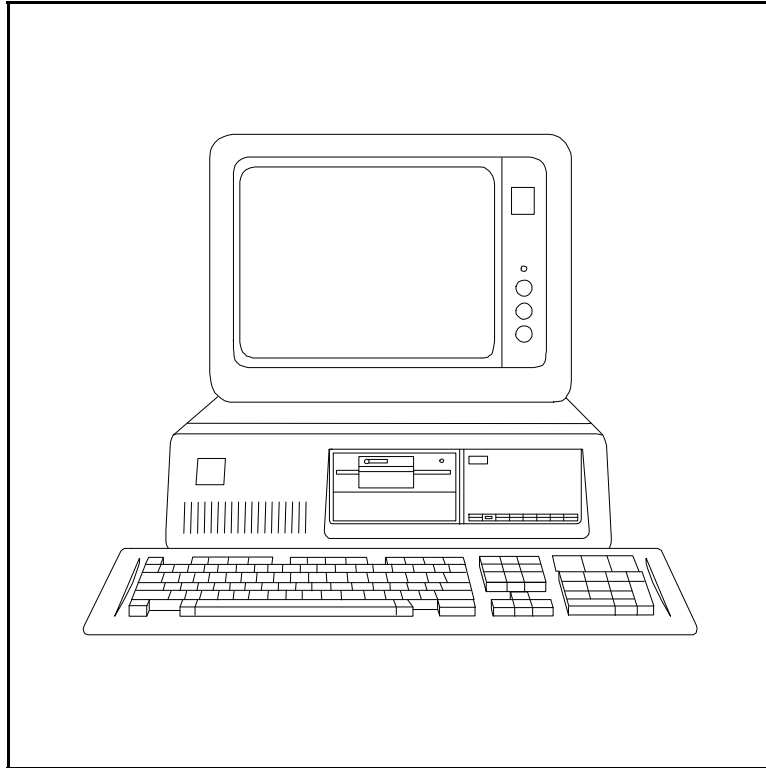


AN INTRODUCTION TO PC HARDWARE
ENT 184: PRINCE GEORGE'S COMMUNITY COLLEGE



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FOREWORD

These course materials were developed for use in the PC Hardware, PC Repair, Repair and Maintenance of Personal Computers, and Introduction to Local Area Networks 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:

- o My wife, Joyce, and my three children (Christina, Matthew and David), who have shared me with hundreds of students over the years;
- o William Lauffer, the dean of Engineering Technology at Prince George's Community College, who gave me the opportunity to develop and teach these courses;
- o Dirk Faas, Bradley Faas, and Darrell Mattheis, 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; and
- o The board of directors for my non-profit organization, Research Technology Associates, which includes Jess Smith, Francis Ennels, Dirk Faas, Darrell Mattheis, and my wife Joyce. They are people to whom I give permission to tell me what to do, and their advice is invariably always excellent.
- o Michael Wiggins, Ken Chapman, Dan and Polly Dyer, Alan Wurtzel, Tony Magnotto, Paul Blose, Mary Waynes, John Peoples, Robert Chang, Godwin Larbi, and all of the staff and volunteers of Computer Reclamation, Inc. The creative input, hard work, and selfless sacrifice of these individuals has helped to make me the instructor that I am, and the raw materials that Computer Reclamation provides helps the students to become the repair technicians they desire to be. The work we do together helps so very many people, and your contributions are recognized and applauded here.

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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Pricing information for this manual and other information about this course series will be provided upon request.

COURSE SYLLABUS: PERSONAL COMPUTER HARDWARE

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FAX - 301/372-0086 (24 hours/day)
Voice Mail - 301/322-0057
No calls on Sunday, please.
Leave a message at my home, and I will return your call.
Computer repair questions/problems should be brought to class.

OFFICE HOURS:

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

TEXTBOOKS AND TOOLS:

REQUIRED TEXT: Upgrading and Repairing PCs, **10th** Edition, by Scott Mueller; published by Que Corporation. Approximate Cost: \$49.95

The purchase of a computer repair toolkit (usually under \$20.00) is **REQUIRED**. I have included details of how to get such a kit in your class notes.

GRADING POLICY:

Test #1	35 percent
Test #2	35 percent
Lab Participation	15 percent
Class Attendance	15 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, and using normal precautions in handling the equipment. Class attendance will be graded by your presence and participation in class. Excused absences will be granted when you contact me in advance, or for unforeseen emergencies.

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) Identify major components and sub-systems of an IBM-class microcomputer;
- 2) Have a basic understanding of what takes place with the computer's hardware when the computer is turned on;
- 3) Understand how MS-DOS operates and uses memory in an IBM-class computer;
- 4) Understand the concept of fault-isolation, and be able to isolate the most typical kinds of faults found in malfunctioning IBM-class computers; and
- 5) Be able to successfully repair faulty IBM-class computers in at least a rudimentary fashion.

CLASS RULES:

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

PLACES TO GET A 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 voltmeter, 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.

WHERE DO I BUY SUCH A TOOLKIT?

Look in places like:

- Sam's Club
- Egghead Software
- CompUSA
- Radio Shack
- MicroCenter
- Office Depot
- Staples
- PC Shows

Call before you go!! Make sure the store has the kits before you travel out there.

NOTE: I share NO financial stake in any of the above-mentioned companies. I simply give them as sources other students and colleagues have used in the past to find decent toolkits for these courses.

PC HARDWARE CLASS READING ASSIGNMENTS

By the third class session of this course (in the 6-week format), or the fourth class session of this course in the 8-week format, you will be expected to have read the following chapters in the Mueller textbook (**10th** Edition):

Chapter Number

Subjects Covered

Chapter 1	Personal Computer Background
Chapter 2	Overview of System Features and Components
Chapter 3	System Teardown & Inspection
Chapter 4	Motherboards
Chapter 5	Bus Slots and I/O Cards (skim)
Chapter 6	Microprocessor Types and Specifications (skim)
Chapter 19	Building a System from Scratch
Chapter 20	Preventative Maintenance, Backups & Warranties
Chapter 21	Software and Hardware Diagnostic Tools
Chapter 22	Operating Systems Software and Troubleshooting

Optional Readings

Chapter 10	Video Display Hardware
Chapter 12	Audio Hardware
Chapter 14	Hard Disk Drives (please skim read)
Chapter 17	CD-ROM Drives

Isn't this a lot of reading?

Yes, it is. However, what you will read here will be covered in the lecture AND in this course manual. It reinforces what we talk about in class, and will give you good questions to ask.

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. The textbook 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, they will. However, I will test on a specific subset of the things mentioned in the text. The Mueller text is used to amplify and broaden the discussions we have in class, as well as the material in the course manual. I will NOT pull sneaky stuff out of the textbook to stump you on a test, but you will find my tests to be fairly comprehensive.

SECTION 1: LEARNING THE BASICS

In the first part of the course, we will focus on learning the essentials about personal computer hardware. You will learn about the following kinds of things:

- o Electrical power and surge suppressors
- o How do computer viruses affect your PC, and how do you deal with virus problems?
- o What are the major components inside your PC, and what do each of these components do?
- o How do different types of the same components compare, one with each other?
(for example, why is an 80486DX processor better than an 80486SX, or an 80386DX?)
- o What is the Power-On Self Test, or POST, and what does it do for the computer user?
- o What are error codes and audio error codes, and how can you decipher these codes?
- o How do you open and disassemble a PC, and how can you identify the major components?
- o What guidelines should you use when testing or checking a PC?
- o How do you fill out a "toe tag", which is an identification sheet labelling each tested PC?
- o How do you visually identify specific computer components?
- o What software can you use to test and identify components in your PC?

This course manual covers all of the topics that will be discussed in the lecture portion of the class. Your instructor will follow the outlines laid out in this manual. The manual has been designed to free you from needing to take lots of notes during the lecture sessions ... the lecture notes for the instructor contain the same kinds of information as your course manual. As the lecture progresses, review the manual and add any explanatory notes into the space provided on each page.

At the end of section one, there is a list of all of the major questions that will be asked on the first test. Use this information as a checklist to prepare you for the first test. Be sure to do the required course readings in the textbook as well ... it will also help you prepare for the examinations in the course.

FACTS ABOUT ELECTRICAL POWER AND SURGE SUPPRESSORS

The voltage you get from the wall socket is NOT always what you expect ...

There are periodic fluctuations in voltage from devices going on and off in your building, problems in the transmission line, electrical storms, bad or faulty transformers, etc. Sometimes these fluctuations in voltage may exceed several thousand volts. When this happens, bad things can happen to good computers (or any other kinds of electrical devices).

Surge Suppressor

A **surge suppressor** provides a way to deal with voltage spikes (but not loss of voltage). The surge suppressor has a metal-oxide varistor (MOV) that will shunt excess voltages to ground, thereby saving your PC.

When buying a surge suppressor, the most important thing to check for is the clamping voltage of the unit. The clamping voltage is that point when excess voltage will be diverted to ground. A good suppressor will have a clamping voltage of approximately 300 volts, and will have a Underwriter's Laboratory (UL) listing of UL 1449. This is sufficient to protect your PC from harmful excess voltage.

Reliable surge suppressor are made by the following companies:

- APC - TrippLite - Curtis

As long as the suppressor has the UL 1449 rating and a 300 volt clamping voltage, it will serve you well. These should cost you between \$30 and \$60 in the local stores.

Uninterruptible Power Supply

An **uninterruptible power supply (UPS)** will have this same technology, but it contains a battery in it as well. The battery in the UPS will allow your PC to continue to operate if power has been cut off to your building. **HOWEVER**, it will only last for a few minutes (5 - 30 minutes). An UPS allows you to shut off your PC in a normal fashion in the event of a power failure. These will cost at least \$100 for a low-end model, and high-performance versions can cost thousands of dollars.

If you have intermittent voltage failures in your area (i.e., the power frequently cuts off for only a second), consider getting a low-end surge suppressor. It will save you immense amounts of grief when using your PC, since all the information stored in RAM is wiped out when power is cut off.

NOTES

HOW DO VIRUSES AFFECT YOUR PC

Viruses will affect your PC in 4 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 (IO.SYS, MSDOS.SYS, and COMMAND.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 MS-DOS how big your hard disk is, and what percentage of it is used by MS-DOS. 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.
EXAMPLE: the 4096 virus.

3 THINGS A GOOD VIRUS PROTECTION PROGRAM SHOULD DO

- 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 4 locations mentioned above.

- 2) **CLEAN up the virus:** A good program must be able to get rid of the virus it finds in any of the 4 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.

Good programs include McAfee's SCAN, and F-Prot. Both of these are shareware programs, and are available from the instructor upon request.

You will want to memorize this page in preparation for tests in this course.

DEFINITIONS OF BASIC COMPUTER COMPONENTS

MOTHERBOARD: The main board (guts) of computer; the central processor chip (CPU) is on the motherboard; all adapter cards plug into the motherboard; it is the largest single board in computer.

There are several types of CPU chips found on motherboards:

8088 CPU; inputs 8 bits of data	Processes 8 bits of data	Outputs 8 bits of data
80286 CPU; inputs 16 bits of data	Processes 16 bits of data	Outputs 16 bits of data
80386SX CPU; inputs 16 bits of data *	Processes 32 bits of data	Outputs 16 bits of data at a time
80386DX CPU; inputs 32 bits of data	Processes 32 bits of data	Outputs 32 bits of data
80486SX CPU; inputs 32 bits of data	Processes 32 bits of data	Outputs 32 bits of data
80486DX CPU; inputs 32 bits of data **	Processes 32 bits of data	Outputs 32 bits of data
'586 CPU: inputs 32 bits of data	Processes 32 bits of data	Outputs 32 bits of data
Pentium/P6/K5 CPU: inputs 64 bits of data	Processes 64 bits of data	Outputs 64 bits of data
Pentium Pro CPU: *** inputs 64 bits of data	Processes 64 bits of data	Outputs 64 bits of data

* The 80386SX CPU takes 2 clock cycles to input 32 bits of data to process; this CPU is a hybrid between an 80286 and an 80386DX.

** The 80486DX is the first CPU to integrate a math co-processor chip into the CPU itself. All CPUs before this had separate math co-processors.

*** The Pentium Pro will only run 32-bit applications.

The Mueller textbook has further information on the different CPU chips that can be installed onto a motherboard.

DEFINITIONS OF BASIC COMPUTER COMPONENTS (PAGE 2)

POWER SUPPLY: Provides electrical power to motherboard, disk drives, and occasionally to the monitor also. Has a fan on it to cool the computer.

VIDEO CARD: Adapter card that sends video signals to the monitor; 4 main kinds of video cards:

Hercules: Monochrome & high-res graphics

CGA: Color & low-res graphics

EGA: More colors and high-res graphics

VGA: Lots of colors and very-high-res graphics
(VGA and Super VGA are compatible)

HARD DISK: Stores large quantities of data for use at a later time. Uses a **HARD DISK CONTROLLER** to connect hard disk to motherboard.

MFM and RLL drives: Typically have separate controllers and hard disks. RLL controllers can store up to 30% more data on the same disk than MFM controllers. Uses 34-pin AND 20-pin cables to transmit data.

IDE Drives: Have hard disk controller and hard disk in ONE unit; slightly more difficult to install additional hard disks to IDE systems. Uses 40-pin ribbon cable to transmit data.

SCSI drives: Uses separate controllers, like MFM & RLL drives, but can transfer data at a much faster rate. SCSI drives are also more expensive. Uses 50-pin or 68-pin cable to transmit data.

FLOPPY DISK DRIVE: Stores smaller quantities of data than a hard disk. Uses a **FLOPPY DISK CONTROLLER** to connect drive to motherboard. 4 main floppy drive types:

5 1/4" 360K: Stores 362,496 bytes of data

5 1/4" 1.2M: Stores 1,213,952 bytes of data

3 1/2" 720K: Stores 720,112 bytes of data

3 1/2" 1.4M: Stores 1,457,664 bytes of data

PARALLEL PORT: Connects printer to computer; sends 8 bits of data (1 byte) at a time.

SERIAL PORT: Connects serial devices (mouse, modem, plotter, digitizer) to computer; sends 1 bit of data at a time.

RAM: Random Access Memory; this is the workspace or desktop of your computer.

DEFINITIONS OF BASIC COMPUTER COMPONENTS (PAGE 3)

- EMS CARD:** Expanded Memory card; adds extra RAM memory to computers that have no more expansion capacity on the motherboard.
- NETWORK INTERFACE CARD (NIC):** Connects your computer to a network of other computers.
- MS-DOS (OR PC-DOS):** The Disk Operating System; controls all of the disk drives as related to the computer.
- APPLICATIONS:** Any programs you use in the DOS environment (Lotus, WordPerfect, etc.)
- NETWORK OPERATING SYSTEM:** Like DOS, but allows the computer and you to use software on the network hard drives.
- CD-ROM DRIVE:** Reads data from Compact Discs (CDs); up to 688MB of data can be stored on 1 CD; READ-ONLY technology - generally, you can't write to a Compact Disc.
- SOUND CARD:** Provides stereo sound from your PC, through EXTERNAL speakers.

If you wish to find additional information about the different types of hardware inside your PC, refer to the Mueller textbook.

You can also use the hypertext program called UPGRADE.EXE, which is found in the workbook that came with the Mueller textbook. It contains information about all of the hardware components defined above, in an easy-to-use automated format. Refer to the Workbook for details on how to install and use the hypertext program.

You will need to know the definitions listed on these pages in order to answer specific questions on the first exam.

NOTES

WHAT IS POST, AND WHAT DOES IT DO FOR YOU?

POST is the Power-On Self Test which your computer performs when you turn it on and/or re-boot. Below is listed what POST checks:

100 Series: Motherboard checks

200 Series: Memory chip checks

300 Series: Keyboard checks

400 Series: Monochrome monitor checks

500 Series: Color monitor (CGA) checks

600 Series: Floppy Disk Drive checks

700 Series: Math Co-processor checks

900-1000 Series: Parallel Port Adapter Checks

1100-1200 Series: Serial Port Adapter Checks

1300 Series: Game Port Adapter Checks

1400 Series: Printer Checks

1700 Series: Hard Disk/Disk Controller Checks

You may also hear a series of beeps when you turn on the computer, IF SOMETHING IS WRONG. Normally, you hear only one short beep. Here is what the DOS Audio Error codes mean:

No display, no beeps: No Power

Continuous beep: Power supply failure

Repeating short beeps: Power supply failure

One long and two short beeps: Display adapter (video card) failure

One long and three short beeps: Display adapter (video card) failure

See the Mueller textbook for a more extensive list of PC error codes.

You will want to memorize this page in preparation for the tests in these courses.

NOTES

STEPS IN THE BOOT PROCESS

- 1) When the PC is powered up, the CPU resets itself, clears out any left-over data, and looks to an address in memory called F000 ...that is where the ROM BIOS chip is located. The ROM BIOS chip is what makes your PC IBM-compatible. When the CPU finds the ROM BIOS chip, it invokes the first program found in memory, which is POST: the Power-On Self Test. This self-test ensures that all of your components are operating properly BEFORE you begin working with the computer.
- 2) As POST checks your computer, it looks to a record of data stored in CMOS RAM that tells what kinds of components are in your PC. Specifically, it records what type of video card, floppy drives, hard disk, memory and so forth are contained in your PC. POST will test your computer based on what it believes is in your PC ... if the information is missing or incorrect, the PC may not be able to recognize or use certain components in your system. It's important to keep a record of what specifically is inside your computer, and that you have a record of what is written into CMOS RAM.
- 3) If POST finds that there is a problem with your PC, it will display an error message or an error code that tells specifically what is wrong with the unit. If it cannot display such a message, it will beep in a specific pattern that indicates exactly what is wrong. If everything is OK with the computer, POST will sound one beep to the system speaker, indicating that all of the tests passed normally with no errors.
- 4) The ROM BIOS will then look to the boot sector of either a floppy disk or a hard disk to find IO.SYS, the boot loader program of your operating system. If it can't find this file in that location, the PC will give an error message to the screen. When it does find the file, it loads the file into RAM, and then your operating system takes charge of the computer.
- 5) MSDOS.SYS then loads into memory (for both DOS and Win95). It contains the bulk of the operating system code that makes DOS or Win95 operate. Specifically, it lets you manage file names, execute programs, and allows hardware and software to manage interrupt (IRQ) requests.
- 6) Then, CONFIG.SYS configures your system for the specific kinds of hardware that are contained in the system. Lines like DEVICEHIGH=C:\MOUSE.SYS tell DOS where to find the mouse driver, and where to load it into memory. DOS and Win95 both use a CONFIG.SYS file.
- 7) Then, COMMAND.COM loads into memory. It is your command interpreter, and it allows you to input commands at a DOS prompt. DOS and Win95 both have COMMAND.COM as one of the system files.
- 8) Finally, AUTOEXEC.BAT loads into memory any programs you wish to run every time you start or reboot your computer. Usually at the end of the AUTOEXEC.BAT file, the PC will call up Windows, or a menu program, or will allow you to log into a network, so that you can begin working with the computer as you would wish. Both DOS and Win95 use AUTOEXEC.BAT.

If any of these steps do not occur in a normal manner, your PC may not boot up as you would expect. Knowing the steps in the boot process will help you when trouble-shooting or analyzing problems with your PC.

GENERAL GUIDELINES FOR REPAIRING COMPUTERS

Use these following ten rules when repairing or trouble-shooting a computer:

- 1) **Gather together your toolkit and any necessary documentation for that specific computer.** You may also want to have the Mueller textbook available ... it is a good resource for technical specifications and system disassembly guidelines.
- 2) **Check for power FIRST, before doing anything else.** 10 - 15 percent of all trouble calls are for nothing more than a popped circuit breaker or a loose plug. Check these things BEFORE doing anything else.
- 3) **Check your external connections to the computer.** Specifically, check the mouse, keyboard, monitor, modem and/or printer cables, making sure that all are secure and in the right sockets.
- 4) **If the computer is still malfunctioning, go ahead then and open the case.** Check to see that all of the cards are fully pressed down into the bus connections, that any socketed chips are fully pressed into their sockets, and that all cable connections are fully attached. Make sure that the drive cables are attached so that the colored stripe on the cable is positioned next to pin 1 on the connector.
- 5) **Clean any dust or foreign material out of the case while it is open.** Dust can cause overheating problems and electrical shorts. Sometimes, insects will nest inside the case as well. All of this needs to be cleaned out before you close up the case. Use compressed air and non-conductive materials to clean out the inside of the case. Take precautions to avoid inhaling excess dust, and consider using protective eyewear if necessary.
- 6) **Try to boot the computer to the hard drive, or to a bootable floppy disk if necessary.** Sometimes the hard disk will become corrupted by a user, or by a virus. If you can't access the hard drive directly, have a bootable floppy disk available. This bootable floppy disk should have a copy of your CONFIG.SYS and AUTOEXEC.BAT files on it, as well as any drivers necessary for devices like your sound card, CD-ROM drive, and mouse. Have a good disk diagnostic program available (SCANDISK, Norton Utilities), and a good virus checking program as well. If your data is severely damaged, you may need to wipe the disk and reload the data from original or backup disks.
- 7) **Check the CMOS setup program, and correct any configuration problems.** If the information in CMOS RAM about your PC's configuration has been changed, or if the battery has died, your computer will not boot correctly, or it will not recognize certain components. Keep a copy of your setup program information handy, so that if something changes, you can correct the problem. Replacement CMOS batteries are about \$15.00, and are readily available. Such batteries should last about 2-3 years.
- 8) **Look for unwelcome changes.** Someone may have turned the brightness down on a monitor, or the LAN staff may have changed your PC's configuration without your knowledge (or approval), or an installation program may have corrupted something in your software. Look for recent changes in your system's operation. You may need to run an uninstaller program to remedy software-related problems.
- 9) **Isolate the problem to one piece of hardware, or one software package.** The problem you are encountering may occur only in one software package, which means the problem has a very limited scope. If the problem occurs in all programs, then it's a systemic problem. Refer to software and operating system manuals as needed, and have the original software disks available, in case a driver needs to be reloaded. If the system just won't fire up, remove all non-essential components, and see if you can cause the problem to re-appear by re-installing components one-at-a-time. This process is usually quite helpful in trouble-shooting even the most stubborn problems.
- 10) **When all else fails, read the manual.** There may be something unique about your computer that requires special attention as directed by the manufacturer.

If, after trying all of these things, the computer still does not work, bring the computer here to the college for attention. We will put a staff member and several student trainees on the case, and do everything possible to correct the problem while you wait. There is no charge for this service, but we do ask for a \$20.00 donation to cover the expenses related to offering this service. Please contact the instructor for details on when and where to bring the computer.

NOTES

COMPUTER RECLAMATION PC REPAIR GUIDELINES

- 1) Assemble a PC, monitor, and keyboard combination as a set. Make sure you have the right components to make the unit operate correctly (i.e., correct keyboard type, correct monitor, etc.) Use the parts identification worksheet to visually identify the components in each PC.
- 2) Make sure you have the right software to test the PC; this would include:
 - IBM XT diagnostic disk
 - IBM AT diagnostic disk
 - bootable DOUBLE DENSITY floppy disk with the following DOS programs on it:
FDISK, FORMAT, SYS, CHKDSK, and DEBUG
 - a generic diagnostic/informational program like SI.EXE, SYSCHK, or some similar type of program
 - a full-blown diagnostic program such as Checkit or Microscope 2000
 - a formatted, BLANK scratch disk to be used for floppy drive write/read testing
- 3) Run any hardware-specific diagnostic software (like the IBM XT or AT diagnostic disk) first before running anything else on the PC
- 4) KEEP WORKING ON ONE PC UNTIL YOU ARE COMPLETELY FINISHED WITH IT; don't get sidetracked working on several PCs at a time.
- 5) FILL OUT AN EVALUATION SHEET FOR EVERY PC YOU WORK ON, AND TAPE THAT SHEET TO THE CASE. Fill out the sheet as accurately as possible; indicate any problems or special needs for each PC on that sheet.
- 6) If you become stuck, or can't figure out a problem, ASK FOR HELP. Someone will be there shortly to help you. Refer to the Mueller textbook or any hardware documentation you have available. It may help you find the solution yourself.
- 7) Don't randomly "jab and stab" replacement parts into a PC. Figure out what would be best to install in the PC, assemble the parts, and perform the repair. Try to replace a defective part with an exact replacement whenever possible.
- 8) If a PC is really dead, consult with someone before proceeding. Some old PCs need a LOT of work; it may be better to use a dead PC for salvage parts, rather than trying to completely resurrect it. We will try to fix every PC we receive, provided we have the parts to do the job. If the parts are unavailable, we may shelf the PC until a later date.
- 9) If you are spending more than 30 minutes on a PC, you are probably spending TOO MUCH TIME on it. If you can't get it to fire up and test in 30 minutes, either get some help, or get another PC that needs less love & attention. Make a note on the PC of what it does or doesn't do, and then move on. DON'T let yourself get too frustrated; sometimes PCs are a pain.

GOOD DIAGNOSTIC AND PREPARATION SOFTWARE

- 1) **Norton Utilities:** Analyzes and reports on computer's main systems; can repair/recover lost data from hard & floppy disks.
- 2) **Spinrite:** Analyzes and repairs media of hard disks; EXCELLENT PRODUCT.
- 3) **Speedstor or Disk Manager:** Prepares hard disk initially for use; re-formats disk when used, so use only when needed.
- 4) **IBM, Compaq, or that brand's own diagnostics:** Most companies provide diagnostic software designed for their own hardware; usually comes with their version of DOS.
- 5) **AMI or Award ROM BIOS:** Newer computers display their configuration information at boot-up; **COPY THIS INFORMATION FOR REFERENCE IN CASE PROGRAM GETS CORRUPTED.** The information is held in the computer's BIOS chip, powered by a battery. If the battery dies, ...
- 6) **AMIDIAG:** Like System Sleuth, but for motherboards with AMI BIOS chips. Program is built into newer AMI BIOS chips.
- 7) **Checkit Pro:** Checks all components in the PC, identifies problems, and it has a very good low-level disk formatting utility.
- 8) **Syschk:** A simple shareware utility available in the ENT 184 lab that gives a quick look at what's "under the hood" of your PC.
- 9) **MSD:** A program available in MS-DOS 6.0, 6.2, and Windows 3.1 that tells you what's "under the hood". Useful for identifying misconfigured equipment.
- 10) **MicroScope 2000:** Excellent diagnostic program. Also comes with a POST card, which allows testing of dead or intermittent PCs. It is expensive, however!
- 11) **QAPlus Pro:** Excellent diagnostic program. Used by many PC manufacturers and authorized repair facilities. DiagSoft, the manufacturer, provides significant discounts to students in PC repair courses; see the instructor for details.

Use the space below to list any other programs that would be helpful to you in diagnosing computer problems, repairing software or disk-based problems, or preparing a new PC for use.

NOTES

HOW TO FILL OUT A TAG ON A TESTED COMPUTER

Listed below is a sample of a tag you will fill out when testing computers in the lab:

80386DX	4MB RAM
VGA Video	2S / 1P
1.44 Floppy	320MB H.D.
Network card	Modem
DOS 6.22	
5/31/97	B. Lloyd

When testing out computers in the lab, you must tag each computer to indicate what it has under the hood. Please use the following guidelines when filling out a tag on the PC. Specifically, indicate the following kinds of things on a yellow post-it note or an evaluation sheet:

- o **Type of CPU (80286, 80386SX or DX, 8088, etc.)**
- o **How much RAM it has**
- o **Type of video card (Mono, CGA, EGA, VGA, 3270)**
- o **Number of SERIAL and PARALLEL ports on the PC**
- o **Type of floppy drive**
- o **Size of hard drive**
- o **Any other devices (network card, modem, etc.)**

Place the post-it note or evaluation sheet on the front of the PC; tape it on, if necessary. Then, date and sign your work to let others know what's been done.

Next, assemble a PC, monitor, keyboard and 2 power cords AS A SET. This ensures that the recipient of the PC gets a set of stuff that has been tested together and works. If available, use some strapping tape and tape the unit together as a set.

Finally, be sure that the PC gets to a C:\> prompt when you turn it on. The future user of the PC needs to plug it in, turn it on, and get nothing but a C:\> prompt. The PC should have a version of DOS on it, as well. If it doesn't, install it before you move on.

Use your software toolkit of evaluation programs (SYSCHK, MSD, Checkit, SYSINFO, etc.) to identify the contents of each PC, and write down the information from these programs onto the tag.

The instructor will provide you with a bootable system disk that has FDISK, FORMAT, DEBUG, and SYSCHK on it, so that you have something to start evaluating PCs with right away.

On the next page is a sample of a workable system identification worksheet. Make copies of this sheet, and use them when evaluating PCs in this course.

SYSTEM IDENTIFICATION WORKSHEET

CPU type: 8088 80286 80386SX 80386DX 80486SX 80486DX Pentium

BIOS Manufacturer: IBM Compaq AMI Award Phoenix DTK Other

Does system power-up? Yes No

Base RAM Memory: _____ Kbytes

Extended Memory: _____ Kbytes

Expanded Memory: _____ Kbytes

Is all available RAM OK? Yes No Error messages? _____

Does keyboard work? Yes No Broken keys? _____

Video adapter type: Mono CGA EGA VGA

Does video card work? Yes No

Number of floppy drives: _____

A: 5.25" HD 5.25" LD 3.5" HD 3.5" LD

B: 5.25" HD 5.25" LD 3.5" HD 3.5" LD

Do floppy drives work? Yes No Which drive(s) failed? _____

Math co-processor? Yes No

Does co-processor work? Yes No

Serial port (modem/mouse): Yes No Number of ports: _____ Are ports OK? Yes No

Parallel port (printer): Yes No Number of ports: _____ Are ports OK? Yes No

Supports a hard drive? Yes No

Is hard drive installed? Yes No _____ Megabytes

Does hard drive work? Yes No Error messages? _____

Is PC ready for use? Yes No

Evaluated by:

Date

HARD DRIVE TESTING GUIDELINES

- 1) Locate a hard drive; notice the appearance of the hard drive.
There are 5 kinds of hard drives: MFM, RLL, ESDI, IDE and SCSI hard drives.

Notice the model number and manufacturer of the drive; use that information to identify the correct specifications **and** drive type for that hard drive (i.e., cylinder & head count, sectors per track, etc.). **Refer to the Mueller textbook or some other reference book to find the correct information.**

- 2) Plug the hard drive into the appropriate test PC and turn on both the monitor and PC.
- 3) Run the ROM BIOS setup program and set the correct drive type.
- 4) Try to access the drive. If it says "Invalid drive specification", run FDISK and then the DOS FORMAT program. If that doesn't work, attempt to low-level format the drive using Disk Manager.
- 4) Use some kind of software to test the hard drive's operation; (Disk Manager, Checkit, XT or AT diagnostics, etc.)
- 5) **If the hard drive works properly, label the drive and store it in the appropriate place in the lab.**
- 6) If the hard drive does not work correctly, test and make sure that the hard drive is correctly attached to the PC.
- 7) If the hard drive is REALLY DEAD, **indicate this on the dead hard drive log and dispose of the hard drive.**
- 8) If you need assistance, let someone know.
If you're unsure of whether a hard drive is OK or not, label the hard drive as such and move on.

MONITOR TESTING GUIDELINES

- 1) Locate a monitor; notice the appearance of the monitor. **If the cable has a 9-pin connector**, it's either Monochrome, CGA, or EGA.

If there is a label with 3-colors on it, then it's probably CGA or EGA.

If the monitor has the word "Enhanced" on it, it's probably an EGA monitor.

- 2) **If the cable has a 15-pin connector**, it is a VGA monitor.
- 3) Plug the monitor into the appropriate test PC and turn on both the monitor and PC.
- 4) Use some kind of software to test the monitor's display capability (Checkit, PC Probe, SYSCHK, etc.)
- 5) **If the screen displays properly**, label the monitor and store it in the appropriate place in the lab.
- 6) If the monitor does not display correctly, test and make sure that the monitor is attached to the correct video card.
- 7) If the monitor is REALLY DEAD, **indicate this on the dead monitor log and dispose of the monitor.**
- 8) If you need assistance, let someone know.
If you're unsure of whether a monitor is OK or not, label the monitor as such and move on.

KEYBOARD TESTING GUIDELINES

- 1) Locate a keyboard; notice the appearance of the keyboard.

There are 2 kinds of keyboards: XT and AT keyboards.

XT keyboards are usually 83-key keyboards.

AT keyboards are usually 101-key keyboards.

Some keyboards have an XT/AT mode switch on the bottom.

- 2) Plug the keyboard into the appropriate test PC and turn on both the monitor and PC.
- 3) Use some kind of software to test the keyboard's operation (Checkit, XT or AT diagnostics, etc.)
- 4) **If the keyboard works properly (that means ALL the keys work), label the keyboard and store it in the appropriate place in the lab.**
- 5) If the keyboard does not work correctly, test and make sure that the keyboard is attached to the correct PC.
- 6) If the keyboard is REALLY DEAD, **indicate this on the dead keyboard log and dispose of the keyboard.**
- 7) If you need assistance, let someone know.
If you're unsure of whether a keyboard is OK or not, label the keyboard as such and move on.

PARTS IDENTIFICATION WORKSHEET

How can I tell what kind of adapter card I have in my hand? You must first look for clues ...

<u>If it has a 9-pin or 25-pin port with pins showing:</u>	You have a serial port on the card.
<u>If it has a 25-socket port with NO pins showing:</u>	You have a parallel port on the card.
<u>If it has a small 9-socket port with NO pins showing:</u>	You have a Mono, CGA, or EGA video card.
<u>If it has a small 9-socket port with NO pins showing and one small RF output socket near the port:</u>	You have a CGA video card.
<u>If it has a small 9-socket port with NO pins showing and two small RF output sockets near the port:</u>	You have an EGA video card.
<u>If it has a small 15-socket port with NO pins showing:</u>	You have a VGA video card.
<u>If it has a barrel connector:</u>	You have a network card.
<u>If it has two telephone jacks on the back:</u>	You have an internal modem.
<u>If it has a larger 15-socket port with NO pins showing:</u>	You have a game port on the card.
<u>If it has a ROUND socketed port:</u>	You have a PS/2 mouse port or PS/2 keyboard port (ports are identical)
<u>If it has a 37-socket port with NO pins showing and 1 card-edge connector on the card:</u>	You have an XT-class floppy drive controller card with an external floppy drive port.
<u>If it has 3 sets of stubs (1 set of 34, and 2 sets of 20 pin stubs:</u>	You have an XT-class hard disk controller.
<u>If it has 4 sets of stubs (2 sets of 34, and 2 sets of 20 pin stubs:</u>	You have an AT-class hard disk/floppy disk controller.
<u>If it has 2 sets of stubs (1 set of 34, and 1 set of 40 pin stubs:</u>	You have an AT-class floppy disk controller with an IDE interface port.
<u>If it has several rows of socketed chips, with 9 chips in each row:</u>	You have a memory card.
<u>If it has several rows of socketed chips, a 25-pin port with pins showing, a small battery, and 1 - 2 sets of stubs on the card:</u>	You have a multifunction card.

You may wish to memorize this list: your knowledge of this information will be tested in a parts identification quiz during the course.

HOW TO IDENTIFY A MOTHERBOARD

When examining a motherboard, look for the following clues to properly identify the board:

- 1) Look for the CPU chip (i.e., 8088, 80286, 80386, etc.). This is the biggest single clue.
- 2) Look at the bus connectors: if there are only 8-bit connectors, it is an XT-class (8088 based) motherboard. If there are 8-bit and 16-bit bus connectors, it is an AT-class motherboard (at least an 80286-based motherboard). If there are light-brown colored bus connectors that look sort of like 16-bit connectors, it's probably an EISA bus motherboard (with an 80386DX or higher CPU).

If there is a small brown connector at the end of a 16-bit bus connector, that would be a VESA Local-bus (32-bit) connector. If there is a small white bus connector on the board, that would be a PCI (32/64-bit) local bus connector. These are found on 80486 and Pentium-class motherboards.

- 3) Also look for signs of conservative design; is the power supply connector standard, is the keyboard plug standard, etc. Non-standard motherboards have options like video cards or drive controllers built into the motherboard, or have non-standard connectors. This will be an issue for upgrading the PC.
- 4) Look for proprietary connections to the motherboard, like a special 32-bit memory card that only Everex '386 computers use that provides room for more memory on the motherboard. Many manufacturers use proprietary devices on their motherboards that won't work on motherboards built by other companies.

NOTES

TIPS TO REMEMBER WHEN RUNNING A CMOS SETUP PROGRAM

Getting In to the Setup Program

Pressing the Delete key gets you into the setup program for AMI and Award BIOS. Phoenix BIOS uses the F1 key, or F2, or Ctrl-Alt-Esc, or Ctrl-Alt-S. Look at the screen for a message explaining what keystroke you should use to enter the setup program.

Standard Setup

Here is where you will set date, time, floppy/hard drive types, video type, and memory size. Be sure you have the hard drive specifications (the number of cylinders, heads, and sectors per track) to enter into the setup program.

Use the left/right arrow keys to move from field to field on the screen. Use the PageUp/PageDown keys, or the plus/minus keys to modify the values in each field. These rules apply in all setup program screens.

Advanced/Extended Setup

The advanced setup lets you set the boot sequence, or perform a full or partial memory test, or enable/disable shadow RAM, or enable/disable cache memory, or enable features like block mode and LBA mode, or to set wait states on the CPU or memory. If you don't know how to set up these features, there should be a keystroke you can press that reloads the factory default settings (look at the bottom of the screen for details). You can try modifying different settings to get better performance on your PC. There is no magic formula ... trial and error works best.

Integrated Peripherals

Some motherboards have the drive interfaces and I/O ports built into the motherboard. This option lets you enable or disable any of these features.

IDE HDD Auto-Detect

This feature allows you to read the drive parameters from the IDE hard drive's diagnostic cylinder into the setup program. Use this feature to input the drive specifications, and to assure that the drive is connected and functioning properly.

Green (Sleep) Features

This option allows you to enable features that shut down certain PC components after a set period of inactivity. You can select which devices get powered-down and when in this screen. Use of green features is NOT recommended for PCs on a network, since a "sleeping" PC may be viewed as shut down by the network file server.

Exiting the Setup Program

You can either save the values you have just changed, or you can exit the program without saving the changes. Both options should be apparent to you on the main setup program screen.

AMI WINBIOS Setup

The newest version of AMI's BIOS looks like Windows 3.1. Use the same rules as you would in Windows to point, click, and change values on the screen.

BASIC DOS COMMANDS NEEDED FOR THIS COURSE

- 1) DIR - Gives a directory of the disk and/or subdirectory you are currently in.
DIR/W - Gives the same as above, but WIDE across the screen.
DIR/P - Gives a directory of the disk and/or subdirectory 1 page at a time.
- 2) FDISK - Used to create, erase, or view a partition table on a hard disk.
FDISK/MBR - Re-writes Master Boot Record, eliminating most boot-sector viruses.
- 3) FORMAT C: /S /V - Formats hard disk, making it bootable.
FORMAT A: /F:360 /U - Formats floppy disk to 360k in a 5.25" high density drive.
FORMAT B: /F:720 /U - Formats floppy disk to 720k in a 3.5" high density drive.
FORMAT A: /Q - Performs a quick format of a previously-formatted disk.
- 4) CHKDSK /F - Checks your hard disk for free space, and eliminates lost clusters of data.
- 5) MEM - Shows how much **conventional, reserved, extended and expanded** memory is used.
- 6) MD (or MKDIR) - Makes a sub-directory on a floppy or hard disk.
- 7) CD - Change directory.
CD\ - Change directory back to the root directory of a floppy or hard disk.
- 8) RD (or RMDIR) - Deletes a sub-directory on a floppy or hard disk; directory **MUST** be empty (without files or other directories) before deleting the directory.
- 9) COPY A:FILENAME.EXT C:\ - Copies a file from a floppy disk to a hard disk.
COPY A:*. * C:\ - Copies all files from a floppy disk (or sub-directory) to a hard disk.
COPY C:\DIRNAME*. * A: - Copies all files from a hard disk sub-directory to a floppy disk.
- 10) DEL FILENAME.EXT - Deletes a DOS file.
DEL *. * - Deletes all DOS files in a disk or directory.
DEL *.TXT - Deletes all DOS files in a disk or directory with the extension TXT.
- 11) SETUP (or INSTALL) - Program name used to install/configure software programs.
Also the name of a disk-based CMOS setup program used on PCs that do not have a setup program built into the System BIOS.
- 12) CONFIG.SYS - User-developed file used by DOS to configure your PC's hardware.
- 13) AUTOEXEC.BAT - User-developed file used by DOS to run your standard startup procedures.
- 14) MSD - Gives the hardware configuration of your PC (DOS 6.0 or above).
- 15) MSAV - Checks your hard disk or floppy disk for viruses (DOS 6.0 and above).
- 16) DEFRAG - Re-orders files on a hard disk, re-assembling fragmented files and optimizing hard disk performance.

STEPS TO PREPARING A HARD DISK FOR USE

1. **You must first perform a "low-level" format on the hard disk, so that the hard disk controller can read the physical media.** The low-level format places the initial magnetic markings on the disk, so that data can be accessed in a sequential fashion by the hard disk controller. You need a special program (like Disk Manager, Speedstor, Checkit, Disk Technician, etc.) to perform the low-level format. XT-class hard disk controllers usually have a low-level format program built into the ROM BIOS of the controller. AT-class controllers usually do NOT have such a program built into the hardware.

When performing the low-level format, you will need to know some technical specifications of the disk. Specifically, how many heads and cylinders the drive has. The drive size is measured by how many read/write heads the drive has, and how many physical cylinders (concentric circles) are found on the disk. You may also need to know the write precompensation cylinder, the reduced write cylinder, and the landing zone where the hard disk's heads are parked at shut-down. You will also need to know at what rate the hard drive controller should interleave the disk; interleave is the rate at which data is laid down on the hard disk. All of the disk specifications can be found in your drive's manual, or even in the Upgrading and Repairing PCs book by Scott Mueller.

If you have an IDE hard disk, you will NOT have to low-level format the disk; the low-level formatting is done at the factory for you. Normally, you will never perform a low-level format on an IDE drive, and some IDE drives prevent low-level formatting after it leaves the factory. Many SCSI disks now come already low-level formatted from the factory.

2. **Second, you must use the DOS program called FDISK to partition the disk.** FDISK partitions the disk; in other words, it tells DOS "How big is this hard disk?". For example; you could take a 100 MB hard disk and use it as one single drive (C:), or divide it into 2 50 MB drives (C: and D:), or into three 33 MB drives (C:, D:, and E:), or some other fashion as you choose. FDISK lets you divide your physical disk into several logical drives, or just partition it into one single drive.
3. **Finally, you must use the DOS program called FORMAT, so that DOS can store data onto the disk.** After you have low-levelled the disk and run FDISK on it, you will enter the following command from the A:\ prompt: **FORMAT C: /S/V**. This command formats the disk, puts the DOS system files on it (so that it is bootable), and the /V switch allows you to put your name on the disk.

Once you have done these three things, you will have a usable hard disk in your computer.

For more detail on this subject, refer to the Mueller textbook.

NOTES

WHAT ISSUES WILL BE COVERED IN THE FIRST TEST

- o Know the definitions of the major types of hardware and devices inside a PC (i.e., motherboard, video card, serial port, etc.); refer to the definitions in the course manual, and the textbook.
- o Know the differences between hardware types, and which is better (i.e., VGA is better than CGA, an 80486DX is better than an 80286, etc.) Understand the terms dot pitch and interlacing. Refer to the textbook and class discussion course manual.
- o Understand what a disk operating system and a network operating system is, as well as what an application is; refer to the definitions in the Course manual.
- o Know the 4 things that can be affected by a computer virus (FAT, partition table, boot sector, .COM and .EXE files), and 3 things a good virus protection program should do (scan, clean, protect). Refer to your class discussion notes.
- o Know the IBM PC POST error codes (i.e., 200 series = memory error, 600 series = floppy drive error, etc.) Know the audio beep codes (1 beep means system is OK, 1 long/2 short beeps means video card failure, etc.). Refer to the list in the Course manual, and the textbook.
- o Know the 3 steps to preparing a hard disk for use in a PC (low-level format, run DOS FDISK, run DOS FORMAT); understand how drive is measured by the cylinder and head count. Know what a partition table is. Refer to the sheet in the Course manual on Hard disk preparation, and the textbook.
- o Understand what a Setup program is for an AT-class PC, how POST uses info in the CMOS chips to test your PC, and how to run the Setup program to inform the PC of the specific components in the system. Refer to your class discussion notes, and the textbook.
- o Understand what a surge suppressor is, and what the term clamping voltage means. Refer to the textbook and class discussion notes.
- o Know how often you should back up your important data: weekly!

SECTION 2: FOCUSING ON THE DETAILS

In the second part of the course, we will focus on learning essential details needed to understand how the PC's hardware operates, and how one can configure and test specific components for proper operation. You will learn about the following kinds of things:

- o How DOS uses memory, and how memory is subdivided into 4 main regions
- o What a typical CONFIG.SYS and AUTOEXEC.BAT file looks like
- o How your PC supports specific serial and parallel ports by using standard IRQs and port addresses
- o How to install a motherboard and build a computer system from scratch
- o How to install multimedia components like sound cards and CD-ROM drives
- o How to buy and support computer systems, and what makes a PC conservatively designed
- o What is a network, what are servers, and how do the major types of networks differ?
- o How do networks pass data from one place to another?
- o How do I install a network card in a PC, and how to I install the Netware client software?
- o Can viruses affect a network, and how?
- o What programs are needed to log into a Novell network?
- o What are the main reasons networked PCs fail, excluding a file server crash?
- o What are the main Novell Netware (version 3.x) utility programs?
- o How do I use the PKZIP/PKUNZIP utility?
- o How do I find evaluation and diagnostic software on the class resource PCs?

At the end of section two, there is a list of all of the major questions that will be asked on the first test. Use this information as a checklist to prepare you for the first test. Be sure to do the required course readings in the textbook as well ... it will also help you prepare for the examinations in the course.

Memory Usage in the DOS Environment

A	<p>This area of memory (Segment A) is referred to as the Extended memory area. It is the area of memory ABOVE 1 MB.</p> <p>This area of memory is found in AT-class computers, <u>including</u> 286, 386, 486 and Pentium computers. It is NOT found in XT-class (8088) computers.</p> <p>The DOS program HIMEM.SYS must be loaded into memory in order to access and use extended memory. The amount of extended memory in your PC depends on the way your motherboard is designed; check your hardware manual first.</p>
B	<p>This area of memory (Segment B) is referred to as the Reserved memory area. It is the area of memory between 640 KB and 1 MB. There is a memory block here that is 64K in size which is used by expanded memory drivers for memory swapping; it is called the EMS window. The rest of the area is used by your video card, ROM BIOS, and other hardware devices.</p>
C	<p>This area of memory (Segment C) is referred to as the DOS/Conventional memory area. This area of memory begins at 0K and ends at 640KB. All of your DOS programs run in this area of memory primarily. Windows programs use this area first also, and then they will use extended or expanded memory as well.</p> <p>MS-DOS is made up of three main program files, and two other files which you create. These files are listed below in the order in which they load into memory:</p> <ul style="list-style-type: none">a) IO.SYSb) MSDOS.SYSc) CONFIG.SYS User-definedd) COMMAND.COMe) AUTOEXEC.BAT User-defined

For more detail on this subject, refer to the Mueller textbook.

You will want to memorize this page in preparation for the tests in this course.

A TYPICAL AUTOEXEC.BAT FILE LOOKS LIKE . . .

```
@ECHO OFF
CLS
PROMPT $P$G
PATH=C:\;C:\DOS;C:\BATCH;C:\WP51;C:\123;
LH GRAPHICS
SET GRAPHICS=VGA
LH C:\DOS\MSCDEX.EXE /D:MSCD001 /M:15
WIN **
```

@ECHO OFF informs the batch file NOT to display any of the following commands to the screen. CLS clears the screen. PROMPT \$P\$G modifies the DOS prompt to show your current directory, followed by the "greater than" symbol. The PATH specifies the directories DOS should look in to find your programs. GRAPHICS allows your printer to print EXACTLY what is on your video screen; the SET command tells GRAPHICS what kind of monitor you have. The LH before GRAPHICS loads the file into extended memory. The program MSCDEX.EXE loads the DOS driver for your CD-ROM drive.

** The last line(s) of your AUTOEXEC.BAT file will differ somewhat, depending on the user. Some users will have WIN as their last line, to invoke Windows. Network users will have listed the files needed to access the network and then LOGIN. Each user will have differing requirements and software to meet his/her needs.

A TYPICAL CONFIG.SYS FILE LOOKS LIKE . . .

```
DEVICE=C:\DOS\SETVER.EXE
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\EMM386.EXE NOEMS
BUFFERS=20
FILES=50
DOS=HIGH, UMB
DEVICEHIGH=C:\DOS\ANSI.SYS
DEVICEHIGH=C:\MOUSE\MOUSE.SYS
DEVICEHIGH=C:\CDROM\CD_ROM.SYS /D:MSCD001 /P:170,15
SHELL=C:\COMMAND.COM /P/E:512
LASTDRIVE=C
```

The SHELL statement specifies explicitly the name of the command processor. SETVER.EXE assists older DOS programs that are incompatible with DOS 5.0 or 6.0. HIMEM.SYS is your extended memory manager. BUFFERS are 512-byte blocks held in memory; when all the buffers are filled, then DOS writes out to a floppy or hard disk. FILES specifies how many files can remain loaded into and active in memory. DOS=HIGH, UMB tells DOS to load MSDOS.SYS into the Upper Memory Area in the PC's hardware. DEVICEHIGH loads device driver files into extended memory, freeing up the conventional memory area. LASTDRIVE explicitly tells DOS what the last drive in the PC is. ANSI.SYS is a DOS driver software that allows "extended ASCII characters" (like hearts, diamonds, box-drawing characters, etc.) to be displayed to the screen. MOUSE.SYS loads the DOS mouse driver software, and the CD_ROM.SYS driver lets your PC recognize your CD-ROM drive.

IRQ & PORT ADDRESS REFERENCE SHEET FOR PARALLEL & SERIAL PORTS

Interrupt levels allow your PC to Prioritize multiple accesses to the CPU.

DMA channels are pathways in your PC that allow data to travel from point A to point B.

Port addresses are like mailboxes, to which information is both picked up and dropped off.

If any of these settings are incorrect, your device (sound card, CD-ROM drive, fax modem) will NOT function properly.

Here is a list of the standard interrupt levels and port addresses for parallel and serial ports:

TYPE OF PORT	IRQ NUMBER	PORT ADDRESS
SERIAL PORTS		
COM 1:	IRQ 4	3F8 H
COM 2:	IRQ 3	2F8 H
COM 3:	IRQ 4	3E8 H
COM 4:	IRQ 3	2E8 H
PARALLEL PORTS		
LPT 1:	IRQ 7	3BC H
LPT 2:	IRQ 5	378 H
LPT 3:	IRQ 7, or 5, or NONE	278 H

COM 1: and COM 3: share IRQ 4, and COM 2: and COM 4: share IRQ 3. However, these COM ports each use unique port addresses, to make sure that each port is uniquely identified.

LPT 3: can share IRQ 7 or 5, but it MUST have a port address that is unique from LPT 1: or LPT 2:.. In some systems LPT 3: will operate with no IRQ level; your software package (i.e., WordPerfect 5.1) will need to know how to directly address the port address being used for LPT 3:..

I have seen many computers that have LPT: ports with slightly different port addresses than shown above, yet the LPT: ports work just fine. Here is an alternate set of port addresses for LPT: ports only.

TYPE OF PORT	IRQ NUMBER	PORT ADDRESS
PARALLEL PORTS		
LPT 1:	IRQ 7	378 H
LPT 2:	IRQ 5	278 H
LPT 3:	IRQ 7, or 5, or NONE	3BC H

Please note that the IRQ settings for these LPT: ports are the same in both charts; only the port addresses are different. Refer to the Mueller textbook for further information.

STEPS TO BRINGING A NEW PC TO LIFE

Mount the motherboard and apply power first ...

When installing the motherboard to the case, use the proper guidelines for mounting the motherboard to the chassis. Then, attach the power supply connections and the PC speaker ONLY: no RAM, no video card, etc. Power the system up and listen for **3 low-toned beeps**. If you hear these beeps, the motherboard is OK (it powers up and finds the CPU). If you hear no beeps, check your power and speaker connections, ensure the CPU is installed OK, and make sure the board is not grounding out. If this does not resolve the problem, replace the motherboard.

Then, install the memory ...

Install the memory to the motherboard; be sure to put it in the right SIMM sockets (look for the designation "BANK 0"). You may need to set some jumpers on the board to get the memory to be recognized properly; also, many boards require more than one SIMM on the board at a time. Once you install the memory, power up the system and listen for a **different** set of beeps (usually 2 high short beeps and 7 or 8 lower-toned short beeps). These beeps are telling you that the video card cannot be found (mainly because it hasn't been installed yet!). If you get such a beep sequence, you can continue and install the video card. If you still get the three low beeps as before, check and re-install the memory. If the memory is installed correctly and you continue to get only the three low beeps, replace the memory.

Then, install the video card and monitor ...

When you have the motherboard and memory installed correctly, then you can install the video card into the system and attach a monitor. When properly installed, you should be able to see the computer going through POST on the screen. If not, then you may have a problem with the video card (check for 1 long and 3 short beeps) or the monitor. If the system hangs after installing the video card, the video card is probably defective, or not installed correctly. If you see no video on the screen after checking the video card, then either the monitor is off (or without power), or the monitor is defective.

Then, install the drives and drive controllers ...

Once you have motherboard, RAM, and video installed properly, attach the drives to the drive controller/interface. Be sure to get the cable stripes attached next to pin 1 on the interface connectors. Also, be sure to attach power cables to the drives. You may now also install the keyboard.

Then, power up and run the CMOS Setup program on the BIOS ...

When the drives are fully connected, then run the Setup program. Watch the screen to tell you what keystrokes to use in order to enter the Setup program. Use the "Auto-detect" feature to detect the IDE-class hard drive(s) in your system. If the auto-detect feature does NOT find the hard drive(s), then power down and re-check your connections. If the computer still cannot find the hard drives (or floppy drives), then either your cables are bad, the controller is bad, the power to the drives is bad, or the drives themselves are bad.

If the drives are recognized by the auto-detect feature, save the setup information and reboot. You can now begin loading DOS onto the PC, and begin software loading as well.

Let the instructor know if you have any questions about this procedure.

IMPORTANT THINGS TO REMEMBER WHEN INSTALLING A MOTHERBOARD

Plastic Standoffs

When you install a motherboard, DON'T screw it directly down to the chassis of the case!

You mount it to the case, using the little **plastic standoffs** provided when you buy the case and power supply (if you don't have any, let me know, and I'll get you some). These standoffs keep the board from shorting out against the case, and they provide enough stability to the board so that you can push cards into the bus connections. If you don't install the standoffs correctly, any of the following things could happen:

- o the board touches against the case and shorts out, potentially damaging the motherboard and other installed components
- o you crack the motherboard when installing the cards into the bus connections
- o you allow the board to warp into an unnatural position by leaving it unsupported

The plastic standoffs have 2 ends to them: one that snaps into the holes on the motherboard, and one end that goes into little slots or grooves on the case. The idea is to have the bottom part of the standoffs slide into the pre-made holes on the case.

If you find that there is a need for a plastic standoff, BUT there is no hole on the case for it, **cut the bottom off of the standoff**, and let the standoff rest on the chassis. This will ensure that the motherboard doesn't touch against the case.

Grounding Points

On most motherboards, there are CERTAIN holes that are designed as **grounding points**, that are intended for you to screw the motherboard down to a metal standoff on the case. *These grounding point holes usually have a silvery-appearance around them.* They are designed to take either a metal screw or a plastic standoff when mounting the board. When using a new case, you will find a bronze metal standoff (or two) in the package of screws that comes with the case. You will usually mount ONLY ONE of these bronze standoffs on the case, and mount the motherboard with a metal screw AT THAT ONE POINT ONLY.

If you mount a metal standoff and a screw into a hole that is NOT a grounding point, you can short out the motherboard and PERMANENTLY damage it. Be very careful to notice the appearance of the holes in the motherboard, and never screw the board down to a hole that is not a grounding point.

Power Supply Connections

There are two power supply connections that connect to the motherboard. Each connector has a pair of black wires on them. The key in attaching these connectors is this: **put the black wires together so that there are 4 black wires next to each other.** This ensures that the power connections are installed correctly. Putting them on incorrectly can subject the motherboard to abnormal voltages and permanently damage the board.

When installing the power supply connectors to the motherboard, **swing them in at an angle, and then gently press them down onto the board.** The connectors have a design that forces you to hook them into the board, and then press them down. Some power supplies have these hook connectors cut off, allowing you to press the supply lines directly onto the board. In either event, be careful when installing power supply lines to the connectors on the motherboard.

IMPORTANT THINGS TO REMEMBER WHEN INSTALLING A MOTHERBOARD (PAGE 2)

If possible, use a dead motherboard and power supply to practice installing power connector; also, practice installing a board to the case with dead components.

NOTES

HOW TO INSTALL A CD-ROM DRIVE IN YOUR PC

- 1) Install the SCSI host adapter (OR CD-ROM interface card) in a free bus connection on your PC. Note that some older CD-ROM drives (like Mitsumi and Creative Labs) are NOT SCSI, but have their own proprietary interface.

MOST non-SCSI CD-ROM drives available today use the ATAPI interface, which is another name for the IDE interface used in most hard drives. With these drives, you can plug your CD-ROM drive into the same cable as your hard drive.

- 2) Set the SCSI ID jumpers on your CD-ROM drive (if it's a SCSI drive), THEN install it into your PC's case; usually you will set the drive to ID #0, or #1 (depending on if you have another SCSI device in your PC already). Remember to attach the SCSI data cable and power cable.

If you have a non-SCSI CD-ROM drive (a proprietary interface), set the IRQ, DMA channel and port address jumpers on the interface card to a setting where the interface will not conflict with other devices in your PC.

Standard interrupt levels for a CD-ROM device are IRQ 10 or 11; standard DMA channel assignments are DMA 5, 6 or 7; standard port addresses are either 300 Hex or 340 Hex.

If you have an IDE CD-ROM drive, plug the drive into the primary (or secondary) IDE interface cable. Be sure to orient the cable so the colored stripe is closest to pin 1 on the drive's cable connector. Set the master/slave jumpers on the CD-ROM drive to the slave setting; you may or may not need to set the PC's hard drive to master, though.

Finally, connect the audio cable from the CD-ROM drive to the drive interface OR your sound card.

- 3) Run the installation program that came with your CD-ROM drive; it will edit your CONFIG.SYS file to load the driver program needed to recognize the drive **at the correct IRQ level, DMA channel and port address**. Also, the installation program will load a program from your AUTOEXEC.BAT file called **MSCDEX.EXE**; this is the MS-DOS extension driver for CD-ROM drives that allows MS-DOS to use the drive.
- 4) Re-boot your PC; it should now recognize your drive.
- 5) Once the drive is working, get a print-out of your CONFIG.SYS file for safe-keeping. Many software installation programs for CD-ROM programs may change your CONFIG.SYS file, and accidentally render your drive inoperative! Have that copy hidden somewhere for safe-keeping.
- 6) You may now replace the lid on your PC's case: the drive is ready for use.
- 7) Be sure to keep your documentation handy; strange things often occur when using CD-ROM drives and their associated software.

NOTES

HOW TO INSTALL A SOUND CARD IN YOUR PC

- 1) Run a program like MSD.EXE or Checkit to find out what free interrupts you have in your PC BEFORE you install the sound card.
- 2) Read the manual for the sound card to see what interrupt level, DMA channel and port addresses you can use for the card; then set the IRQ jumpers (if necessary) for the sound card. (NOTE: some sound cards have their jumpers set by software, rather than by moving a physical jumper or switch; see your manual for details.) Most cards comes factory configured the "proper way".

Standard IRQ settings are IRQ 7 or 5; standard DMA channels are DMA 1 AND 5 (a sound card will use 2 DMA channels); standard port addresses are 220 Hex, and also 330 Hex for the MIDI interface found on most sound cards.

- 3) NOW install the sound card.
- 4) Run your installation program for the card to load the software drivers that will enable the card to operate.
- 5) Attach your speakers to the sound card. Normally, the sound card will disable the stock speaker inside your PC; therefore, you will need external speakers for your sound card. These speakers cost anywhere between \$20 and \$50.
- 6) Run the test program that comes with your sound card; make sure it sounds right.
- 7) If the sound is scratchy, you may need to modify the DEVICE= statement in your CONFIG.SYS file to deal with this problem; consult your manual for details. You may also find you have a problem with one of the DMA chips (there are 2 in an AT-class PC) on your motherboard.
- 8) Make sure your sound card and your CD-ROM drive work together well; some sound cards conflict with each other and will cause one or both to malfunction. If this is the case, contact the manufacturer for assistance. You may need to replace the card with a different brand if the problem can't be solved.
- 9) Test the sound card in Windows; the installation program should have created a program group that has audio utilities, and it should have modified Windows to play sounds. You should also be able to play audio CDs through your sound card (and CD-ROM drive) while in Windows.

NOTES

WHAT MAKES A MULTIMEDIA PC?

Several things are necessary to make a typical PC into a Multimedia class of PC:

- 1) At least an 80386DX CPU, preferably an 80486DX CPU.
- 2) An SVGA class video card, usually a high-performance card;
- 3) A CD-ROM drive, at least a double-speed drive that is XA-ready, Kodak Photo CD ready, and has at least a 300KB sustained data transfer rate;
- 4) A sound card of some kind, one that is Sound Blaster/AdLib compatible (I STRONGLY recommend a true Creative Labs Sound Blaster card - no clones);
- 5) Windows 3.1, OS/2, Windows NT, or some operating system/environment that will access and use CD-ROM drives and configure for sound cards.
- 6) In a DOS environment, you must load the DOS program MSCDEX.EXE, which enables MS-DOS to utilize a CD-ROM.
- 7) In a DOS environment, you must load a driver program for your sound card so that it will work with DOS. Some sound cards have drivers that work EXCLUSIVELY with Windows, and NOT in DOS.
- 8) A mouse, to make the graphical environment of Windows or OS/2 easier to use.

NOTES

TIPS TO REMEMBER WHEN BUYING A PERSONAL COMPUTER

- 1) Know what you want BEFORE you go looking or buying. Many people get convinced they need a more expensive or "powerful" computer, when in fact they do not. People who do word processing for a living do not need a Pentium-based computer necessarily; an 80486DX-based PC will do just fine when buying new, and in fact an 80386-based PC will really do just as well. DECIDE WHAT YOU WANT THE COMPUTER FOR BEFORE YOU BUY IT! Let your software choices and intended uses of the PC drive your purchasing choices, not what some salesman says. If necessary, bring a knowledgeable person along who can help to sort out the truth from the noise.
- 2) Comparison shop the area stores: DON'T buy on impulse. Write down what you want to buy, be as specific as you can. Compare the prices of several dealers in the paper; call the companies if necessary and have them give you a price quote. Many will even fax you a price quote. If you like a system and it's \$40 more than a competitor's price, see if they will match the price - many will do this. Take at least 2 weeks to go through this process.
- 3) Get ALL promises for service & support IN WRITING before buying the PC. Verbal agreements between you and the salesman are never binding in a court of law, if things should get to that point. Therefore, get any warranties, service agreements, and support agreements IN WRITING before you buy your PC. Speak to a supervisor or manager if necessary, but don't accept any verbal agreements as binding commitments.
- 4) Test the computer before it leaves the store or house.

Nothing is more frustrating to the new computer owner than to find that the 150Mhz Pentium system will only run at 90 Mhz, or that your 3.5" floppy drive doesn't work, or that your monitor has squiggly lines all over it when you leave it on for more than 10 minutes. The store should have already tested the computer before you pick it up, but this isn't always the case. It only takes 5-10 minutes to assemble the system and test everything; insist on doing this. Use a diagnostic program like Checkit or Norton Utilities to evaluate the operation of your computer. If something's not right, insist that they fix it BEFORE it leaves the store. Use the same rules when buying a used computer from someone's home: run diagnostic software on it BEFORE you fork over the cash.

- 5) Insist on getting some menu software installed on your PC, and have someone properly configure your application software BEFORE you venture into the PC world. The main reason new PC owners get so frustrated is that they have no easy way to get in and out of their new programs. MS-DOS is not an easy operating system for the novice to use. Therefore, make sure that you get some kind of menu software (Automenu, Direct Access, Windows, etc.) installed and properly set up on your PC before you start using all of your new software. Have the store or some well-trained PC maintenance person set up the programs on your hard disk as well as the menu program you choose. By doing this, you will be able to use your programs immediately, without having to struggle with DOS.
- 6) Never buy from the guy in New Jersey - ALWAYS BUY FROM LOCAL, REPUTABLE SOURCES. The guy in New Jersey is probably a reputable dealer, and probably sells quality parts. BUT, if your part breaks during the warranty period, where do YOU have to go (or mail the part) to get a replacement ... Always buy from local retailers that are reputable, that sell name-brand equipment, that give warranties, and that have a good name in the local industry.

Above all, CAVEAT EMPTOR (Let the buyer beware!).

TIPS TO REMEMBER WHEN SUPPORTING COMPUTER SYSTEMS

- 1) Learn as much as you can yourself. The old adage goes "Give a man a fish, and he will depend on you for fish; teach a man to fish, and he will feed himself." The more YOU know of the technology and how to use it, the better off you will be. Remember, the PC is your friend and your tool, not your adversary. Plan to make computer courses and seasons of learning part of your normal work time.
- 2) Find a "guru" who you can turn to in times of need. Sometimes, you have to go to the Rock that is higher than yourself. When those times come, have a person (or persons) who will covenant with you to help you learn through problem situations. Have a hardware AND a software guru who will help trouble-shoot both kinds of problems.
- 3) Use the resources of a local college to help yourself, and to support your system. Community colleges have a wealth of training programs specifically designed to help adult and working learners. Take continuing education courses, or even credit courses for needed skills. Find out if there is a cooperative education program that might get you low-cost (or no-cost) skilled help for your computer system or internet site.
- 4) Tie into existing resources. Don't re-invent the wheel, unless the existing wheel is no good. If another compatible organization in your area has computer resources or internet resources that can be shared for lower cost, consider using them instead. Partner with other organizations that can get you more visibility or added-value to your service.
- 5) Predict failures as well as successes. Plan for problems, and have a plan when they occur. Have some spare hardware parts (hard disks, video cards, etc.). **BACK UP YOUR IMPORTANT DATA EVERY WEEK.** Expect jobs to take a little longer than they should ... expect the toner cartridge will need replacing.
- 6) Work your way out of a job. Train someone as you go along that will learn what you do, so they can do it if you can't. Make sure others know how to get all the jobs done, and encourage them to participate in the tasks you do. One day you may be called on to do something new ... make sure someone else can fill your shoes.

NOTES

WHAT MAKES A PC "CONSERVATIVELY-DESIGNED"?

A conservatively-designed PC doesn't have a lot of extra devices built into the motherboard, such as:

- Video cards
- Parallel/serial ports
- Network cards
- Drive interfaces (floppy or hard disk)
- SCSI host adapters
- Sound cards

It is better, from a repair standpoint, to have these devices plugged into the bus connectors of the motherboard as separate devices than to have them integrated into the motherboard. Why? These individual devices are easy to replace and much less expensive than replacing an entire motherboard for the failure of a single part on that motherboard.

Devices can also be "non-conservative" in their design; for example, many IDE interface cards have floppy drive controllers, parallel/serial/game port interfaces, and other devices built into a single card. This card has one primary chip that handles all these interfaces; when that chip fails (and it does frequently), then the entire card is trashed.

Manufacturers that make "non-conservative" motherboards and systems include:

Gateway 2000 Dell AST CompuAdd Compudyne
Tandy Packard Bell Compaq

Most local home-brewers build conservatively-designed PCs ... such companies in the Washington DC area include:

Microplus Intellicom Computech MicroPower PC
PC Warehouse CCS

Refer to the Mueller textbook for a further discussion of this subject.

Use the space below to list additional manufacturers that build conservatively-designed PCs.

NOTES

WHAT EXACTLY IS A NETWORK?

A **network** is a means whereby intelligent end-user PCs can share common resources, such as:

- o A file server: a computer with large hard disks that all network users share; your application software and data will likely reside on this file server, not on your PC's hard disk
- o A print server: a computer dedicated to buffering print jobs sent by network users to centralized or shared printers
- o A communications server: a computer dedicated to allowing outside users access to the network, usually through a telephone line.
- o A mail server: A computer dedicated to providing e-mail (electronic mail) to users of the network.

In a network, the end-user PCs are intelligent; that is, the terminals have a CPU in them that allows them, NOT a centralized CPU, to do the computing work. This is called **distributed processing**. You have the ability to store your data on a local hard disk or floppy disk, and your application software can be loaded from either a local disk, or from the file server. The file server does NOT process the data; your local PC does.

In **centralized processing**, the terminals are not intelligent (they have NO CPU within them), and a centralized CPU is shared by all users. You store your data in a centralized data storage facility, and run your programs from the centralized CPU, sharing CPU time with all other users. You generally cannot save your data to a local disk drive. When the centralized CPU goes down, so does everyone.

Local area networks are exactly that: local. They are distributed over a small area, and allow a number of users to share common resources. Generally, a LAN is limited to 255 users per LAN.

LANs can connect with other LANs to form a Wide Area Network (WAN), or can connect to mainframe or minicomputers through devices like **routers** or **bridges**. This is how people can communicate from one network in Washington to users on another network somewhere else, like in Seattle. Such a connection could be made through leased phone lines, dedicated transmission lines, or by satellite.

NOTES

WHAT EXACTLY IS A SERVER?

A File Server:

A file server is nothing more than a fast PC (80486 or better) that has the following kinds of devices in it:

- o A fair amount of Random Access Memory (RAM), usually 16 megabytes or above;
- o Large hard drives (usually above 1 GB) with fast access times (usually 10 ms or less) that are highly reliable and can take the stress of multiple users accessing the drives for long periods of time;
- o A decent network card, usually one with extra RAM built onto the network card itself; and
- o The file server portion of Novell Netware (or some other network operating system) loaded onto it, so that multiple users will have access to the drives on the file server.

The server has one function in life: giving you access to files and information stored in its hard disks.

A Print Server:

A print server is nothing more than an average or faster-than-average PC (80386 or better) that has the following kinds of devices in it:

- o An average amount of Random Access Memory (RAM), usually 4-8 megabytes;
- o Garden variety hard drives (usually above 100-500 MB) with average access times (usually 15 ms or less) that are reliable enough to take the stress of multiple users accessing the drives for long periods of time;
- o A decent network card, usually one with extra RAM built onto the network card itself; and
- o The print spooler portion of Novell Netware (or some other network operating system) loaded onto it, so that multiple users will be able to send print jobs to the server. The shared printer usually will be attached to the print server, but this is not necessarily always the case.

The print server has one function in life: giving you the ability to share a network printer with multiple users on the network system.

A Communications Server:

A communications server is a specialized type of PC that has the ability to allow outside users to dial into the network from remote locations. This allows remote users the same kinds of network capabilities as those connected to the network in-house. These kinds of PCs are often called **chatterboxes**. Each device within the communications server contains a self-contained PC on a card, with a modem of some type built into the card. Chatterboxes are somewhat expensive, but they give remote users a great deal of flexibility to process data in the field.

NOTES

WHAT EXACTLY IS A SERVER? (PAGE 2)

A Mail Server:

A mail server is a PC (80486 or above) that has the host electronic mail (e-mail) package running on it. E-mail allows you to send messages and files from one network user to another. The mail server needs to have a fairly large hard drive to accommodate all of the messages being sent to and from users within the network. Periodically the list of mail messages may need to be purged, to eliminate old messages that should have been deleted from the system long ago. One would do this in order to free up disk space on the mail server for new messages. Many mail packages can give administrators and users the option to delete mail messages automatically when a message gets to a certain age.

NOTES

MAJOR TYPES OF NETWORK TOPOLOGIES

ETHERNET BUS

An Ethernet Bus network is like a "highway for data." Data is passed in a "party-line" fashion; each PC waits for quiet on the line, then transmits the message down the line to the next station. Each PC or workstation on the bus checks to see if a message is traveling along the bus before sending their messages. All messages pass through all workstations on their way to their destination. Messages reflect back towards the file server by way of a **terminator** at the end of the cable that reflect the network signal in the reverse direction. Twisted-pair (10BaseT) or ethernet cable may be used in this scheme. A broken cable or un-terminated cable run, however, can crash the entire network.

ARCNET

An ARCNET network sends messages from the file server to an intelligent **hub**, which routes the network message to the proper PC or workstation. ARCNET networks pass **tokens** which are specifically for one and only one PC on the network. The failure of one PC or cable line from hub to PC will not cause a system-wide network failure, as with an Ethernet bus network. Twisted-pair (10BaseT) or ethernet cable is generally used with such a network. This system passes data much like the phone company routes telephone calls, through the use of the hubs as switching devices.

MAJOR TYPES OF NETWORK TOPOLOGIES (PAGE 2)

TOKEN RING

Token ring network send messages in the form of tokens from one PC/workstation to another, in an "assembly-line" fashion. If there is a break in the cable, the token is then passed in the opposite direction towards the receiving PC. The ring topology allows verification that a message has been received by the proper PC. Extensive monitoring of the network is possible in a ring topology. Failure of a single workstation or a break in the network line will not cause a system-wide network failure. Additional rings can be accessed through **bridges**, which control the flow of information between the two ring networks.

What are three things that can cause a Local Area Network (or a PC on the network) to fail:

- a) BAD CABLE
- b) BAD NETWORK INTERFACE CARD
- c) BAD NETWARE/NETWARE NOT CONFIGURED CORRECTLY FOR THAT PC

What Novell Netware program INITIALIZES THE NETWORK CARD in your local PC?

IPX.COM

What Novell Netware program ESTABLISHES THE SESSION BETWEEN YOUR PC AND THE NETWORK, letting the LAN know that you are ready to use the network once you login?

NETX.COM

HOW DO NETWORKS PASS DATA FROM ONE PLACE TO ANOTHER?

Ethernet Networks

Ethernet networks pass data in a "party-line" fashion. That means the network waits for quiet on the communications line, and then it "shouts as loud as it can, hoping to be heard". The more users there are on the network, the more crowded and confused the communications line becomes, and the less efficient the network becomes as well. Data is passed from one PC to another, with the NIC in each PC re-broadcasting the signal as it goes along the line.

Arcnet and Token-ring Networks

Arcnet and token-ring networks pass data in an "assembly-line" fashion. That means that the network passes data in the form of tokens at a consistent, regular rate of speed. The same number of tokens are passed at the same speed whether there are 5 nodes or 150 nodes on the network. Tokens are "marked" as to who is the intended recipient of the token. Token-passing is bi-directional; if the recipient can't receive the token via one route of cable, the network will send the token in the opposite direction of the cable in an attempt to find the recipient.

Ethernet Address Numbers

All data transmitted on networks are coded with a 16-digit ethernet address that indicates the intended recipient of the information. This ethernet address is unique to each network interface card (NIC); no two NICs anywhere have the same ethernet address. The network software uses this ethernet address in its work to transmit data from one place to another.

NOTES

HOW WILL MY COMPUTER OPERATE IF IT'S CONNECTED TO A LAN?

For the most part, your computer will operate on a LAN just as it would without a LAN. You will log onto a disk drive (that is actually a network drive), change directories to the place where your application software is located, and execute your program just as you would if the software were on your hard drive inside your PC.

Several things will have to happen, though, in order for you to gain access to your network drive(s):

- 1) You will have to load & run some kind of driver software that makes your PC able to use the network card plugged into the bus connection inside your PC. This is usually done when DOS loads the driver programs listed in your **CONFIG.SYS** file.
- 2) You will need to run the network operating system programs needed to initialize your network card for use by the operating system, identify your PC as a legitimate node on the network, and allow an identified user to log into the network. With Novell Netware, these would be **IPX.COM, NETX.COM, and LOGIN.EXE**.
- 3) Your network administrator will have to **map** specific drive designations to you, **grant you rights** to access files in the drive and directory, and probably use the **capture** command to route your print requests to a network printer.
- 4) You will probably access most of your application software on the network drives with the assistance of a **menu program** that allows you easy access to your programs and data. Examples could include Novell Main Menu, Direct Access, or Windows.

For the most part, everything is the same on a network drive as it is on a local hard drive. **DIR** gives you a directory of files on your current drive and subdirectory; **COPY** copies files from one place to another; **DEL** deletes files; **REN** renames files. The idea of a network drive is to give you as identical an environment on a network drive as you do on a local hard drive.

NOTES

WHAT HAPPENS WHEN YOU LOGIN TO A NOVELL NETWORK

- 1) The DOS program **IO.SYS** loads into memory, just like it does without a network.
- 2) The DOS program **MSDOS.SYS** loads into memory, just like it does without a network.
- 3) The user-created file **CONFIG.SYS** loads into memory and the device drivers specified in it are also loaded into memory, just as always. Specifically for networks, though . . .
 - a device driver program is loaded to initialize your network card and allow your PC's hardware to recognize and use the network interface card (NIC).
- 4) The DOS program **COMMAND.COM** loads into memory, just like it does without a network.
- 5) The user-created file **AUTOEXEC.BAT** loads into memory and executes the commands found in it, just as always. Specifically for networks, though . . .
 - the Novell Netware program **IPX.COM** is loaded into memory; this program also initializes your network card, but so it can use Novell Netware.
 - the Novell Netware program **NETX.COM** is loaded into memory; this program establishes the session between your computer and the rest of the network, and it tells the network file server to recognize the PC as a legitimate node on the network. It also gives you access to the **F:\LOGIN directory**, so a user can login at any time.
 - the Novell Netware program **LOGIN.EXE** is executed, which allows a user to login to the network, provided that the person is a recognized user of the network. The person is asked for a **login name**, and also for a **password**. If both the user name and password are correct, the person is logged into the network, and given access to specific drive designations on the network file server.
- 6) Once the person has logged into the network, the **system login script** takes control of the PC. This login script contains:
 - the **MAP** commands that specify the drive designations for the network directories you will be allowed to access;
 - the **CAPTURE** command that routes your network printing jobs to a specified print server and printer;
 - any commands or executable programs your network administrator wishes you to run on your PC (i.e., virus checking programs, etc.); and
 - the menu program your network administrator wishes you to use (Novell Main Menu, Direct Access, Windows, etc.)
- 7) After you are finished using the network, you issue the command **LOGOUT** to log out of the network. Turning off your PC without logging off will force the network file server to log you out as well.

NOTES

WHAT HAPPENS WHEN THE SERVER BREAKS DOWN?

EVERYTHING STOPS!

More specifically, when the **file server** breaks down, no one is able to access their programs or data. Further, you may not be able to save your work out to the file server, or even to your local hard disk as a last resort. The scenario is much like when the lights all go out in a dark theater: no one knows where to go, and everyone steps on each other trying to get out. The file server is the most important link in data access, retrieval and storage. If it goes down, all of these processes stop as well. It's just like when your hard disk quits in the middle of a computing session; when it fails, great is the fall thereof.

When the **print server** breaks down, all of the print jobs in the print queue will be destroyed. Once the print server is rebooted, you may then re-send your print job back to the server, where it will process the job for you.

When the **communications server** breaks down, your line into the network is lost. You will not be able to re-establish your outside link to the network until the communications server is brought back on-line.

When the **mail server** breaks down, you will be unable to access the e-mail service on the LAN. Depending on the severity of the problem, you may lose some or all of your mail messages, especially those that were sent just before the crash. If the hard disk on the mail server is severely damaged, you will very likely lose some or all of your e-mail messages. If it's just a problem with a locked-up mail server or a temporary communications problem, you will likely be back in business in short order, with little or no loss of mail.

A side note: most servers, especially file servers, have some means of backing up their hard disks. Most file servers **duplex** their disks, having 2 hard disks (each with a separate disk controller) making mirror image copies for all data transactions going onto the server. Some servers use **mirroring**; 1 disk controller creates two mirror image copies of each file on 2 separate hard disks. The problem with mirroring comes when the 1 disk controller crashes, and both drives go off-line. Duplexing allows the backup disk drive to continue working while the primary controller or hard disk is off-line or being repaired. File servers, mail servers, and some print servers will use either duplexing or mirroring to continually backup your data.

NOTES

IF I UNPLUG OR DISCONNECT MY NETWORK CABLE, WHAT HAPPENS TO THE LAN?

Generally, very bad things happen when you make a break in the network cable.

If you have an Ethernet bus network:

Breaking the cable line has disastrous effects on the network. In an Ethernet bus network, a cable break causes a system-wide crash that affects EVERYONE on the network. The bus cable line has a terminator at the end of the line, which reflects signals back to the server(s). If the server cannot locate the end of the cable line or receive back the reflected signal, the server becomes unable to communicate with any device located on the network. Signals from PCs attempting to communicate with the server either get lost down the broken cable line, or collide with the signals from other PCs attempting to communicate on the LAN. Even a momentary break in connection can crash an entire network of PCs. Therefore, DON'T DO IT! If you are simply disconnecting your PC from the LAN, and you are NOT creating a break in the line, that is acceptable. Just unplugging your PC from the LAN will not crash the system; creating a break in the cable line WILL crash the network.

If you have an ARCNET or Token Ring network:

Breaking the line in one of these types of LANs will generally not have the same kind of disastrous effects as with an Ethernet LAN. Since these LANs communicate through the passing of **tokens** from PC to PC, having a cable break becomes less of an issue. If a PC drops out of the loop, the LAN bypasses that PC and passes the token to the next available PC. If you are the PC for which the token is designated, and your PC is the one that goes off-line, the token is returned to the server as undeliverable. In an ARCNET setting, if you break the cable between the server and the **hub**, you may cause serious problems for the rest of the network, and could potentially crash the network.

In any setting, if you break the line from the file server to the rest of the network, you cause a major system failure (obviously!).

As a general rule, never disconnect or create a break in any network cable line during prime use hours, always inform all users before making a break in the line, and attempt to isolate the cable run from the rest of the LAN before making breaks or repairs to the line.

NOTES

**CAN COMPUTER VIRUSES BE SPREAD THROUGH A LAN,
AND CAN MY COMPUTER BE INFECTED?**

Absolutely!!

Viruses are passed from disk to disk. Your network disk drive is no different than a floppy disk drive or hard drive in your PC, with respect to passing viruses. If you copy an infected file from your hard disk to a network disk, the network drive will be infected AND anyone copying that file from the server to their hard disk or local floppy disk will become infected as well.

Therefore, it is vital that you or your network administrator include in either your **AUTOEXEC.BAT** or **LOGIN SCRIPT** some type of virus protection program that will scan your hard disk for viruses, and remain memory-resident during your computing session to alert you to any virus threats to your computer during your session.

There are many good virus protection programs available on the market today, ranging from freeware programs like F-PROT, to shareware programs like MacAfee's SCAN program, to commercial programs like Central Point Anti-Virus and Norton Anti-Virus. Make sure that your virus program is compatible with the network operating system you are using BEFORE you buy it.

It is also important for you to emphasize to your users to be aware of computer viruses, and instruct them NOT to load anything from a floppy disk up to a server or local hard disk until the disk has been scanned by a virus protection program. Also, users should routinely scan the files on their network drives for viruses, just as a precaution.

NOTES

HOW DO I INSTALL A NETWORK INTERFACE CARD?

There are several easy steps involved in installing a network interface card (or NIC) into a PC:

- 1) **Open the case of the PC and locate an unused bus connection on the motherboard.** Once you have removed the case from the PC, you will be able to look inside the PC and determine if there is a free, unused bus connection (a slot) located on the motherboard. If you have a 16-bit network interface card (the card has 2 sets of gold contacts), you will insert it into a 16-bit bus connection (a slot that has a 2-part connector). If you have an 8-bit network card (it has only 1 set of gold contacts), you may insert it into either an 8-bit or a 16-bit bus connection.
- 2) **Before installing the NIC, set the jumpers on the NIC to the desired IRQ level, DMA channel and port address.** In PCs, the devices that plug into the bus are prioritized by interrupt level, or IRQs. This allows the PC to allocate CPU time by orders of priority. Generally, network cards are set to IRQ 5, but the cards can be set to any free IRQ level for that specific PC. The DMA channel is the data path through which information travels from the bus to the CPU and memory. NICs will generally use DMA channels 5, 6, or 7. Port addresses are locations in memory where data is picked up and delivered between an adapter board and the motherboard. Generally, NICs use port address 280 or 300 hex, but can use any free port address found in the PC.
- 3) **Install the NIC in the free bus connection.** This involves pressing the card into the bus connector on the motherboard, and installing the retaining screw onto the case (so that the card doesn't creep up out of the bus connection). **DO NOT ATTACH THE NETWORK CABLE TO THE NIC AT THIS TIME, FOR ANY REASON**
- 4) **Before installing the top of the case, turn on the PC, install the network card drivers into a directory on the PC's hard disk, and modify the CONFIG.SYS file to load the network card driver software at boot-up time.** In order for the PC to recognize and use the NIC, you must load some driver software into memory during the boot-up process so that the PC will recognize and use the NIC. This involves adding a DEVICE line to your CONFIG.SYS file; when this line is added, DOS will locate and load the driver software into RAM during the boot-up process.
- 5) **RUN THE DIAGNOSTIC PROGRAM FOR YOUR NETWORK CARD BEFORE ATTACHING THE CABLE TO IT.** A defective NIC on 1 PC can crash an entire network of active users; therefore run the diagnostic program that came with your NIC before attaching it to any network cable. Once you have determined that the card is working properly, then re-install the computer's case top and attach the network cable to the NIC.
- 6) **Install the network operating system software into a directory on your hard disk, and modify your AUTOEXEC.BAT file to boot up to the network file server.** Create a directory on your hard disk (i.e., MD NOVELL), and then install the network operating system software into that directory. Next, change your AUTOEXEC.BAT file so that you load the network software into memory at boot-up time, remembering to add a line to LOGIN into the network. Finally, re-boot your PC and attempt to log into the network.

If you follow these steps, you will have successfully installed a NIC into a PC and made it able to link to the network.

NOTES

HOW DO I INSTALL NOVELL NETWARE ONTO MY PC?

Novell Netware comes with a disk called the **Workstation Shell Generator (or WSGEN) disk**. This disk allows you to create the file called **IPX.COM**, and gives you a file called **NETX.COM** that you will copy onto your hard disk.

IPX.COM is a program that initializes your network card, and enables your PC to "talk to the network". **IPX.COM** is actually compiled and created by the WSGEN disk installation program. During the installation program, you will be asked what brand and model of network card you have installed in your PC. Based on that information, the program creates a version of **IPX.COM** that is specific for that network card type. **IPX.COM** CANNOT be copied from PC to PC if there are different types of network cards in each PC. If all of your PCs have the same type of network card, you can run the installation program on 1 PC and then copy it to all other PCs in your area that have the same configuration.

Newer versions of Novell Netware have an adapted version of IPX called **IPXODI.COM**. This new version allows you to run the IPX network protocol, AND other data networking protocols (like TCP/IP) simultaneously. To use **IPXODI**, you must load a program from Novell called **LSL.COM**, which stands for "link support layer". Then, after loading **LSL.COM**, you must load your network card driver in your **AUTOEXEC.BAT** file. Then, run **IPXODI**. This will allow multiple communication protocols to operate at the same time during your Netware session.

NETX.COM establishes the session between your PC and the rest of the network, and "allows DOS to communicate with **IPX.COM**". In earlier versions of Novell Netware, there were separate versions of this program for each version of DOS. For example, **NET3.COM** would be used if you had DOS 3.x on your PC, and **NET4.COM** if you had DOS 4.x on your PC. Currently, **NETX.COM** adapts to the version of DOS you are using. There are also versions of this program called **XMSNETX.COM** and **EMSNETX.COM**, which can be loaded into extended or expanded memory, respectively.

Newer versions of Netware also come with a program called **VLM.EXE**. **VLM** (which stands for "virtual loadable module") does the same thing as **NETX.EXE**, but it also allows for peer-to-peer networking to occur. You may load either **NETX** or **VLM**, depending on whether you wish to support peer connections between users.

You will copy **IPX.COM** (or **IPXODI.COM**) and **NETX.COM** (or **VLM.EXE**) onto your hard disk, usually into a directory called **NOVELL**. Once you run **IPX.COM** and **NETX.COM** on your PC, you will find that your PC's clock is now synchronized with the file server's date and time, and you will have access to an **F:** drive with a **LOGIN** subdirectory. If you type **LOGIN** and hit Enter, and if you are a registered user, you will gain useful access to the network if you enter your correct user name and password.

NOTES

MAIN NOVELL NETWARE UTILITY PROGRAMS

- 1) **SYSCON**: this is the SYStem CONfiguration program, which allows you to see your login script, your account balance and restrictions, station and security restrictions, and it allows you to change your password. If you are a lowly network user, this program has certain limits; if you are a network administrator, it gives you a great deal of power over network users. This program allows administrators to add users, restrict or limit user privileges, or setup the system login scripts for all users.
- 2) **PCONSOLE**: this program allows users and administrators to view the activity of different print servers and printers along the network. It also allows users to delete print jobs or move them from backed-up printers to other printers on the network. You are also afforded more features with this program if you are an administrator.
- 3) **FILER**: allows you to view, edit copy and move files on network drives **for which you have rights**. If you have no rights or privileges to see or access a file, you cannot use FILER to copy/edit/move/delete it. Again, administrators have more features and abilities to affect files on network drives. This program is much like a DOS shell program, such as DOSSHELL, XTREE, or QDOS II.
- 4) **SALVAGE**: this program allows you to recover deleted files **from network drives only**. However, there are certain limitations to this program. Since many people use a network disk drive, the likelihood is high that someone can over-write the space on the disk once held by your data files. Therefore, it is important that you use SALVAGE immediately, once you discover an accidental erasure of data on a network drive. If you are on a busy network server, you may have 1-3 days to recover your deleted files.
- 5) **WHOAMI**: tells the user who you are logged on as, the network server logged into, and the version of Netware being used on the server, and the time you logged into the network.
- 6) **MAP**: allows you to assign a drive designation to a network directory on a file server, and allows you to see what drives have been mapped for you.
- 7) **CAPTURE**: allows you to intercept printer output and re-route it to a network printer. **NPRINT** is similar to the DOS PRINT command, but it sends the output to whatever network printer you have specified in the CAPTURE command.

NOTES

WHAT IS PKZIP, AND WHAT CAN IT DO FOR ME?

PKZIP and PKUNZIP are file compression programs; that is, they allow you to compress large data files into small ones, so that they are more easily stored on your floppy or hard disk. When needed, the files can be restored to their normal size for their intended uses. You can use PKZIP to compress a file, a group of files, a directory, or even an entire disk, all at one time. Then, PKUNZIP will allow you to "unzip" the files back to their original state.

HOW DO I COMPRESS A FILE USING PKZIP?

1. First, identify which file (or files) you wish to compress with PKZIP, determining in which drive and subdirectory the files are located.
2. Then, at the **I:\ZIPFILE>** DOS prompt, type the following command:

PKZIP -A I:\ZIPFILE\ZIPFILE.ZIP C:\DIRNAME\FILENAME.EXT (Enter)

Invokes PKZIP;
the "-A" adds data
to the ZIP file;

This is the name of the
ZIP file you are creating;

This is the name of the
file you wish to compress.

For example:

- 1) To ZIP a single file called **shf906.tal** in the **C:\TALLY** subdirectory, you would enter the following:

PKZIP -A I:\ZIPFILE\SHF906.ZIP C:\TALLY\SHF906.TAL (Enter)

This command puts the zipped file in the **C:\ZIPFILE** subdirectory with the filename **SHF906.ZIP**.

- 2) To ZIP a group of files with a **.906** extension in the **C:\TALLY** subdirectory, you would enter the following:

PKZIP -A I:\ZIPFILE\906ALL.ZIP C:\TALLY*.906 (Enter)

This command puts ALL the files with a **.906** extension in the **C:\TALLY** into a zipped file in the **C:\ZIPFILE** subdirectory called **906ALL.ZIP**.

- 3) To ZIP an entire subdirectory of files, you would enter the following:

PKZIP -A I:\ZIPFILE\TALLYDIR.ZIP C:\TALLY*. * (Enter)

This command puts ALL the files in the **C:\TALLY** into a zipped file in the **I:\ZIPFILE** subdirectory called **TALLYDIR.ZIP**.

WHAT IS PKZIP, AND WHAT CAN IT DO FOR ME? (PAGE 2)

3. PKZIP creates a "ZIP file" which contains the compressed data from your original file(s). Your original, uncompressed data file is NOT destroyed, deleted, or changed during this process. Once you have "Zipped" your data files, you may then delete the originals, if you wish.

HOW DO I UNCOMPRESS A FILE USING PKUNZIP?

1. First, identify the ZIP file you wish to uncompress with PKUNZIP, determining in which drive and subdirectory the file is located.
2. Then, at the **I:\ZIPFILE>** DOS prompt, type the following command:

PKUNZIP I:\ZIPFILE\ZIPFILE.ZIP C:\TALLY (Enter)

Invokes PKUNZIP;

This is the name of the
ZIP file you are uncompressing;

This is the name
of the
subdirectory the
uncompressed
files will go to.

PKUNZIP will then take the compressed file and uncompress it into the subdirectory you specified at the DOS prompt. For example, to UNZIP the ZIP file called **shf906.zip** and put the uncompressed files into the C:\TALLY subdirectory, you would enter the following:

PKUNZIP I:\ZIPFILE\SHF906.ZIP C:\TALLY\ (Enter)

If you just wanted to see what files were compressed into this ZIP file BUT not uncompress them, you would enter the following:

PKUNZIP -T I:\ZIPFILE\SHF906.ZIP (Enter)

FINDING FILES ON THE RESOURCE PCs

The Resource PCs are provided so that you can do the following things:

- o Try out and practice using the software you'll need in your "Software Toolkit"
- o Copy this software onto disks for use during the class

The files are placed into directories on these PCs' hard disks; here are the directory names of where you will find specific files:

Programs

Directory Names

Disk Manager (for formatting hard disks):	C:\DM or C:\DM51
Checkit 2.1 (for diagnosing computers):	C:\CK
Syschk 2.39 (for toe-tagging PCs):	C:\SYSCHK
F-Prot (anti-virus program):	C:\F-PROT
Norton Utilities: C:\NORTON or	C:\NU (requires 3 disks)
MSD (Microsoft Diagnostics):	C:\DOS (DOS 6 or above)
IDEINFO (utility to identify IDE drives):	C:\IDEINFO
Setup program (for PCs w/out internal Setup):	C:\PBSETUP

To copy files from the hard disk to your floppy disk, do the following:

- 1) Put your floppy disk into the A: (or B:) drive;
- 2) Type CD**dirname** (where dirname is the directory name you wish to use);
- 3) Type **copy *.* A:** and press Enter;
- 4) Remove your disk from the drive.

This procedure will copy all of the files in that directory to your floppy disk.

See the instructor or one of the assistants if you have any questions.

WHAT ISSUES WILL BE COVERED IN THE SECOND TEST?

- o Know all the definitions of the various hardware types in a PC, the differences between the different CPU types, and know the error codes from last test
- o Show/draw diagrams of 3 major network topologies: ethernet bus, arcnet/starlan, and token ring
- o List 3 things that cause networked PCs to fail: bad cable, bad network card, incorrect network software
- o What Netware program initializes your network card in your PC?
What Netware program establishes the session between your PC and the rest of the network?
- o Know how networks pass data (i.e., ethernet passes data in a party-line fashion, arcnet and token ring networks pass tokens in an assembly-line fashion)
- o Know the 4 main regions of memory in a PC: Conventional, reserved, extended, and expanded. Know where each of these regions begin and end (i.e., conventional memory ends at 640k). Know what an EMS window is, and how it passes data to an expanded memory card.
- o Know the three program files and two user-created files that make MS-DOS work; also, know the order in which these programs load into memory.
- o Know how a PC uses extended or expanded memory (load a memory manager; HIMEM.SYS for extended memory, EMM.SYS for expanded memory)
- o Know how many hard drives you can install in a PC (up to 7 with SCSI drives, only 2 with all other drive technologies)
- o Know about the setup program in an AT-class PC, how to access it, and how you use it when upgrading a PC (changing the CMOS Setup information when adding a new floppy/hard drive). Also know about the POST test that's built into the BIOS chips, and how POST uses the setup information in the CMOS chips.
- o What can be setup in the ROM BIOS setup program?
 - Floppy drive type, hard drive type, date, time, memory size, wait states, etc.
- o Know the three main types of IBM Compatibility (operating system, ROM BIOS, and Hardware)
 - What are the problems or advantages with each?
- o What is conservative design, and why is it important?
 - Having discrete parts plugged into the device bus minimizes cost and hassles when components fail.
- o Why might my PC need a special version of MS-DOS?
 - To deal with hardware incompatibilities and peculiarities.
- o What is a ROM Dubbing chip, and how can it help your PC?
 - Gives added drive support (both floppy and hard)
- o Upgrading BIOS chips
 - NEVER swap brand X chips with brand Y chips
 - What is a user-defined drive type?

WHAT ISSUES WILL BE COVERED IN THE SECOND TEST? (PAGE 2)

- o Upgrading DOS versions
 - Do I have to backup my data and re-format the drive? (NO!) Run the upgrade program that comes with DOS.
- o What is the difference between MFM and RLL drives, etc.?
 - Different encoding schemes permit more data storage in same physical space
- o Understand memory usage in the DOS environment, and the 4 major types of memory in a PC: conventional, reserved, extended, and expanded memory. Refer to the textbook, the sheet in the Course manual on memory use, and your class discussion notes.
- o How would I ...
 - Install a new motherboard?
 - Replace a defective floppy drive?
 - Install a high-density floppy drive?
 - Install a new (or second) hard disk? (All types)
 - Install a parallel/serial port card?
 - Upgrade to a better video card?
- o What are interrupts, and how do they affect your PC's operation?
 - They prioritize multiple accesses to the CPU at the same time.
- o How would you determine there was an interrupt problem (conflict) in your PC, and how would you fix the problem?
 - Neither interrupted device that had a conflict would work right.
 - Remove one device and change the IRQ settings to a unique IRQ.
- o What should you do AFTER installing/upgrading new equipment?
 - TEST IT!!!
- o Be prepared to answer some repair scenarios; I'll give the situation, you review the clues and the answer choices given, and make the best possible choice.
 - Look for error codes
 - ALWAYS check for power before opening the case
 - Listen for beeps: 1 beep means PC is OK, 1 long/2 short beeps means bad video card, etc.
 - Make sure everything is plugged in to where it belongs
 - How do you replace a defective drive controller or defective hard drive
 - How do you deal with a virus-infected PC
 - Make sure printer is on and the software has right printer specified
 - When all else fails, remove all non-essential components and try to isolate problem
 - Make sure there are no "pilot error" problems (putting a high-density floppy into a double-density drive, and then wondering why the disk is unreadable; compiling programs in PASCAL or C, and getting into an infinite loop)

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.

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

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

Services provided by Research Technology Associates, Inc. include:

- o Picking up unwanted and surplus PC equipment from individuals and corporations;
- o Refurbishing computer equipment at our facilities;
- o Placing this equipment in non-profit organizations throughout the world;
- o Providing training and support to various organizations, and
- o Teaching individuals computer repair techniques through the ENT 184 (PC Hardware) and ENT 284 (PC Repair) 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:

- o The training opportunities offered through PG Community College provide students valuable job skills for today's computer-oriented business market;
- o Computers end up in deserving schools and non-profit corporations, not in landfills; and
- o 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 301/372-2889.

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
Upper Marlboro, MD 20772-7924**

**FAX: 301/372-0086
E-mail: wlloyd@nheri.org**

Our phone number is **301/372-2889**.

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 80286, 80386 and 80486-class PCs with floppy and hard drives
- o Monochrome, CGA, EGA and VGA color monitors
- o Macintosh, Mac Plus, and Mac SE computers
- o Dot matrix printers and/or laser printers

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 price we charge 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. A current price list is available from Research Technology Associates upon request; please call our main office for details.

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 301/372-2889. We look forward to serving you.

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**

**FAX: 301/372-0086
E-mail: wlloyd@nheri.org**

Our phone number is **301/372-2889**.

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

- o 8088 XT-class PCs with floppy and hard drives
- o 80286 and above AT-class PCs with floppy and hard drives
- o Monochrome, CGA, EGA and VGA color monitors
- o Keyboards and mice
- o Macintosh, Mac Plus, Mac SE, MAC LC series and Power Mac computers
- o Dot matrix printers 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 have three locations throughout the DC area where you can deliver your surplus equipment.

We CAN come to your site and pick up your equipment, also. You will need to 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:

- o Test, repair and evaluate computer equipment
- o Pick up and deliver computer equipment (trucks and/or station wagons are needed, too)
- o 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 301/372-2889. We look forward to serving you.