/Home">http://www.motorola.com/Consumers/US-EN/Home</a></td>
</tr>
<tr>
<td>Nokia</td>
<td><a href="http://www.nokiansa.com/">http://www.nokiansa.com/</a></td>
</tr>
<tr>
<td>HTC Corporation</td>
<td><a href="http://www.htc.com/us/#/?slide=0">http://www.htc.com/us/#/?slide=0</a></td>
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<td>Sony Ericsson</td>
<td><a href="http://www.sonyericsson.com/cws/products/mobilephones">http://www.sonyericsson.com/cws/products/mobilephones</a></td>
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You may wish to visit these websites to explore some of the models and features for the available lines of smartphones and PDAs.
SYSTEM IMAGING WITH NORTON GHOST ENTERPRISE EDITION

Introduction to Cloning a Windows NT, Windows 2000, Windows XP or Windows Vista Computer

You are about to clone a computer that is using the Windows NT, Windows 2000, Windows XP or Windows Vista operating system, and you want to know if there is anything you should do to prepare.

There are a number of issues that must be considered when cloning Windows NT, Windows 2000, Windows XP or Windows Vista:

**Ghost versions**: Which Ghost version you use to create and restore the image file.

**Windows versions and service packs**: What Windows version is run on the source computer.

**Cloning Windows NT/2000/XP/2003 Servers**: Whether the source computer is a server.

**Differences between the source and destination computers**: How physical differences between the source computer and destination computers affect the operating system, drivers, and configuration settings, and how encryption on the source computer affects the destination computer.

**Restoring the uniqueness of a Windows NT/2000/XP/Vista installation after cloning**: Configuration settings that must be different on the destination computers than on the source computer.

**Ghost versions**

Ghost has improvements in its handling of NTFS partitions in each Ghost version. Update Ghost to the latest version. See the documents How to determine your version of Ghost and How to obtain current version of Symantec Ghost.

Norton Ghost 2002 and earlier, and Symantec Ghost 7.5 and earlier cannot save images to local NTFS partitions. However, some Ghost versions can save images to NTFS partitions that reside on a remote computer. Norton Ghost 2003 and Symantec Ghost 8.x can save image files to local NTFS partitions. See the documents Storing Ghost image files directly to NTFS partitions and Using Ghost to save or write an image to a different computer.

**Windows versions and service packs**


When working with Windows 2000 installations, Ghost supports Windows 2000 Professional, Server, and Advanced Server with or without Service Pack 1 (also Service Pack 2, 3, or 4 with Symantec Ghost 8.x). See the document Ghost compatibility with Windows 2000.

When working with Windows XP installations: Norton Ghost 2002, Norton Ghost 2003, Symantec Ghost 7.5, Symantec Ghost 8.x and Symantec Ghost 11.x support Windows XP. See the document Ghost compatibility with Windows XP. Note that Windows XP includes a Product Activation feature that may affect cloning. Product Activation is a Windows XP licensing feature. For information on how Product Activation affects cloning, read the Microsoft article How to use Sysprep with Windows Product Activation or Volume License Media to Deploy Windows XP, article number 299840 in the Microsoft Knowledge Base at http://support.microsoft.com/support.

Windows Vista is only supported with Symantec Ghost version 11.x.
Cloning Windows NT or Windows 2000/2003 Servers

Ghost can clone a Windows NT or Windows 2000/2003 Server for backup or migration purposes. However, in most cases, Ghost cannot clone a server for rolling out that server to many computers, and Symantec does not support Ghost when used for this purpose. See the document 'Does Symantec Ghost work with Server operating systems?'.

Backups

When cloning a Windows NT/2000/XP/Vista/2003 computer for backup purposes only, most of the information in the remainder of this document does not affect the cloning process.

That is, when you intend to restore the image to the same computer that you created the image of, information in the sections "Differences between the source and destination computers" and "Restoring the uniqueness of a Windows NT/2000/2003 installation after cloning" is relevant in only the following situations:

- You intend to change the computer name
- You intend to change other identifying information on the computer
- You might restore the image to a different hard disk or computer

Differences between the source and destination computers

Microsoft operating systems vary in their ability to deal with cloning to hardware environments that differ from the environment that they were initially installed on. The operating system affects how well a cloning operation will work when cloning between two computers that have different hardware. Windows NT is relatively inflexible when adapting itself to a hardware environment that differs from that which it was initially installed on; however, Windows 2000’s Plug-and-Play capabilities help alleviate this inflexibility. Subsequently, there are several restrictions to be considered when migrating a Windows NT, Windows 2000, Windows XP or Windows Vista (Windows NT/2000/XP/Vista) installation from one hardware environment to another:

Hardware Abstraction Layer (HAL) differences

Windows NT/2000 use a HAL to communicate with the drivers for various hardware devices on the computer. This saves the operating system from needing to "know" about differences between different models of the same type of hardware device.

Because different computer vendors can write their own HALs (to take advantage of specific hardware features or to install Windows to their computers), an image of a computer that uses a particular Original Equipment Manufacturer (OEM) HAL may not function on a computer that has different hardware.

To prevent such problems, ensure that you clone Windows NT/2000 computers that have a specific OEM HAL only to computers that the HAL was intended for. Check with your OEM vendor for information.

Driver specific issues

An installation of Windows NT/2000/XP/Vista that is configured for a specific set of hardware devices may not work correctly if the installation tries to run on a computer with a different set of hardware devices. For example, a Windows NT/2000/XP/Vista installation on a computer that uses an IDE hard disk will probably not work on a computer that uses a SCSI hard disk.

Other examples of problematic hardware device classes are network cards, video cards, sound cards, and so on. The effect of a nonfunctioning device varies. For example, Windows uses a generic VGA video driver if Windows cannot get the originally installed video driver to load correctly.
Windows 2000/XP/Vista is better than Windows NT at handling the differences in hardware between computers when you run Microsoft's System Preparation Tool (Sysprep) at the Windows 2000/XP/Vista computer before cloning that computer.

- For Windows 2000 installations, use Microsoft's Sysprep tool on the source computer before cloning from that computer. This indicates to the booting clone that it must rebuild its Plug-and-Play driver database. If the driver installation files are also included in the image, then the operating system will configure itself automatically to the new hardware environment. This option is not available with Windows NT because Windows NT does not support Plug-and-Play.
- For Windows XP/Vista installations, use Microsoft's Sysprep tool on the source computer before cloning from that computer.
- Microsoft has an article discussing hardware differences between the source and destination computers when using Sysprep with Windows 2000. See the document Using the System Preparation Tool on Dissimilar Computers (Article number 216915), in the Microsoft Knowledge Base.

If you used Sysprep with a Windows 2000/XP/Vista installation and still encountered difficulties with hardware differences, or you want to clone a Windows NT installation, take the following points into consideration:

- Do not clone a computer that uses an IDE hard disk to a computer that uses a SCSI hard disk.
- Consider removing all nonessential hardware drivers from the source computer before cloning, and then, after cloning, reinstalling the correct drivers on the destination computers.
- In the situation where a population of destination computers can be broken down into two or more distinct groups based on their hardware setup, create an image for each group. Alternatively, on the model (source) computer, create a separate hardware profile for each hardware environment. After you write the image to the destination computers, choose the correct hardware profile when you start each computer. This can be achieved by installing Windows on a particular hardware setup and creating a hardware profile for that setup, cloning that installation to another hardware setup, creating another hardware profile, and so on until all hardware setups are covered and then using the image taken from the last setup.
- Some limited success has been reported for installing all possible drivers for all possible peripherals before cloning and relying on incorrect drivers to fail when the resultant clones boot. This will not work in all cases because some incorrect drivers may be sufficiently similar to the correct drivers to not fail. This would cause two or more drivers to attempt to perform the same function, causing problems accessing and using the device.

Encrypted files or folders on the source computer

Windows NT/2000 cannot read encrypted files and directories when the SID has changed (after a rollout, Sysprep or Ghost Walker provides a new unique SID for each client computer). This problem occurs only when the destination computers will have a different SID than the source computer and does not affect Ghost backups, because the SID of the computer does not change after a backup has been restored.

To prevent this problem, unencrypt all files and directories before cloning a Windows NT/2000 system, then re-encrypt the files and directories after using Sysprep or Ghost Walker on the client computers to provide new user names and SIDs.

Restoring the uniqueness of a Windows installation after cloning

A requirement of Windows NT/2000/XP/Vista is that each computer in a domain or workgroup be uniquely identified by the computer name, and, if in a domain, also by the user account's security identifier (SID) and the domain account. When you clone from one computer to another, both computers share the same name, SID, and domain account, and Windows NT/2000/XP/Vista allows only one of the computers to join the workgroup or domain at any one time. If you clone a computer for backup purposes, this is not a problem.
If, however, you want to use both computers on the same domain or workgroup, only one of the computers can be logged on at any one time unless you change the identification of one of the computers before attempting to log that computer on to the domain. The following sections discuss how to change the identification of the destination computer.

**Security identifier (SID) for workstations participating in a domain**

The Windows NT/2000/XP/Vista networking and security subsystems rely on a unique token known as a Security Identifier (SID). This token is randomly generated at installation time. Each user account, security group, and computer has its own SID. When an installation is cloned, all the SIDs are also duplicated. This duplication results in a Windows installation that is no longer unique. For more information on the Security Identifier, refer to Microsoft's document Do Not Disk Duplicate Installed Versions of Windows (Article 162001).

Having a non-unique SID is a problem if the target workstation participates in a workgroup or domain:

- In a workgroup, duplicate SIDs result in a loss of the ability to differentiate and control security access by users and groups.
- In a domain, Windows does not allow two computers having the same SIDs to log on to the domain. In addition, Windows 2000 and newer domains rely more heavily on the SID as a unique token for administering and controlling security than Windows NT 4 domains, which base security access on domain user names and passwords.

To resolve the problem, use a SID changer on each target workstation to regenerate a unique SID:

- If cloning a Windows 2000/XP/Vista installation, use Microsoft's System Preparation (Sysprep) tool.
  
  Note: Although Ghost Walker successfully changes the SID on most Windows computers, Microsoft's System Preparation (Sysprep) tool changes the SID and prompts Windows 2000 to rebuild its Plug-and-Play driver database. To use Sysprep instead of Ghost Walker or the Ghost Console SID Change option, see the document How to use Sysprep with Ghost.

- If you run a Task in Ghost Console to rollout an image, use the SID Change option in the Task. When cloning, use either Sysprep or the SID Change option, but not both options.
- In other situations, run Ghost Walker at the target computer to change the SID and the computer name. Note that Ghost Walker is available only in the enterprise Ghost versions and Norton Ghost 2003.

If you use a SID changer other than Ghost Walker, the SID Change option, or Sysprep, make sure that the SID changer also changes all instances of the old SID where the SID is used to control access to files, registry settings, and so on. If the SID changer does not update old instances of the SID, some application programs may not work. In addition, Windows will no longer recognize the security settings, resulting in either no access to selected system resources, or global access to system resources, increasing security risks on the system.

For more information, see the document How to change the SID on a Windows XP, Windows 2000, or Windows NT computer.

**Computer name for workstations participating in a domain**

Windows NT/2000 requires that each computer on a domain have a unique computer name (NetBIOS name).

To change the computer name of the destination computer, use one of the following methods:

- If cloning a Windows 2000 installation, run Microsoft's Sysprep tool at the source computer immediately prior to creating an image of that computer. See the document How to use Sysprep with Ghost. You can also use this method if you will be taking the original image with GhostCasting or boot disks.
If rolling out a Windows NT/2000/XP/Vista installation by running a Task in Ghost Console, mark the Apply Computer Name option in the Configuration used for the Task before executing the Task. For cloning Windows 2000, use either Sysprep or the Apply Computer Name option, but not both options.

Run Ghost Walker at the destination computer after cloning to it, and before restarting it. Note that Ghost Walker is available only in the enterprise Ghost versions and Norton Ghost 2003.

Start the destination computer after cloning to it, and do not log on to the domain. Change the computer name in the Network Control Panel applet, and then restart the computer and log on to the domain.

**Domain account for workstations participating in a domain**

A Window NT/2000/XP/Vista domain controller keeps track of all workstations in the domain by an entry for each workstation in the domain controller's user accounts database. This entry includes the workstation's computer name. When you change a workstation's computer name after cloning, the workstation no longer matches its entry in the database, and the workstation cannot be authenticated on the domain. That is, the workstation cannot log on to the domain.

To prevent this problem, remove the source computer from the domain before creating an image of the source computer. After cloning to the destination computer, add the destination computer back to the domain. Note that if you use Ghost Console in Norton Ghost 6.04 Enterprise Edition, Symantec Ghost 6.5 Enterprise Edition, Symantec Ghost 7.0, Symantec Ghost 7.5, or Symantec Ghost 8.0 to clone to the destination computer, Ghost automatically adds the computer back to the domain for you.

The Ghost enterprise versions do not require that you remove the source computer from the domain before cloning if Ghost originally added the computer to the domain. This is because Ghost uses the "Add Workstations to Domain" rights. See the Microsoft article number 139365, Capabilities of the "Add Workstations to Domain" Right.

Here is an example of when it is not necessary to remove the source computer from the domain before cloning:

- You add the source computer, computer A, to the domain.
- You remove computer A from the domain.
- You use Ghost to create an image file of computer A.
- You used a Ghost enterprise version to roll out that image file to the target computers. That is, you write the contents of the image file to one or more computers, writing over the previous contents of the disks or partitions. Ghost adds these computers to the domain.
- You use Ghost to create an image file of one of the target computers from step 4. Because Ghost added the computer to the domain in step 4, you do not need to remove the computer from the domain before creating the image file.

**Summary**

**Preparations to make before cloning**

- Update Ghost to the latest version.
- Ensure that the source computer uses a version of Windows NT, Windows 2000, Windows XP or Windows Vista that Ghost supports.
- If cloning a Windows NT/2000/2003 Server, ensure that the image will be used only as a backup, and not for migrating a server installation to other computers.
- Determine whether the source computer uses an OEM HAL. If it does, clone an image of that computer only to computers that have the same hardware.
- If the source and destination computers do not use identical hardware, evaluate the hardware differences with respect to the points listed in the previous section, "Driver specific issues."
Preparations at the source computer

- If the image will be used to migrate a Windows NT, Windows 2000, Windows XP or Windows Vista installation to a different computer, that is, the image will be used for other than backup purposes, unencrypt all files and folders on the source computer before using Ghost to clone the computer.
- If the source Windows NT/2000/XP/Vista computer is a member of a domain, remove the computer's account from the domain before using Ghost to clone the source computer. If the source computer is a member of a workgroup, no changes are needed.
- If cloning a Windows 2000, Windows XP or Windows Vista computer, run Sysprep immediately prior to cloning.

Using Ghost to clone

- Using Ghost to create an image file: If you have several types of destination computers, this may involve creating several image files. For instance, you might have one image file for a specific OEM HAL, another for a computer using IDE hard drives, and another for a different OEM HAL on a computer that uses SCSI hard disks.
- Changing the configuration of the client computers:
  - If you ran Sysprep on the source computer before cloning, Sysprep runs automatically on the destination computer after cloning. Use Sysprep to change the computer name and SID.
  - If, prior to creating the image file, you did not use Sysprep and you did not mark the SID Change option and the Apply Computer Name option in a Task in Ghost Console, change these attributes after cloning. That is, after restoring the image, run Ghost Walker at each destination computer to change the SID or computer name or both.
- Adding the client computer to the domain: After writing the image to the client computers, add each computer back into the domain if necessary.
How to prepare a workstation for control by the Ghost Console

You need to know how to prepare a workstation, so that you can use the Ghost Console to push out an image or configuration to other workstations on your network.

This document provides the procedure for setting up the workstations (client computers) on your network to work with the Ghost Enterprise Console.

This procedure uses GhostCast only for the setup

- Symantec Ghost Console rolls out images and configuration information without having to revisit each client computer.
- The procedure can be used for preparing client computers to work with the Symantec Ghost Console.
- See "Technical Information" for an alternative procedure that uses GhostCast also for the initial rollout.

Note: Symantec Ghost 7.0 uses Ghost Multicast, rather than GhostCast. This is merely a name change, and references to GhostCast also apply to Ghost Multicast.

Cloning with a virtual boot partition

This is the process to use with Symantec Ghost 7.5 or later when you do not want to install a Ghost boot partition on the client computers.

- If the client computers are running Windows NT, Windows 2000, Windows XP or Vista, then, in most cases, this process does not require visiting the clients.
- The following process does not require the use of GhostCast and does not require the steps "Create a boot partition image file" and "Write the boot partition image to the client computers."

To clone by using a virtual boot partition

1. Install the Symantec Ghost Client on the client computers.
   • For most Windows XP Professional, Windows 2000, and Windows NT computers, this step can be done from the Ghost Console and does not require visiting each client computer. Note the exceptions in the section "Remote Client install" in the following document:"How to install the Ghost Client for Symantec Ghost 7.5." at: http://service1.symantec.com/SUPPORT/ghost.nsf/docid/2001121215552725
   • Use the Remote Client Install procedure, or the Install at Client procedure, as described in the document "How to install the Ghost Client for Symantec Ghost 7.5." at: http://service1.symantec.com/SUPPORT/ghost.nsf/docid/2001121215552725

2. Create a "model" image file that includes the Ghost Client.
   a. Prepare the model computer.
      • Install the operating system.
      • Install the Symantec Ghost Client.
      • Install other programs that you want to have on the client computers.
   b. Create and run a "Ghost Console Task" that will create an image of the disk or partition that is on the model computer.
      • To open a new "Task", select File> New> Image Dump.
      • The "Task" saves an image file on the Ghost Server computer or on another network computer.
      • The Symantec Ghost Console does not require that you first install a Ghost boot partition to the model computer.
      • Note: If the model computer does not have a Ghost boot partition, Ghost automatically uses a Ghost virtual boot partition instead.

3. Backup the client computers.
4. Write the "model" image file to the client computers:
   a. Create a Ghost Console Task that will roll out the image to the client computers:
      • To open a new "Task", select File> New>Task.
      • Check the Clone option on the "General tab."
      • Configure the "Task" to write the image to the client computers. This process overwrites the
        operating system and all files on the Target computers.
   b. Run the "Task" that you created.

5. Restore the data.

This completes the setup procedure and the initial rollout of the operating system. When complete, you should
have a client computer without a hidden boot partition and Windows 95/98/Me/NT/2000/XP/Vista should be
running with the Ghost Client software installed.

Cloning without a virtual boot partition

These steps are required to clone (from one to many computers) when you do not use a virtual boot partition.
Only Symantec Ghost 7.5 and later include the Ghost Virtual Boot Partition.

To prepare client computers to work with Ghost Console, you must install the Ghost Client on the client
computers and add a hidden Ghost boot partition to the client computers.

Create a "model" image file that includes the Ghost Client

This process installs the Ghost Client to a "model" computer, creates an image of that computer, and saves
the image as a file on a network drive.

1. At the model computer:
   • Prepare the model computer, which is a Windows 95/98/Me, Windows NT, or Windows
     2000/XP/Vista computer, by installing the operating system that you want to roll out to the client
     computers. You can also install applications on this computer. The applications will be automatically
     rolled out with the operating system because later you will clone the entire disk.
   • Install Symantec Ghost to the model computer. During the installation, select the Console Client
     option instead of the Console (with Standard Tools) option.

2. At the server computer:
   • Install Symantec Ghost to a Windows Me/98/NT/2000/XP/Vista computer.
   • During the installation, select the Console (with Standard Tools) option instead of the Console Client
     option.
   • Create a Network Boot Disk using the Ghost Boot Wizard. You will later use this floppy disk to start
     the model computer.
   • Prepare the GhostCast Server to accept image data from the model computer and save that image
data as an image file:
     • Start GhostCast Server.
     • Enter a Session Name (the name can be anything you want).
     • Select Disk Image.
     • Select Dump From Client. This option tells Ghost to "dump" the image data from the model computer
to a location specified in the next step.
     • Click Browse to give the image file a name and a location to be saved. Because this process creates
       a new file, use a new filename. Do not choose a filename that already exists.
     • Select Accept Clients. This tells the Ghost Server to wait for messages from the network that are
       addressed to the Session Name you entered in a previous step.
3. At the model computer:

   a. Create the image:
      • Boot the computer with the Network Boot Disk created earlier.
      • Click GhostCast (Multicasting in Ghost 7.0).
      • Enter the Session Name. Use the same Session Name that you used at the server computer. This is
        how the two computers initially recognize each other on the network.
      • Select the Source disk.
      • Select Compression Type (Optional).
      • Select Proceed with Dump.

   b. When the image file has been created, restart the computer with the same Network Boot Disk, and
      leave Ghost running at the main screen.

Create a boot partition image file

Use Ghost Boot Wizard to create a boot partition image, which is an image of a hidden Ghost boot partition,
saved as a file.

• Start Ghost Boot Wizard on the server computer.
• Click Console Boot Partition> Next.
• Select the type of network card from the list and click Next.
• This displays the "Symantec Ghost Boot Wizard - Client Type" window.
• Select the network interface card (NIC) drivers for the "client computer", not the server. These files will be
  saved on the hidden Ghost boot partition, from which the client computers will boot.
• This screen shows you the locations of programs needed by Ghost; if these are filled in, and the option
  Symantec Ghost Console Client is checked, then click Next.
• Specify DHCP or Static IP and click Next.
• Note: If you are not sure whether the client computer will use DHCP or Static IP, contact your network
  administrator.
• Type a name and location for this Boot image file, and then click Next.
• Note: This process creates a new file. Be sure to use a new file name. Do not select a filename that
  already exists.
• Click Next at the confirmation screen.
• The Wizard now saves the boot image file to the directory that you specified above.

Write the boot partition image file to client computers

Use GhostCast Server to write the boot partition image to a hidden boot partition on the client computer's drive,
replacing the previous disk information. After you complete this step, Ghost runs from the hidden boot partition
and can accept Tasks from the Console. This hidden boot partition makes future visits to the client computer
unnecessary.

Diagnostic partitions

Note that some computers, such as many models of Compaq, include a diagnostic partition placed there by
the manufacturer. Writing the boot partition image or the "model" image file to such computers is likely to write
over the diagnostic partition. Writing over the diagnostic partition removes any services provided by that
partition. To retain the diagnostic partition on such computers, consult your computer manufacturer.
Using the model computer as client

You can include the model computer as one of the client computers (Steps 2 and 3 of the following procedure). If you write the boot partition to the model computer and write the image to it (Step 5), you can later use the Ghost Console to pull images from the model computer, rather than using GhostCast Server.

To write the boot partition image to client computers
1. At the server:
   - Start the GhostCast server.
   - Enter a Session Name (the name can be anything you want).
   - Select Disk Image.
   - Select Load To Clients.
   - Click Browse and select the boot image file you just created with Ghost Boot Wizard.
   - Select Accept Clients.

2. At each client computer, use GhostCast to accept the hidden boot partition:
   - Start the computer with the Network Boot Disk.
   - If Ghost is not running, type:
     ```
     Ghost
     ```
   - Click GhostCast (Multicasting in Ghost 7.0).
   - Enter the Session Name.
   - Select the Destination Disk.
   - Select Proceed with Load.

3. At each client computer, prepare to accept the rollout of the operating system:
   - Remove the Network Boot Disk from the client computer.
   - Restart. The computer will boot into the hidden boot partition and will be ready to accept Tasks from the Console.

Write the "model" image file to the client computers

You can now use the Symantec Ghost Console to restore the Image that you made in the section titled "Create a 'model' image file that includes the Ghost Client."

For information on creating a Task to restore the image to the client computer, follow the directions in the "Ghost Getting Started Guide" located in the "Documents folder" on the Ghost installation CD. You can also download the "Getting Started Guide" located on the Symantec FTP site at:


Restore the data and verify the partition

If you previously backed up data from the client computers, restore the data to the client computers.

This completes the setup procedure and the initial operating system rollout. You should have a client computer with a hidden boot partition (you can use FDISK or GDISK to verify this) and Windows 95/98/Me/NT/2000 should be running with the Ghost Client software installed.
Using GhostCast for both the setup and the initial rollout

The previous procedure uses separate steps to roll out the hidden Ghost boot partition and the "model" image to the client computers. This is so you can use GhostCast for the setup only, and then use the Ghost Console for rolling out the operating system. Alternatively, you can use GhostCast for both the setup and the initial rollout, then use the Ghost Console for subsequent rollouts. The following procedure provides the general steps to use GhostCast for both the setup and the initial rollout:

• Create two partitions on the "model" computer.
• Install the operating system and applications to the first partition.
• Install the Ghost Client to the first partition.
• Create an image file of the first partition. This is the "operating system partition" image file.
• Use Boot Wizard or Multicast Assist Wizard to create a boot partition image.
• Write the boot partition image to the first partition of the model computer. This writes over the previous partition.
• Write the "operating system partition" image to the second partition of the model computer. Now the model computer has both a hidden boot partition, and an operating system partition.
• Create a disk image file of the model computer. This image file includes both a hidden boot partition, and an operating system partition.
• Use GhostCast Server to rollout the disk image to many computers.

NOTES
MACINTOSH PCs AND THE MAC OPERATING SYSTEM

Overview of the Hardware Aspects of the Mac

The Macintosh or Mac, is a series of several lines of personal computers designed, developed, and marketed by Apple Inc. The first Macintosh was introduced on January 24, 1984; it was the first commercially successful personal computer to feature a mouse and a graphical user interface rather than a command-line interface.

Through the second half of the 1980s, the company built market share only to see it dissipate in the 1990s as the personal computer market shifted towards IBM PC compatible machines running MS-DOS and Microsoft Windows. Apple consolidated multiple consumer-level desktop models into the 1998 iMac all-in-one, which was a sales success and saw the Macintosh brand revitalized.

Current Mac systems are mainly targeted at the home, education, and creative professional markets. These include the iMac and the entry-level Mac mini desktop models, the workstation-level Mac Pro tower, the MacBook, MacBook Air and MacBook Pro laptops, and the Xserve server.

Production of the Mac is based on a concept where Apple facilitates all development aspects of its hardware, and creates its own operating system that is pre-installed on all Mac computers. This is in contrast to most IBM PC compatibles, where multiple sellers create hardware intended to run another company's operating software. Apple exclusively produces Mac hardware, choosing internal systems, designs, and prices. Apple does use third party components, however.

Current Mac CPUs use Intel's x86 architecture; the earliest models (1984-1994) used Motorola's 68000-series CPUs, and models from 1994-2006 used the AIM alliance's PowerPC CPU. Apple also develops and supports the operating system for the Mac. The modern Mac, like other personal computers, is capable of running alternative operating systems such as Linux, FreeBSD, and, in the case of Intel-based Macs, Microsoft Windows. However, Apple does not license Mac OS X for use on non-Apple computers.

Apple directly sub-contracts hardware production to Asian original equipment manufacturers such as Asus, maintaining a high degree of control over the end product. By contrast, most other companies (including Microsoft) create software that can be run on hardware produced by a variety of third-parties, like Dell, HP/Compaq, and Lenovo. Consequently, the Macintosh buyer has comparably fewer options.

The current Mac product family uses Intel x86-64 processors. Apple introduced an emulator during the transition from PowerPC chips (called Rosetta), much as it did during the transition from Motorola 68000 architecture a decade earlier. All current Mac models ship with at least 2 GB RAM as standard. Current Mac computers use ATI Radeon or nVidia GeForce graphics cards. All current Macs (except for the MacBook Air) ship with an optical media drive that includes a dual-function DVD and CD burner, called the SuperDrive.

Macs include two standard data transfer ports: USB and FireWire (except for the MacBook Air and MacBook, which do not include FireWire). USB was introduced in the 1998 iMac G3 and is ubiquitous today, while FireWire is mainly reserved for high-performance devices such as hard drives or video cameras. Starting with a new iMac G5 released in October 2005, Apple started to include built-in iSight cameras to appropriate models, and a media center interface called Front Row that can be operated by an Apple Remote or keyboard for accessing media stored on the computer.

Apple was initially reluctant to embrace mice with multiple buttons and scroll wheels. Microsoft's IntelliMouse, featuring two buttons and a scroll wheel, was introduced in 1995 to great success. Macs did not natively support multiple buttons until Mac OS X arrived in 2001, when Apple offered wired and Bluetooth wireless single-button mice. In 2005, Apple introduced the Mighty Mouse, which looked like a traditional one-button mouse, but actually had four buttons and a scroll ball. A Bluetooth version followed in 2006. In 2009, Apple introduced the Magic Mouse which uses multi-touch gesture recognition similar to the iPhone instead of a physical scroll wheel or ball.
Overview of the Mac Operating System

The original Macintosh was the first successful personal computer to use a graphical user interface without a text-based command line. It used a desktop metaphor, depicting real-world objects like documents and a trashcan as icons onscreen. The System software introduced in 1984 with the first Macintosh and renamed Mac OS in 1997, continued to evolve until version 9.2.2. In 2001, Apple introduced Mac OS X, based on Darwin and NEXTSTEP; its new features included the Dock and the Aqua user interface. During the transition, Apple included an emulator known as Classic allowing users to run Mac OS 9 applications under Mac OS X, version 10.4 and earlier on PowerPC machines. At the time this book is written, the most recent version is Mac OS X v10.6 "Snow Leopard." In addition to Snow Leopard, all new Macs are bundled with assorted Apple-produced applications, including iLife, the Safari web browser and the iTunes media player.

Mac OS X enjoys a near-absence of the types of malware and spyware that affect Microsoft Windows users. Mac OS X has a smaller usage share compared to Microsoft Windows (roughly 5% and 92%, respectively), but it also has secure UNIX roots. Mac OS X has a much larger market share than Mac OS 9, with over 35,000 known viruses and malware, ever had. Worms as well as potential vulnerabilities were noted in February 2006, which led some industry analysts and anti-virus companies to issue warnings that Apple's Mac OS X is not immune to malware. As of 2009, no Mac OS X virus and only two OS X worms (requiring user action and validation to infect) has ever been detected. Apple routinely issues security updates for its software.

The Mac and it's operating system led the way for many computing innovations that we now consider standard and commonplace. Some of these advances included:

- A graphical user interface (GUI)
- Use of a mouse, and also the trackball and trackpad
- The Microsoft Office suite of applications (yes, they started on the Mac)
- Integrating sound into the operating system for specific system events
- 3.5" floppy disks and drives
- SCSI hard drives, as well as USB and Firewire ports
- CD-ROM and DVD-ROM drive technology
- Ergonomically-designed laptops
- Desktop publishing and website design applications
- Optimizing the computer and operating system for use on the Internet
- Integrating the Mac with other devices such as the iPod, iPhone and digital imaging devices
- Building applications that encouraged use and development of music and video on a PC

Originally, the hardware architecture was so closely tied to the Mac OS operating system that it was impossible to boot an alternative operating system. The most common workaround, used even by Apple for A/UX, was to boot into Mac OS and then to hand over control to a program that took over the system and acted as a boot loader. This technique was no longer necessary with the introduction of Open Firmware-based PCI Macs, though it was formerly used for convenience on many Old World ROM systems due to bugs in the firmware implementation.[citation needed] Now, Mac hardware boots directly from Open Firmware or EFI, and Macs are no longer limited to running just the Mac OS X.

Following the release of the Intel-based Mac, third-party platform virtualization software such as Parallels Desktop, VMware Fusion, and VirtualBox began to emerge. These programs allow users to run Microsoft Windows or previously Windows-only software on Macs at near native speed. Apple also released Boot Camp and Mac-specific Windows drivers, which help users to install Windows XP or Vista and natively dual boot between Mac OS X and Windows. Though not condoned by Apple, it is possible to run the Linux operating system using Boot Camp or other virtualization workarounds.

Because Mac OS X is a UNIX like system, borrowing heavily from FreeBSD, many applications written for Linux or BSD run on Mac OS X, often using X11. Apple's less-common operating system means that a much smaller range of third-party software is available, but many popular applications such as Microsoft Office and Firefox are cross-platform and run natively.
Advantages to The Macintosh and Mac Operating System

There are many advantages to the Mac computing platform as compared to the typical PC running Windows. Even though PCs vastly outnumber Macs, and despite the fact that both platforms have their advocates and critics, there are specific features of the Mac platform that are superior to PCs. Here is a list of some of these advantages:

- True Plug-and-Play compatibility; there are no incompatible Apple Mac devices
- Networking (wired and wireless) Macs is far easier than networking PCs
- More stable and intuitive operating system
- Virtually no risk of virus or malware corruption
- Operating system seamlessly integrates with multimedia devices and Internet
- Ease of installing and uninstalling applications
- Wide range of familiar applications (such as MS Office, Mozilla Firefox, QuickBooks)
- Mac operating system automatically recognizes PC-formatted files and disk media
- Hardware and operating system available from one source: Apple
- Newer Macs can use PC-compatible video cards, memory, hard drives, and other hardware components

Summary and Lab

In this course, we will demonstrate how to use a Macintosh computer, and how to install the Mac operating system. The lab section will provide opportunity for the students to experiment with using a Macintosh, and compare how it work with a typical PC running Windows.

The instructor recommends that, if possible, the student obtains or purchases a Macintosh computer for use at home. By availing yourself of the opportunity to explore and practice using a Mac, the student will become familiar with it's operation, and also how the computer can be serviced and upgraded. Used Macintosh computers are available at computer shows and thrift shops, and copies of the operating system installation CDs will be available from the instructor.
As mentioned in the course syllabus, several class days will be dedicated entirely to working “The Help Desk” at the MarketPro computer shows held throughout the Washington DC area.

At these computer shows, we offer a service where customers at the show bring in their problematic laptops and PCs, and we work to repair or diagnose the problems. This will provide you with an extraordinary opportunity to work on actual consumer PCs with issues such as viruses / malware, hardware failures, operating system corruption, application installation and removal, and laptop power problems. These days are considered lab sessions for the course, and attendance is expected at the computer show.

Specific step-by-step procedures should be used when greeting customers, questioning customers about the reported problems, making an initial determination of the exact problem, developing a plan of action to correct the problem, communicating the repair plan to the customer, implementing the repair, and assuring the customer of the corrective actions. In some cases, when a computer repair is not feasible or reasonable, the customer should be given options for equipment replacement that is within their budget. Listed below is the process for handling customers at the Help Desk:

**Greeting Customers**

When the customer comes into the Help Desk arena, don’t just start working on their PC. We need to greet the person, ask some basic questions to see if we can perform the work, make sure there aren’t other people waiting already in line, and collect some basic information from the customer before proceeding. Follow these steps when greeting a customer:

- Be inviting, polite and professional
- Ask the customer what seems to be the problem
- Provide the customer with the information sheet about our services and requested service charges
- Have the customer sign in on the clipboard, providing us with their name, phone number, and problem description
- Place a label on the PC or laptop with the customer’s name, phone number and reported problem
- Make sure at least one person is responsible for the work; put that person’s name on the sign-in clipboard, indicating who will be doing the work
- Place the computer or laptop in an available space on the table, and begin connecting the unit to power, monitor, keyboard and mouse
- If there is a line of people waiting for services, let the customers know there is a “triage person” who can sign them in; let the customer know there is a wait time involved, and allow them to leave the computer in a safe location

**Questioning Customers About the Reported Problems**

Once the computer is signed in and ready to be worked upon, discuss briefly with the customer what the reported problems are with the unit. Determine what is happening, when it happens, when it may have started happening, and whether the person made recent changes to their computer. Don’t spend a long period of time asking questions; just get the basic facts from the customer. In the next step, you will begin testing the computer, and you can validate what the customer is reporting. You may find that what the customer reports is not in fact the actual problem, but their perception of what they think is wrong. It may be helpful to take down some simple notes of what the customer says to you, if things are busy at the show.

**Making an Initial Determination of the Exact Problem**

Power up the computer or laptop, and try to replicate the reported problem(s). Usually the problems will become apparent in a short period of time. The typical problems encountered at the Help Desk include the following:
• **Virus and malware infection of the computer:** the PC will be slow, fail to boot properly, display error messages, fail to load or run certain applications, or fail to boot at all.

• **System fails to power up at all:** power supply problems or a short in a major component are common situations. Laptops may have a broken AC adapter jack within the case of the laptop.

• **Hard disk drive failure:** the drive will make grinding or improper noises, or may not power up at all. Error messages from POST may indicate the problem. Drive cables may be mis-connected or damaged, and/or power cables may be damaged or not connected. Master-slave jumpers may be set incorrectly.

• **CD/DVD drive failure:** the drive may not spin up, or may spin without correctly reading the disk. Drive cables may be mis-connected or damaged, and/or power cables may be damaged or not connected. Master-slave jumpers may be set incorrectly. There may be Windows Registry problems that are preventing the drive from being recognized. Add-on software (like a DVD playback application or a disk mastering software) may not be installed, or incorrectly installed. The drive may have been subjected to misuse, abuse, or exposed to contaminants like dust or sticky fluids.

• **Memory problems:** memory DIMMs or SIMMs may have been overheated or damaged by static electricity. Improper or mis-matched memory may have been installed. Memory may not have been correctly inserted into their sockets. Dust in the sockets may be preventing the memory from being recognized.

• **USB connection problems:** USB devices were not properly ejected, potentially causing static discharges and damage to the system board. Drivers may need to be reloaded. Improper insertion of USB cables may have damaged the plug on the system board.

• **CPU or system board failures:** CPU overheating may have damaged the processor. Overall system overheating may have damaged the system board. Improper installation of devices while the system is powered up may have damaged the system board. Power supply connectors to the system board may not be totally connected, or disconnected by accident. A shorted-out device (like a modem or NIC) in a PCI bus connection could create a short along the device bus. Improper or incomplete ROM BIOS upgrades may have permanently damaged the system board.

• **Application software failures:** application will not run, or will not perform certain functions correctly. Uninstallation and reinstallation of the application is the proper solution.

• **Operating system failures:** an improperly performed operating system installation or upgrade could corrupt the PC’s ability to boot. Virus or malware infection may have corrupted the operating system to the point where it will not boot. Running a repair of the operating system is the first, best option. Wiping and reloading the entire operating system is the last but best option.

• **CRT Monitor failure or LCD failure on a laptop:** monitors should simply be replaced; do NOT attempt a repair. LCD screens on laptops can be replaced, but by an expert; cost to replace a laptop LCD can exceed the worth of the unit.

Use these guidelines, along with the information in this text, to make your initial determination of the computer problem. Have your hardware and software toolkits, along with the course DVD and any utility software, available to perform this work.

Do not rush, and do not let the customer badger you or “advise” you when performing your problem analysis. If the customer REALLY knew what was wrong, they would be fixing it themselves. Invite the customer to watch, or to visit the show while you are performing this analysis.

Consult with the instructor if there are any problems or unusual situations encountered during testing. Consult with your fellow students as well for advice and confirmation.

**Developing a Plan of Action to Correct the Problem**

Once you have determined the actual problem, figure out what needs to be done (and/or what needs to be purchased by the customer) to perform the repair. Double-check with the instructor and the Help Desk assistants to confirm that your plan is reasonable and sound. The descriptions of typical Help Desk problems shown above will guide you in what needs to be accomplished, in order to complete the repair.
Communicating the Repair Plan to the Customer

Before starting the repair process, consult with the customer. There may be replacement parts that need to be obtained at the computer show, at the customer’s expense. The cost of these parts may exceed the customer’s ability to complete the repair at this time. There may be customer data on the hard drive that should be preserved (or attempted to be preserved) during any re-installation of the operating system.

Explain to the customer all of what needs to be done to bring the system back to normal operation; do so in plain English. Ask the instructor or the Help Desk assistants to speak to the customer with you, if there is any misunderstanding or concern from the person. Obtain agreement from the customer before implementing your repair plan. If the customer chooses not to perform the repair, provide them with your recommendations of what needs to be done.

Implementing the Repair

If the repair requires the purchase of new or replacement components, go with the customer into the show, and assist them in purchasing the RIGHT equipment before starting the process. Do not assume that the customer knows what to purchase, or from whom. Ask the instructor or the Help Desk assistants to guide you to the correct vendors that will have the proper parts at a reasonable price. The customer is entirely responsible for the cost of the replacement parts, and any warranty considerations that convey with that part.

Perform the repair once you have all of the necessary parts, tools and software. Work diligently, without rushing or wasting time. Enjoy the experience, and don’t let yourself become stressed. Ask for assistance if needed. Invite the customer to watch, if it seems appropriate. Answer any customer questions if they arise.

Let the customer know approximately how long it will take to perform the repair. If the process takes longer than expected, let the customer know that they can pick up the computer the following day, or from the school in several days. We want to complete all repairs by the end of the show, unless it is absolutely unavoidable.

Repairs should be fully complete, and all aspects of the computer should be 100 percent operational. A 98 percent repair job is NOT complete; everything should work as designed. Do not consider the job completed until everything is finished and you are satisfied that the system is 100 percent correct. Ask the instructor and/or the Help Desk assistants for guidance, if you want to verify that everything is completed properly.

Assuring the Customer of the Corrective Actions

Once the repairs are completed, demonstrate to the customer that the system is working properly. Answer any questions, and refer any issues to the instructor or the Help Desk assistants for clarification. Remember: when the customer is satisfied, then we are satisfied. This is a major part of quality assurance in the IT service industry.

Collecting the Service Charge

We do ask for a $40.00 service charge for the work performed at the Help Desk. This price is significantly lower than what is charged for computer repairs in the field. This charge enables our non-profit organization, Research Technology Associates (RTA), to perform various kinds of charitable work in the local community, and also around the world. It also prevents people from viewing us as merely a free service and taking advantage of our offering.

The $40.00 service charge does not include the cost of additional parts, operating system software or application software. We do not give away copyrighted software to customers for free, such as Microsoft Office. We can reload operating systems if there is a Microsoft Certificate of Authenticity (COA) on the PC, or if the customer has an authentic copy of the operating system installation CD. We do provide and install free anti-virus, anti-spyware and utility software applications for our customers, and will install copyrighted applications if the customer has the original disks (not copies).
If a customer complains that $40.00 is too much to fix a computer, don’t even argue with them; the person OBVIOUSLY does not know how expensive computer repairs can become. They will discover that fact very shortly, when they try to have the computer serviced elsewhere. If someone simply does not have the $40.00, have the customer speak to the instructor. We are willing to waive a charge for someone with a genuine financial hardship.

The $40.00 service charge is considered to be a tax-deductible contribution; receipts are available upon request. The triage person at the Help Desk can provide the receipt to the customer. All monies should be given to the triage person, or to the instructor. Checks can be made payable to RTA, and cannot be pre-dated or post-dated. We do not accept credit or debit cards of any kind.

Providing Options for Equipment Replacement

If the computer or laptop is beyond repair or the repair price will cost more than the value of the unit, explain this to the customer, gently. Take the customer through the computer show and offer different alternatives for replacing the unit. The computer show has new, refurbished and used computer equipment that is sold at well below retail market prices. There will be many options for the customer to consider, so help them as best you can. Ask the instructor or one of the Help Desk assistants for guidance as needed.
WHAT IS RESEARCH TECHNOLOGY ASSOCIATES, INC.?

Research Technology Associates, Inc. is a non-profit corporation, as stated in Section 501(c)(3) of the IRS Code. Our IRS tax ID number is 52-1991918.

The goals of the Research Technology Associates, Inc. are simple:

- Locate and obtain surplus computer equipment in our community;
- Test and refurbish this equipment;
- Distribute this computer equipment to schools and various non-profit organizations in our community; and
- Provide quality training at an affordable cost to schools, charitable organizations, and the non-profit community.

Services provided by Research Technology Associates, Inc. include:

- Picking up unwanted and surplus PC equipment from individuals and corporations;
- Refurbishing computer equipment at our facilities;
- Placing this equipment in non-profit organizations throughout the world;
- Providing training and support to various organizations, and
- Teaching individuals computer repair techniques through the ENT 1840 (PC Hardware) ENT 2840 (PC Repair), ENT 2860 (Advanced PC Configuration and Troubleshooting), and DPR 396/397 (A+ Certification Preparation) courses offered at PG Community College.

Engineering students at Prince George’s Community College and other local community colleges provide much of the labor, resources and volunteer time needed to test and repair this equipment. Our volunteer base comes from a broad cross-section of people from throughout our community. Our Board of Directors is comprised of business leaders and computer technicians from all over the Washington DC area.

Research Technology Associates, Inc., gives individuals and corporations a way to give back to the community:

- The training opportunities offered through PG Community College provide students valuable job skills for today’s computer-oriented business market;
- Computers end up in deserving schools and non-profit corporations, not in landfills; and
- Individuals and corporations receive tax deductions for donating their surplus equipment.

Volunteers are needed to transport computers from donor organizations to our offices in Upper Marlboro MD, and to our repair facility at Prince George’s Community College in Largo MD. We also need volunteers who can test, repair and prepare computers for distribution to various charitable organizations.

For further information about Research Technology Associates, Inc., or if you would like to volunteer your services, please contact Bill Lloyd, Corporation President, on 301/782-3585. You can email us at LLOYDWA@pgcc.edu.

Visit our website at http://academic.pgcc.edu/~wlloyd/rta.
GUIDELINES FOR OBTAINING EQUIPMENT FROM RESEARCH TECHNOLOGY ASSOCIATES

If you want to obtain computer equipment from Research Technology Associates, Inc., you will need to do the following things:

1) **Send your request to:**

   Research Technology Associates, Inc.
   12221 Van Brady Road
   E-mail: LLOYDWA@pgcc.edu
   Upper Marlboro, MD  20772-7924

   Our phone number is 301/782-3585.

2) **Provide us with your non-profit organization's name, address and phone number;**

3) **Provide us with a record of your non-profit or charitable organization status, such as:**
   o a 501(c)(3) form which your organization filed with the IRS, or
   o a photocopy of your state tax exempt number.

4) **Indicate as precisely as you can what you would like to receive.** We routinely receive the following kinds of PCs:
   o Pentium-class PCs with floppy and hard drives
   o VGA color monitors (CRT and LCD flat-panel)
   o Macintosh and iMac computers
   o Dot matrix, ink-jet and/or laser printers
   o Scanners and other miscellaneous computer equipment

   Requests for more advanced equipment than this may take some time to fill. Also, requests for multiple PCs may be delivered on a flow basis.

   Let us know if you need more than one PC, or if you just need a certain component (i.e., a monitor, a hard drive, a video card, etc.)

5) **Have patience.** Our waiting list is growing, just as our corporation is growing. Depending upon the request, you may have to wait several weeks to receive your PC. We are a volunteer organization: we receive no tax subsidies, and our volunteers and board members receive no compensation. We will fill your order for a PC as soon as possible.

6) **Make arrangements to pick up the PC when it's ready.** Once your PC is ready, you will make arrangements to pick it up. We can ship the PC to your location, but you will need to pay for the shipping. It's usually cheaper to come to our office and pick it up. Contact us at our main office for details.

7) **Write a check to Research Technology Associates, Inc.** We provide computers to non-profit organizations at greatly reduced prices. The contribution you provide for a computer defrays our costs in obtaining, refurbishing and delivering the PC to you. We receive no Federal, state or local funding for our program; therefore, we use the income generated from the sale of computers to sustain our work.

8) **Let us know of organizations that are disposing of surplus PC equipment.** We are always looking for organizations that are disposing of their surplus computer equipment. Companies and individuals that donate equipment to our organization receive a letter which can be used for tax deduction purposes with the IRS. The more PCs we receive, the faster we can get you the equipment you need.

If you have further questions, please call us at 301/782-3585. We look forward to serving you.

You also can visit our website at http://academic.pgcc.edu/~wlloyd/rta for more information.
GUIDELINES FOR DONATING EQUIPMENT TO RESEARCH TECHNOLOGY ASSOCIATES

If you want to donate computer equipment to Research Technology Associates, Inc., you will need to do the following things ...

1) Contact our organization at:

   Research Technology Associates, Inc.
   12221 Van Brady Road
   Upper Marlboro, MD  20772-7924
   E-mail: LLOYDWA@pgcc.edu

   Our phone number is 301/782-3585.

2) Indicate as precisely as you can what you have to donate. We routinely accept for donation the following kinds of equipment:

   o Pentium-class PCs with CD-ROM and hard drives
   o VGA color monitors (CRT and LCD flat-panel)
   o Keyboards and mice
   o Macintosh, and iMac computers
   o Dot matrix, ink-jet and/or laser printers
   o Scanners and/or other miscellaneous computer/office automation equipment
   o Software

   The more we know about the equipment you have AND the condition of the equipment, the better we can service people who are currently on our waiting list.

3) Make arrangements with Research Technology Associates, Inc. to deliver the PCs to us, OR arrange for us to pick up the PCs from your location. If you can deliver your PC to us, that would be most helpful. We CAN come to your site and pick up your equipment, also. Please contact us for details on picking up the equipment from your site. Volunteers with our organization will come to your site to pick up the equipment.

4) Let us know if you would like a tax-deductible receipt for your records. Research Technology Associates, Inc. is a non-profit corporation, as specified in Section 501(c)(3) of the IRS Tax Code. Persons or organizations contributing equipment to Research Technology Associates will, upon request, receive a letter acknowledging the donation which can be used for tax deduction purposes.

   Please let us know to whom the letter should be sent, including the person's or organization's name, address and ZIP code.

5) Let us know of any other organizations that are disposing of surplus PC equipment. We are always looking for organizations that are disposing of their surplus computer equipment. The more PCs we receive, the better we can serve the various non-profit organizations that look to us for assistance.

   If you or your organization will have additional equipment to donate in the future, please let us know. We can make arrangements to pick up the equipment at that time.
6) **Consider volunteering with Research Technology Associates, Inc.** We are always in need of persons who can do the following things:

- Test, repair and evaluate computer equipment
- Pick up and deliver computer equipment (trucks and/or station wagons are needed, too)
- Answer telephones and prepare correspondence for the mail

We encourage you or your organization's employees to contribute a few hours a week to the work of Research Technology Associates, Inc. Contact our office for details.

If you have further questions, please call us at 301/782-3585. We look forward to serving you.

You also can visit our website at [http://academic.pgcc.edu/~wlloyd/rta](http://academic.pgcc.edu/~wlloyd/rta) for more information