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The Need For Hands-On IT Classes

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Honors Thesis

By
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Contents

Abstract

This paper describes why SIU needs a class that incorporates hands on in an advance telecommunications course. It gives a brief history of the Internet along with the need for IT skilled workers their education and the future expectations of the Internet. The paper also gives an example of what the class structure would be.

This class has some differences between the two networking courses already in existences regards to their outcomes. ELM 415 would be very Hands-on type of course where students spend a great deal of time in lab installing and configuring software and hardware. The assessment would be primarily performance based, where they have to demonstrate working systems. The course would be a last in a series of courses that have been designed so that students who wish to put in a little more time on their own can be prepared to take the Cisco Certified Network Associate certification test. The prerequisite courses to ELM 415 are similar in that they are very lab intensive with a focus on installation, configuration, and troubleshooting.

With a large growth and need in the IT field, SIU needs to take advantage of this and advance students in their personal growth and education. SIU also can take advantage of the opportunity of economic growth, of which comes student enrollment and recognition in the field.

Hands On Classes for SIU

***Definition of Telecommunications**: is derived from the Greek "tele" (distant) and "communicate" (sharing). In modern terms, telecommunication is the electronic transmission of sound, data, facsimiles, pictures, voice, video, and other information between systems using either analog or digital signaling techniques. Transmission may take place over guided media (copper cables and fiber-optic cables) or unguided media (wireless radio) (Sheldon, 1998, p. 959).*

The reason Southern Illinois University needs hands on classes in advance telecommunications. With the growth of the Internet and with the many branches that the Internet touches from e-commerce, e-mail or to just plan surfing the web a great demand for skilled workers in the field of telecommunications and computer specialties is growing in leaps and bounds.

No one knew thirty years ago when the Internet was born (ARPANET) that it would turn into so many things to so many people. It has changed the world economy and changed how we communicate and receive information. It started out being just four hosts at four different universities in California and Utah. Since then the Internet has grown to some 56 million hosts, 10 million Web sites, and 200 million users worldwide, according to Robert Zakon in the Hobbes' Internet Timeline (1999).

History Of the Internet

The time is nineteen sixty nine we are fighting a war and America is beginning to wonder why, President Nixon is elected and announces that he will start pulling troops out of Vietnam. In this same time period in upper state New York what was to be a small concert turned in to what some would consider a shrine call Wood Stock. America was enjoying some of its greatest achievements in its history. Neil Armstrong and Edwin Aldrin just landed on the Moon. There is one item that was being developed during this

time by the United States Department of Defense and by academia that would change the way the world thinks, works and played called ARPA.

From its genesis as four networked host computers residing on university campuses in 1969 which was funded by the Advanced Research Projects Agency (ARPA) that would eventually change world economies and be called the Internet. Words like "Internet," "e-mail," "the Web," and "e-commerce" would become part of a common global vernacular.

But it was the birth of the World Wide Web that rendered the Internet applicable to mainstream users. In 1991, Tim Berners-Lee, working at CERN, the European Laboratory for Particle Physics in Geneva, Switzerland, posted a Web application on the Internet. Then, in 1993, a group of students at the National Center for Supercomputing at the University of Illinois developed a browser called Mosaic eventually commercially called Netscape, which gave the Web the graphical user interface it needed to enable the masses to use the Internet.

"The Web is what made the Internet publicly visible," says Robert Kahn. After Mosaic's release, the number of Web sites quickly jumped by an order of magnitude -- from about 10,000 in 1994 to 100,000 in 1996.

IT Employment Outlook

There are more than a million good reasons to consider a career in the Information Technology (IT) industry today. That's because employers will create a demand in this country for roughly 1.6 million IT workers this year. With demand for appropriately skilled people far exceeding supply, half of these positions--843,328--will likely go

unfilled. In a total U.S. IT workforce of 10 million, that shortfall means one job in every dozen will be vacant.

A white-hot global economy driven by a high-powered technology engine is propelling IT jobs to the center of attention at organizations worldwide. The demands for skilled workers are growing out of sight. Employment is projected to grow 117 percent between 1998 and 2008, making this the fastest growing industry. Job opportunities will be excellent for most workers; the best prospects will be found in the professional and technical occupations, reflecting continuing demand for higher-level skills to keep up with changes in technology according to the Occupational Outlook Handbook (2000).

The gap between supply and demand

The 10 million strong workforce of IT workers is far larger than one might expect based on previous reports. This number does not include jobs in government, not-for-profit organizations or small entrepreneurial firms. It provides evidence of a sea of change in the nature of work and emphasizes that the Internet and IT have become the twin pistons of the national economy. The demand for IT workers is large and growing. Employers will attempt to fill 1.6 million new IT jobs in 2000.

The demand for IT workers is widespread with interesting variations by geographic region. The South has the largest number of IT workers overall. The Midwest has the largest demand for IT jobs-35% of the total. The western region is second largest with 28% of the total demand also according to the Occupational Outlook Handbook (2000).

The greatest need for IT workers is in the largest segment of the economy--smaller non-IT firms. Companies with 50-99 employees need 1 million IT workers next

year or 70% of the total demand for all new IT employees. This group also has the highest skills gap; managers from these firms reported the highest rate of unqualified applicants and the greatest difficulty in filling positions.

While Non-IT companies have more aggregate demand, the average IT company has far more jobs to fill-five times as many jobs for tech support representatives, six times as many for web developers, and 12 times as many for database developers.

The hottest, most in demand jobs

Technical support jobs are in demand by both IT and non-IT companies alike (one-third of all new positions over next 12 months). Required skills ranked highest for technical support jobs by managers were: 1) Troubleshooting (9 7 percent); 2) Facilitation/customer service (91 percent); 3) Hardware/software installation, configuration upgrades (82 percent); and 4) Systems operations, monitoring, maintenance (67 percent). E-business and interactive media are not only stealing headlines and dominating the business press. Demand for workers with web-related talents is now almost 13 percent of all IT jobs.

Fifty percent of all jobs are in the two positions that exist in almost every organization--technical support and network administration. While database development and software engineering positions occur in only a portion of firms, they represent 20 percent of new IT positions.

The skills workers need to grab one of these hot jobs

The single most important skill is a good knowledge base in the relevant area, according to most (62 percent) of managers surveyed. The second most desirable skill is hands-on experience. More than one-third of the skills identified as important are non-

technical skills such as good communication, problem-solving, and analytical skills, along with flexibility, and the ability to learn quickly.

As one would expect, key skills vary by job. The largest skills gaps are for enterprise systems integration and web development positions. These positions have high complexity and a scarcity of qualified applicants.

The best ways for workers to acquire these skills

Managers identify a large number of methods to acquire skills. Four-year colleges, private technical institutes, seminars and short courses, informal training and community colleges were all selected as effective methods to develop skills for applicants.

Four-year colleges and private technical institutes were rated highest among pre-hire skill acquisition methods when comparing all positions. Short courses and seminars, informal training, and community college were rated high when analyzing specific positions. The preferred method of training varies by position. Four-year college is the preferred method for developing skills in database development and software engineering. Seminars and short courses are the preferred method to learn web development skills. Private technical institutes are strong in developing enterprise systems analysis skills and database development and administration capabilities.

Training after the employee is hired is rated as significantly more effective than pre-hire methods of training; 84 percent of the managers rated on-the-job training as effective or very effective compared to 41 percent rating pre-hire training as high. Managers strongly prefer on-the-job training when it has a structured format and a defined curriculum.

The certification by applicants through a vendor or industry certification program is of moderate importance. Managers ranked certification as 3.5 on a five-point scale measuring importance. Fifty percent of the managers ranked certification as important or very important.

Ten percent of firms hire partially qualified workers and provide training to the employee to become fully qualified. The most common coping strategy when managers are unable to hire IT staff is outsourcing and temporary or contract employees. However, outsourcing shifts the problem. Outsourcing firms responded with the same problem--a severe shortage of IT workers and a skills gap in key positions.

The second most common coping strategy when unable to find qualified IT workers is to shift work to existing employees.

The situation is particularly acute for networking professionals and others involved in the e-commerce arena. E-commerce and the Web are here to stay, and woe to the company that doesn't make finding, hiring and keeping talented staff its top priority. Over the next few years, demand for talented IT employees will continue to outstrip supply--by the end of this year, more than 800,000 IT positions will be unfilled in the United States alone, with 1.2 million open jobs by 2005 and potentially dramatic consequences for U.S. business.

The demand for networking to facilitate the sharing of information, the expansion of client/server environments, and the need for specialists to use their knowledge and skills in a problem solving capacity will be major factors in the rising demand for computer systems analysts, engineers, and scientists. Moreover, falling prices of computer hardware and software should continue to induce more businesses to expand

computerized operations and integrate new technologies. In order to maintain a competitive edge and operate more cost effectively, firms will continue to demand computer professionals who are knowledgeable about the latest technologies and able to apply them to meet the needs of businesses.

Increasingly, more sophisticated and complex technology are being made available to individual users who can design and implement more of their own applications and programs. The result is a growing demand for computer support specialists, help-desk personnel, and technical consultants. Likewise, the explosive growth in electronic commerce—doing business on the World Wide Web—and the continuing need to build and maintain databases that store critical information on customers, inventory, and projects is fueling demand for database administrators current on the latest technology.

New growth areas usually arise from the development of new technologies. The expanding integration of Internet technologies by businesses, for example, has resulted in a rising demand for a variety of skilled professionals who can develop and support Internet, Intranet, and web applications. The growth of electronic commerce means more establishments use the Internet to conduct their business on line. This translates into a need for information technology professionals who can help organizations use technology to communicate with employees, clients, and consumers. Explosive growth in these areas is also expected to fuel demand for specialists knowledgeable about network, data, and communications security.

As technology becomes more sophisticated and complex, employers in all areas demand a higher level of skill and expertise. Individuals with an advanced degree in

computer science, computer engineering, or an MBA with a concentration in information systems should enjoy very favorable employment prospects. College graduates with a bachelor's degree in computer science, computer engineering, information science, or management information systems should also enjoy favorable prospects for employment, particularly if they have supplemented their formal education with practical experience. Because employers continue to seek computer professionals who can combine strong technical skills with good interpersonal and business skills, graduates with non-computer science degrees, who have had courses in computer programming, systems analysis, and other information technology areas, should also continue to find jobs as computer professionals. In fact, individuals with the right experience and training can work in a computer-related occupation regardless of their major or level of formal education.

Hands On Classes

Francis Saucedo is studying to become a Cisco Certified Network Associate (CCNA). He has tried simulated courseware, but he prefers to learn on real equipment. "Just having live routers to bang on is the most important thing," says Saucedo, a systems engineer for Sprint in Chicago. Naturally, Sprint can't afford to have him practice in a production environment and bring the network down. So to access routers, Saucedo turned to an online course at CyberState University (CSU) of Lafayette, Calif. CSU and MentorLabs of Annapolis, Md., are two of only a handful of companies that make access to live equipment a focus of distance-learning courses.

Organizations don't want to hire people who can pass a test but who have no hands-on experience. "Companies don't hire people for their knowledge but for their skills," says David James Clarke IV, a network instructor at CSU.

Greg Long, vice president and general manager of MentorLabs, agrees that simulations aren't the best way to learn. "Simulations are programmed and are limited to what the author thinks is the best way to solve a problem," he says. "What you're learning about is the author's mindset." Access to real equipment lends an unpredictability that simulations can't provide, he adds.

Chuck Diltz, a network consultant in New York, recently passed his Cisco Certified Internetwork Expert exam after taking a MentorLabs course. "The exam is all-encompassing, and it's difficult to gain experience with all the network protocols and features in your job," he says. "With MentorLabs, I was able to get hands-on practice in areas I was weakest."

CSU instructor Clarke sets up a hypothetical corporation for his classes, then builds live labs around the company's networks. Students spend 150 hours completing 50 different labs focused on designing, building, configuring and troubleshooting the networks.

Long and Clarke say employers are starting to see the value inherent in their brand of discovery-based learning because companies end up with better-trained and more valuable employees.

Long says one company recently placed vLab in a head-to-head competition against more traditional computer-based training. One group used vLab and a CCNA study guide, while another group with comparably skilled network engineers used the same manual and 12 off-the-shelf computer-based training lessons. After 10 days and the same amount of time dedicated to CCNA-track learning, everyone in the vLab group

passed the exam, while the members of the computer-based training group all failed, Long says.

The Internet Future

What else can we expect in the next decade? Cisco's Stephen Wolff, states for one, envisions an Internet in the not-too-distant future where networked virtual reality plays a large role in training, collaboration, and conferencing. He also sees the networked home, where "your microwave, your air conditioner, and your car will all be connected to the Internet" to enable users, utility companies, security companies, and other service providers to gain remote control over in-home functions for convenience and safety.
But that's just the beginning of tomorrow's Internet, according to Cerf, who sketches a future that includes an interplanetary Internet. "It's my guess that in the next 30 years, we will want to interface with space stations and colonies on the moon, Mars, and possibly other planets," he predicts.

His musings may sound far-fetched. But Barry Leiner, Director of the Research Institute for Advanced Computer Science, points out: "When the 'Net was invented, nobody envisioned a Yahoo! or an eBay. But that's the way technology is. Nobody saw that the automobile would spawn shopping malls and suburbs, either."
Where's the rush into a networked world taking us? That's the big question that Internet thinkers routinely ponder, but it's no surprise that the roadmaps of tomorrow's information superhighway are mainly guesswork.

But one fact about the likely shape of tomorrow's Internet gets wide agreement: "More of us will be networked," says Cisco's Stephen Wolff. "Less than 2 percent of the world's population now uses the Internet." Nua Ltd., an Irish research organization,

estimates that 201 million people are now on line, meaning that some 5.8 billion are not. In much of the world, Internet users are only counted in the hundreds per nation. Nua cites statistics showing 150 users in Burundi, and a like number in Sierra Leone.

"Bringing the Internet to these regions will be a challenge," says Wolff, who nonetheless believes it is occurring. "Look at China. Its Internet adoption rates are soaring," he says. "Other nations will surely follow."

SIU Benefits

SIU is standing at the threshold of a new era of education. It has the facilities to be able to have online classes from the Internet or to have a distances learning class from East St Louis or around the world. The economic growth for SIU and Southern Illinois would be expanded. Classes of this type would encourage economic growth for the area, which would spur development for the surrounding cities and Illinois.

With the great need for skilled workers in this field, this gives SIU a great advantage. It has the chance to take young students as well as those returning to school and educate them in a field that needs skilled workers. The potential for students to get jobs are there and the foundation for SIU is firmly formed for this transition. With only 2% of the world connected to the Internet, SIU has a great potential to teach these type of classes and be a effective influence in the type of education that works.

ELM 415 Advance Telecommunications Class Structure

Master Syllabus

COURSE NUMBER AND TITLE: ELM 415 - 3 Advanced Networking Systems

COURSE DESCRIPTION:

This course covers the installation and integration of multiple operating systems in a wide area network enterprise utilizing digital telecommunication lines. Topics include data distribution through routers, switches, and hubs to multiple local area networks; installation and configuration of network devices; and interfacing analog equipment to digital telecommunication lines. A variety of network operating systems, application software, and hardware will be used allowing students to install and configure, in a laboratory environment, various telecommunication and network functions found within departments in typical business enterprise systems. Lecture and lab. Prerequisites: ELM 315

PREREQUISITE TO: None

COURSE OUTCOMES:

Outcome 1:

The student will be able to install and integrate multiple network operating systems in a WAN environment.

Objectives:

A. Install and configure a Microsoft network operating system for multiple users and client computers.

B. Install and configure a Novel network operating system for multiple users and client computers.

C. Install and configure a Linux network operating system for multiple users and client computers.

D. Install and configure Microsoft and Linux desktop operating systems to be clients of the computers running the network operating systems.

E. Configure each network operating system so client computers on each system can share files and peripherals across platforms.

Assessment Measures:

1A-C. The student will follow procedures for installing all network operating systems with appropriate services and drivers to allow client computers to successfully log on to the servers and access files and resources.

1D-E. The student will follow procedures for installing all desktop operating systems with appropriate services (SAMBA, NetWare Client) and drivers and demonstrate the ability of the client computers to successfully log on to the servers and access files and resources across platforms.

Outcome 2:

The student will be able to install, troubleshoot, and verify the proper operation of all networking hardware used to segment a LAN into multiple collision domains.

Objectives:

A. Interpret a wiring diagram to determine how to connect computers, hubs, and a switch through a patch panel.

B. Identify and describe the function of all external indicators on the hubs, NIC cards, and switch that are available to verify proper connections and data traffic.

C. Configure the switch locally through the serial port using hyperterminal and remotely using Telenet.

D. Use the ping and traceroute commands to troubleshoot and verify proper network connections.

Assessment Measures:

2A. The student will successfully install all appropriate wiring to connect all network devices.

2B. The student will take a multiple choice test.

2C. The student will demonstrate the ability to access the switch locally and remotely and successfully enable and disable ports.

2D. The student will demonstrate the ability to use the default and customized ping command to verify proper connections between nodes on the network. In addition the student will use the traceroute command to identify the routers on the network. The student will also submit a hard copy print out of the results of the ping and traceroute commands.

Outcome 3:

The student will be able to install and configure the Internetwork Operating System for two Cisco routers using the high speed serial interface (HSSI) and ISDN lines for data distribution to two different networks.

Objectives:

A. Use the Internetworking Operating System commands to display and modify the configuration parameters of the routers.

B. Configure static routes.

C. Configure IP addresses and IP hosts.

D. Configure the routers to use the Ethernet, ISDN, and high speed serial interface (HSSI).

E. Configure the routers to automatically use the ISDN lines if the high speed serial interface fails.

F. Configure routers to use RIP and IGRP routing protocols.

G. Develop standard and extended IP and IPX access lists.

H. Configure Telenet on a client computer to access and configure a router remotely.

Assessment Measures:

3A. The student will take a multiple choice test.

3B-G. The student will demonstrate the ability of the client computers to communicate across networks by using the ping and traceroute commands. In addition the student will submit a hard copy print out showing how the router is configured.

3H. The student will log on to the network, start and configure Telenet on a Windows client computer, access the router, and successfully modify the configuration of the router.

Outcome 4:

The student will be able to interface analog devices to digital telecommunications lines using digital MODEMs.

Objectives:

A. Configure ISDN MODEMs (terminal adapters) and the ISDN simulator to be able to use telephones, FAX machines, and computers using analog MODEMs to send information between networks.

B. Connect all devices together with appropriate cabling.

C. Send voice and data between devices through the ISDN simulator.

Assessment Measures:

4A. The student will access the ISDN MODEMs and the ISDN simulator through their respective serial ports and successfully follow configuration procedures.

4B-C. The student will use two telephones to successfully place a call between two different networks. In addition the student will use two computers with analog MODEMs to communicate across two different networks.

Outcome 5:

The student will be able to describe, compare, and contrast common LAN and WAN networking protocols.

Objectives:

A. Identify the function of the various header sections of the IPX/SPX and TCP/IP protocols and compare them to the OSI model.

B. Describe PPP communication and configuration on routers.

C. Describe how to configure RIP and IGRP routing protocols.

D. Identify and describe where and when nonroutable, routed, and routing protocols are used.

E. Describe and contrast Ethernet, Token Ring, and FDDI in regard to topologies, media , and methods of data transmission.

F. Describe ISDN communication for voice, data, and video networks and explain how to connect to ISDN.

G. Describe the various types of DSL services available for network communications.

H. Describe the various methods for transporting data on WAN carrier types including point-to-point, T- carrier lines, SONET, ISDN, Frame Relay, X.25, ATM, and wireless systems.

Assessment Measures:

5A-H. The student will take a multiple choice test.

Outcome 6:

The student will be able to identify various techniques of maintaining, troubleshooting and analyzing networks.

Objectives:

A. Compare and contrast SNMP and CMIP.

B. Identify and explain the purpose of various types of network audits.

C. Use a network analyzer to identify working devices on the network, cabling problems, and faulty NIC cards.

Assessment Measures:

6A-B. The student will take a multiple choice test.

6C The student will demonstrate the ability to use a network analyzer to detect a faulty NIC card and to obtain MAC addresses of client and server PCs.

Outcome 7:

The student will be able to install firewall software and configure a router to filter packets.

Objectives:

A. Install the Cisco IOS firewall software.

B. Configure basic packet filtering on a router.

C. Configure IP and IPX filtering on a router.

D. Configure the route as a firewall.

Assessment Measures:

7A. The student will follow the installation procedures for the Cisco IOS firewall software and demonstrate the ability of the router to successfully boot after the installation.

7B-D. The student will follow router configuration procedures and demonstrate the ability of the router to filter an individual address, a group of addresses, and addresses representing an entire network.

TOPICAL OUTLINE:

	Topics	**Percentages of Time**
I.	Installation and Interoperability of Network Operating Systems	20%
	A. Installing network operating systems from multiple vendors B. Installing and configuring network operating system services to allow the exchange of data and the use of resources across multiple network operating system platforms C. Routing data from multiple network operating systems in a WAN	
II.	Digital Transmission of Data in Telecommunications	10%
	A. T-carriers B. ISDN C. Frame Relay D. DSL E. ATM F. X.25 G. SONET	
III.	Ethernet	5%
	A. Segmenting B. CSMA/CD network access protocol C. Wiring considerations D. Emerging Ethernet technologies	
IV.	Installation, Configuration, and Management of Network Devices	15%
	A. Digital MODEMs B. Hubs, bridges, switches, routers C. Media installation D. Network design	
V.	IP Addressing	3%
	A. Classes B. Subnetting	
VI.	Installing and Configuring Routers	20%
	A. The Internetworking Operating System (IOS) B. Configuration commands C. Configuring Access lists D. Configuring TCP/IP, and IPX/SPX addressing E. Configuring PPP and frame relay F. Configuring ISDN and HSSI	
VII.	Network Protocols and Standards	12%

A. Routed protocols, TCP/IP, IPX/SPX,
B. SNMP, CMIP
C. Frame format, data encapsulation
D. Routing protocols, RIP, IGRP
E. OSI layered model

VIII. Maintaining and troubleshooting Networks 5%

A. SNMP, CMIP
B. Network audits
C. Network analyzers

IX. Network Security 10%

A. Proxy Servers
B. Firewalls
C. Virus monitoring
D. Backup
E. Power protection

TEXTBOOK:

Required:

Hudson, K, & Caudle, K. (2000). CCNA Guide to Cisco Routing. Cambridge, MA: Course Technology

Reference:

Hudson, K, & Cannon, K. (2000). CCNA Cisco Networking Fundamentals. Cambridge, MA: Course Technology

Palmer, M, & Sinclair, R. (1999). A Guide to Designing and Implementing Local and Wide Area Networks. Cambridge, MA: Course Technology

ELM Independent Study - Advanced Telecommunications Presentation Outline

I. Introduction - Brian Kearney
- How the class fits in to the curriculum
- The Beginning
- The Project
  - Objectives
    - Install the infrastructure
    - Verify communication across the entire enterprise system
  - Teams
- Overview of how the class will work
  - Test and analyze the functioning system
  - Install and configure hardware/software using rotating labs (technology centers)
  - Install and configure hardware/software as a team
  - Test and analyze the functioning (hopefully) system

II. Overview of the System - Dan Alexander
- Hardware
- Software
- Flow of Information

III. ISDN - Mike Hartley
- The ISDN simulator
  - Replaces the phone company
  - 2 B Channels and 1 D channel
  - Features:
    - U and S/T interface
    - Basic Configuration
  - Primary Options
- ISDN Modems
  - Purpose - Analog to digital
  - Setup

IV. The Network Operating Systems - Hillary
- Objectives
- The three operating systems
- Functions identified for the three systems
  - NT - Multimedia
  - Novell - Application server
  - Linux - Web Server

V. The Routers - Jeff Squibb
- Routers
- ISDN and the High Speed Serial Port

Application
Demonstration

VI. Resources - Lindsey Fenton
The difficulty of having too much information.
Phone, On-Line, Books
Display cabinet of resources
Creating documentation

VII. Summary of the Project - David Young
Challenges
Hardware
Working in groups
Communication
Software - Different operating systems, Protocols, Diagnostic utilities, Remote administration

Cisco 2503 Router Configuration

Note: this configuration is for the cisco3091 router from the independent study network.

Connect a console cable between the console port on the back of the computer to be used in the configuration and the console port on the back of the router.

From the Windows startup screen, select Programs, select Accessories, select Communications, and select HyperTerminal.

When the HyperTerminal dialog box appears, establish a communication using the COM1 port. Use the parameters of 9600 baud, 8 data bits, no parity, and two stop bits.

After about 30 seconds, several lines of information should begin appearing on the screen. One line should appear as follows: "Would you like to enter the initial configuration dialog? [yes]:" Press the Enter key to begin the configuration process.

A question should appear on the screen asking you if you would like to see the current interface summary. Hit the Enter key.

A message should appear telling you to enter global parameters.

Enter host name [Router]: cisco3091 <Enter>

Enter enable secret: pail

Enter enable password: shovel

Enter virtual terminal password: vterm1

Configure SNMP management? [yes]: no

Configure Vines? [no]: no

Configure LAT? [no]: no

Configure AppleTalk? [no]: no

Configure DECnet? [no]: no

Configure IP? [yes]: yes
    Configure IGRP routing? [yes]: yes
    Your IGRP autonomous system number [1]: 15

Configure CLNS? [no]: no

Configure bridging? [no]: no

Configure IPX? [no]: yes

Configure XNS: [no]: no

Configure Apollo? [no]: no

Enter ISDN BRI switch type: [none]: basic-ni1
Note: the switch type question may prompt you to make a selection from a table

Configuring interface BRIO:
Is this interface in use? [yes]: yes

Configure IP on this interface? [yes]: yes
IP address for this interface? 192.168.0.161
Number of bits in subnet field [0]: 5
Note: the subnet field question may ask for the subnet address, in which case you enter 255.255.255.248

Configure IPX on this interface? [no]: yes
IPX network number [1]: B000

Configuring interface BRI1:
Is this interface in use? [yes]: no

Configuring interface Ethernet0:
Is this interface in use? [yes]: yes

Configure IP on this interface? [yes]: yes
IP address for this interface: 192.168.0.169
Number of bits in subnet field [8]: 5
Note: the subnet field question may ask for the subnet address, in which case you enter 255.255.255.248

Configure IPX on this interface? [no]: yes
IPX network number [1]: B001

Configuring interface Ethernet1:
Is this interface in use? [yes]: no

Configuring interface Serial0:
Is this interface in use? [yes]: yes

Configure IP on this interface? [yes]: yes
Configure IP unnumbered on this interface? [no]: no
IP address for this interface: 192.168.0.153
Number of bits in subnet field [8]: 5
Note: the subnet field question may ask for the subnet address, in which
case you enter 255.255.255.248

Configure IPX on this interface? [no]: yes
IPX network number [2]: B002

Configuring interface Serial1:
Is this interface in use? [yes]: no

Use this configuration? [yes/no]: yes
The save configuration question may ask you to choose from three options, (0) go back to IOS command prompt, (1) return to setup without saving, (2) save configuration
and exit. Choose (2).

A message should appear telling you that the system is building a configuration file. When the file is constructed, another message will appear telling you to use the enabled mode to modify the configuration. Press Enter.

At the **cisco3091>** prompt, type the command **enable**. When asked for the password, use the enable password, which is **pail.**

The prompt should now be **cisco3091#.** Enter the command **configure terminal.** The prompt should now be **cisco3091 (config)#.**

The following commands should be entered (bold letters indicate command name):

cisco3091 (config) # **hostname** cisco3091
cisco3091 (config) # **username** cisco4738 **password** secret1
cisco3091 (config) # **isdn switch-type** basic-ni1
cisco3091 (config) # **interface** BRI 0

The last command should change the prompt to **cisco3091 (config-if) #.** Enter the following commands:

cisco3091 (config-if) # **ip address** 192.168.0.161 255.255.255.248
cisco3091 (config-if) # **isdn spid1** 0835866101 18008358661
cisco3091 (config-if) # **isdn spid2** 0835866301 18008358663
cisco3091 (config-if) # **encapsulation ppp**
cisco3091 (config-if) # **ppp authentication chap**
cisco3091 (config-if) # **dialer load-threshold 128 outbound**
cisco3091 (config-if) # **ppp multilink**

cisco3091 (config-if) # **dialer map** ip 192.168.0.162 **name** cisco4738 **speed** 56
broadcast 18008358662
cisco3091 (config-if) # **dialer-group** 1
cisco3091 (config-if) # **exit**

The prompt is returned to **cisco3091 (config) #.**

cisco3091 (config) # **dialer-list** 1 **protocol** ip **permit**
cisco3091 (config) # **ip route** 192.168.0.176 255.255.255.248 192.168.0.162
cisco3091 (config) # **ip route** 192.168.0.176 255.255.255.248 192.168.0.154
cisco3091 (config) # **ip default-network** 192.168.0.176
cisco3091 (config) # **interface** serial 0
cisco3091 (config-if) # **backup interface** BRI 0
cisco3091 (config-if) # **backup delay** 5 30
cisco3091 (config-if) # **clock rate** 56000
cisco3091 (config-if) # **bandwidth** 56
cisco3091 (config-if) # **exit**
cisco3091 (config) # **exit**
cisco3091# **copy running-config startup-config**
cisco3091# **exit**

Note: the clock rate command and the bandwidth command are used on the router that is to be the DCE.

The following configuration is for the cisco4738 router from the independent study network.

Connect the console cable to the console port on the back of the router. Establish a connection with the router as was done with cisco3091. If the routers are networked together, make sure that the serial cable and Ethernet cable are disconnected. If this session is occurring directly after the first configuration session, then you may just have to plug in the console cable, wait a few seconds, and hit the Enter key.

A message should appear telling you to enter global parameters.

Enter host name [Router]: cisco4738 <Enter>

Enter enable secret: pail

Enter enable password: shovel

Enter virtual terminal password: vterm1

Configure SNMP management? [yes]: no

Configure Vines? [no]: no

```
Configure LAT? [no]: no

Configure AppleTalk? [no]: no

Configure DECnet? [no]: no

Configure IP? [yes]: yes
        Configure IGRP routing? [yes]: yes
        Your IGRP autonomous system number [1]: 15

Configure CLNS? [no]: no

Configure bridging? [no]: no

Configure IPX? [no]: yes

Configure XNS: [no]: no

Configure Apollo? [no]: no

Enter ISDN BRI switch type: [none]: basic-ni1

Configuring interface BRIO:
Is this interface in use? [yes]: yes

        Configure IP on this interface? [yes]: yes
                IP address for this interface? 192.168.0.162
                Number of bits in subnet field [0]: 5
                Note: the subnet field question may ask for the subnet address, in
which
                case you enter 255.255.255.248

        Configure IPX on this interface? [no]: yes
                IPX network number [1]: B000

Configuring interface BRI1:
Is this interface in use? [yes]: no

Configuring interface Ethernet0:
Is this interface in use? [yes]: yes

        Configure IP on this interface? [yes]: yes
                IP address for this interface: 192.168.0.177
                Number of bits in subnet field [8]: 5
                Note: the subnet field question may ask for the subnet address, in
which
                case you enter 255.255.255.248
```

Configure IPX on this interface? [no]: yes
IPX network number [1]: B001

Configuring interface Ethernet1:
Is this interface in use? [yes]: no

Configuring interface Serial0:
Is this interface in use? [yes]: yes

Configure IP on this interface? [yes]: yes
Configure IP unnumbered on this interface? [no]: no
IP address for this interface: 192.168.0.154
Number of bits in subnet field [8]: 5
Note: the subnet field question may ask for the subnet address, in which
case you enter 255.255.255.248

Configure IPX on this interface? [no]: yes
IPX network number [2]: B002

Configuring interface Serial1:
Is this interface in use? [yes]: no <Enter>

Use this configuration? [yes/no]: yes
The save configuration question may ask you to choose from three options, (0) go back to IOS command prompt, (1) return to setup without saving, (2) save configuration and exit. Choose (2).

A message should appear telling you that the system is building a configuration file. When the file is constructed, another message will appear telling you to use the enabled mode to modify the configuration. Press Enter.

At the **cisco4738>** prompt, type the command **enable**. When asked for the password, use the enable password, which is **pail**.

The prompt should now be **cisco4738#**. Enter the command **configure terminal**. The prompt should now be **cisco4738 (config)#**.

The following commands should be entered (bold letters indicate command name):

cisco4738 (config) # **hostname** cisco4738
cisco4738 (config) # **username** cisco3091 **password** secret1
cisco4738 (config) # **isdn switch-type** basic-ni1
cisco4738 (config) # **interface** BRI 0

The last command should change the prompt to **cisco4738 (config-if) #**. Enter the following commands:

```
cisco4738 (config-if) # ip address 192.168.0.162 255.255.255.248
cisco4738 (config-if) # isdn spid1 0835866201 18008358662
cisco4738 (config-if) # isdn spid2 0835866401 18008358664
cisco4738 (config-if) # encapsulation ppp
cisco4738 (config-if) # ppp authentication chap
cisco4738 (config-if) # dialer load-threshold 128 outbound
cisco4738 (config-if) # ppp multilink
cisco4738 (config-if) # dialer map ip 192.168.0.161 name cisco3091 speed 56
                        broadcast 18008358661
cisco4738 (config-if) # dialer-group 1
cisco4738 (config-if) # exit
```

The prompt is returned to **cisco4738 (config) #.**

```
cisco4738 (config) # dialer-list 1 protocol ip permit
cisco4738 (config) # ip route 192.168.0.168 255.255.255.248 192.168.0.161
cisco4738 (config) # ip route 192.168.0.168 255.255.255.248 192.168.0.153
cisco4738 (config) # ip default-network 192.168.0.176
cisco4738 (config) # interface serial 0
cisco4738 (config-if) # backup interface BRI 0
cisco4738 (config-if) # backup delay 5 30
cisco4738 (config-if) # exit
cisco4738 (config) # exit
cisco4738# copy running-config startup-config
cisco4738# exit
```

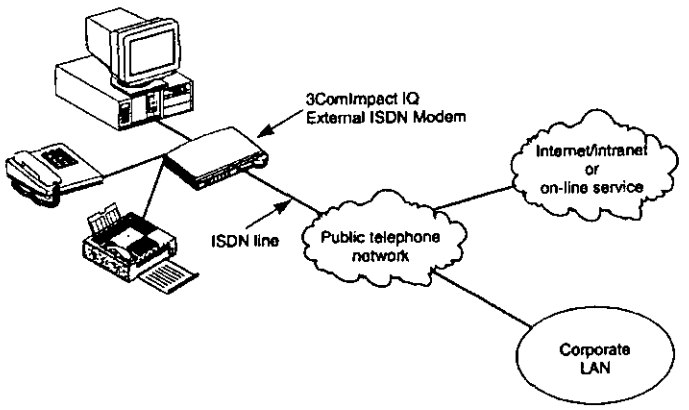
3ComImpact IQ EXTERNAL ISDN MODEM

SETUP AND CONFIGURATION INSTRUCTIONS

Materials needed:
- 3ComImpact IQ external ISDN modem
- 115-volt AC power adapter (supplied with modem kit)
- 3 1/2" floppy diskette containing 3Com configuration software
- ISDN cable with RJ-45 connectors at each end
- 25-pin male to 9-pin female serial cable
- Telephone cable with RJ-11 connectors at each end
- Telephone

The 3ComImpact IQ external ISDN modem, model 3C882, is an external, stand-alone ISDN Basic Rate modem for connection with digital telephone services from local telephone companies in North America. The 3C882 is equipped with an NT1 terminating device, and thus should be connected to the U Interface point of the ISDN service provided by the telecommunications carrier.

The 3C882 modem is designed for users who require high-speed access to the Internet, intranet, online information services, or corporate local area networks (LANs). A typical 3C882 ISDN modem installation is shown in the following diagram.



The 3C882 modem is designed to transmit data at speeds of up to 128 Kbps in its standard configuration. Transmission rates of up to 230.4 Kbps are possible with the use of hi/fn® compression and a high-speed serial port.

INSTALLING THE CONFIGURATION SOFTWARE

1. Install the 3 1/2" floppy disk containing the 3Com configuration software into the floppy disk (A:) drive
2. From the Windows startup screen, select Start, and then select Run
3. The file to be run is the Setup.exe file on the floppy disk. You can either type A:\Setup.exe in the Open box of the Run dialog box, or click Browse, select the A: drive, and select Setup.exe.
4. Click OK
5. When the Welcome screen appears, click Next
6. Choose the destination drive or directory for the software to be copied to. The default is C:\3comiq\
7. Click Next
8. The next screen will be a status report on the file copying process. If a message appears asking you if you wish to view the ReadMe file now, you can select either yes or no. The ReadMe file will be discussed in just a moment
9. The next screen that appears will contain the message that the Setup is complete. There should be a dialog box containing the message *You may run the installed program by double-clicking on the program icon installed.* Click OK

At this point, or when you try to run the 3ComImpact IQ software, a message may appear instructing you to update the driver modem to the latest version. The ReadMe file contains all the information on this subject. If the driver has already been installed on your computer, this will not be necessary. If the new driver has not bee installed, then you will be prompted to do so at some point. The ReadMe file instructions for updating the driver for Windows 98 are below.

NEW MODEM DRIVER (IMPACT.INF FILE) FOR WINDOWS 95/98 AND WINDOWS NT 4.0

This release includes a new impact.inf file (i.e., driver) which allows Windows 95/98 and Windows NT 4.0 and above users to make use of the Call Preferences feature which is part of MS Dial-Up Networking. In Windows 95/98, for example, Call preferences is located in Dial-Up Networking under File/Properties/Configure/Connection.

For Windows 98:

--After you have installed your ISDN Modem software, reboot your PC with the ISDN Modem still powered up. Windows Plug and Play will automatically build a drive database and install its own, older version of the 3ComImpact IQ modem driver. You must therefore take the additional step of updating the modem driver after Plug and Play has finished the installation. To update the driver, follow the instructions below for updating using Windows 98.

To update the modem driver if you already have an old driver installed, follow the proper instructions below for your operating system:

For Windows 98:

--From the Start menu, select Settings, and then Control Panel.
--Double-click the System icon, then choose the Device Manager tab.
--Under Modem in the list of devices, choose the 3ComImpact IQ driver that you want to update.
--Click Properties, then choose the Driver tab. Click Update Driver, and then Next.
--Check "Display a list of all other drivers in a specific location so you can select the driver you want," and then click Next.
--Click Have Disk, and then either insert your 3Com diskette into drive A or click Browse and select the directory to which you downloaded the impact.inf file. Click OK.

NOTE: If you are using a 230K COM port, you will be able to add the 230K driver as a separate step (below).

--Click Next.

If at this point you receive an Update Driver Warning asking if you are sure you want to use the driver you selected, click YES.

--Click Next, then Finish, and then Close.

If you are using a 230K COM port, follow these additional steps to add the 230K driver:

--From the Control Panel window, double-click Modems, then click Add.
--Check "Don't detect my modem. I will select it from a list," and then click Next.
--Select 3COM, then select 3ComImpact IQ 230K (if there is more than one version, choose the most recent). Click Next.
--Select the appropriate COM port to which your modem is connected. Click Next, and then Finish.

NOTE: After you have finished updating the modem driver, you should also check to make sure that the proper driver is selected in EACH of your Dial-Up Networking profiles. For each profile (from the Dial-Up Networking window), right-click the profile icon, and then choose

Properties. For Windows 98 in particular, make sure that "3ComImpact IQ Plug and Play" is NOT the selected driver.

INSTALLING AND CONFIGURING THE MODEM

You should familiarize yourself with the components of the front panel and back panel of the 3C882 modem prior to installation. The LED status display, shown in the figure below, consists of eight front panel LEDs that are described in the table that follows the diagrams.

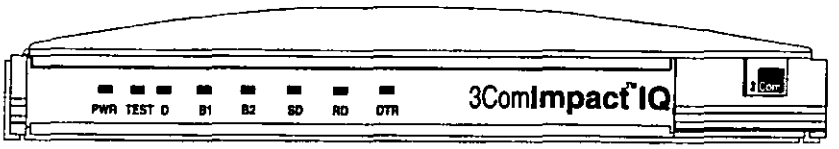


Figure 2-2 Front Panel LED Indicators

Figure 2-3 shows the back panel.

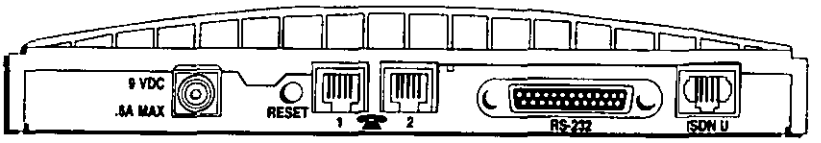


Figure 2-3 Back Panel Connectors

Front Panel LED Indicator Definitions

LED	Color	Description
PWR	Green	Power Indicator: Lit when power is on.
TEST	Green	Self-test/Status: Flashes when the modem is executing its Power-up self-test or a user-initiated reset. If the results of the self-test or reset are normal, then the LED goes off. If the result of the self-test is abnormal, and a fault is detected, the LED remains on but dies not flash.
D	Green	D channel status: Indicates that the ISDN physical network interface and the D channel status: Goes of once the physical interface and D channel signaling are synchronized.

		Flashes if the physical interface establishes synchronization and the ISDN D channel signaling procedures are not properly established. Remains lit if the physical ISDN interface is not synchronized or if it is disconnected.
B1	Amber or Green	B1 channel activity: Green indicates a circuit-switched data call in progress. Amber indicates a circuit-switched voice call in progress. If a call is in the dialing state, the LED flashes. The LED goes off when the call is disconnected
B2	Amber or Green	B2 channel activity: Green indicates a circuit-switched data call in progress. Amber indicates a circuit-switched voice call in progress. If a call is in the dialing state, the LED flashes. The LED goes off when the call is disconnected
SD	Green	Send Data: Indicates that information is being transmitted over the serial data port from the computer to the ISDN modem
RD	Green	Receive Data: Indicates that information is being transmitted over the serial data port from the ISDN modem to the computer.
DTR between	Green	Data Terminal Ready: Indicates that communication the ISDN modem and the computer has been established.

Installing the Serial Cable to the Modem

Insert the 25-pin male end of the serial cable into the RS-232 serial port on the back of the modem. Connect the 9-pin female end of the cable to a serial COM port on the back of the computer. The COM1 port is the default port for this procedure.

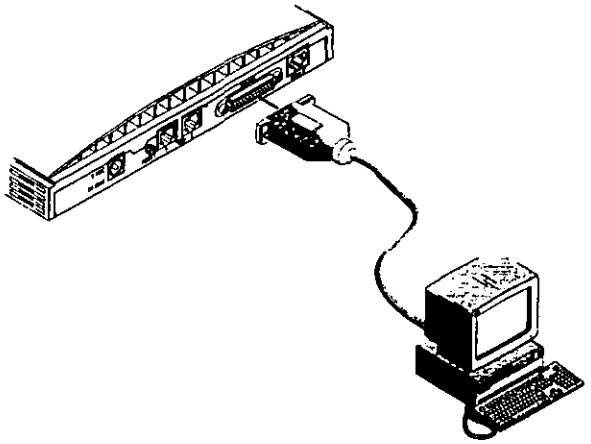
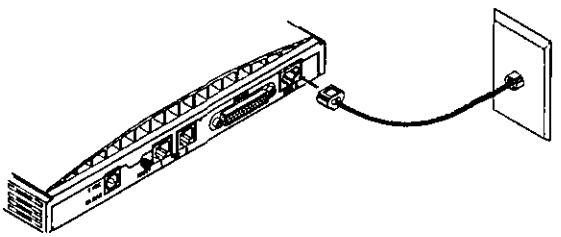


Figure 2-4 Computer to 3C882 ISDN Modem COM Port Connection

Installing the ISDN Cable

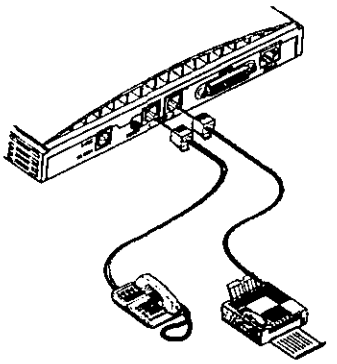
Connect one end of the RJ-45/RJ-45 ISDN cable to the RJ-45 ISDN line port labeled ISDN U on the back panel of the modem. Connect the other end of the ISDN cable to the U interface of Port 1 of the ISDN simulator.



The diagram above shows the proper connection for the modem end of the ISDN cable. Instead of hooking to a telephone jack with the other end of the ISDN cable, as you probably would be doing in a real-life situation, you will instead be connecting to the ISDN simulator.

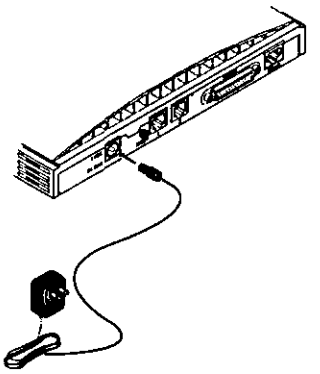
Installing Analog Equipment

Install one end of the RJ-11/RJ-11 telephone cable into telephone port 1 on the back of the modem. Install the other end of the cable into the appropriate RJ-11 connector on the telephone.



Installing the Power Cable

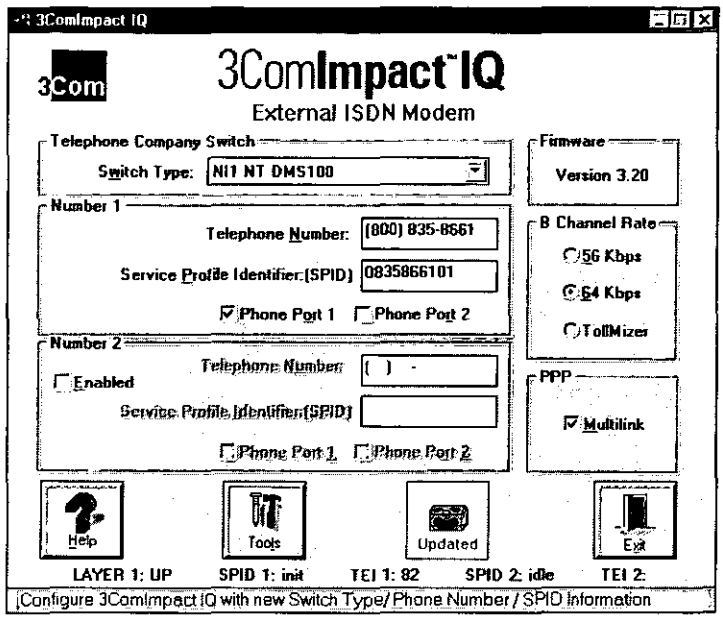
Connect the ISDN modem power cable to the 9 VDC power connector on the back panel of the modem. Plug the transformer into a standard 110-volt AC wall outlet.



Configuring the Modem

You are now ready to configure the 3ComImpadt IQ modem using the 3Com configuration software. All of the connections described above should be in place, and the ISDN simulator should be powered up and finished with its self-test.

The 3Com modem configuration screen should appear like this:



1. From the Windows startup screen, select Start, select Programs, and select 3ComImpact IQ.
2. As the configuration program loads up, you may see a message that says *UPLOADING CONFIGURATION*. The current configuration loaded on the modem's NVRAM, if any, is being uploaded to the PC. A screen indicating that the SPID Wizard is starting up will appear. The first message will be *Checking SPID Status*. The second message will be *Starting SPID Wizard*. When this second message appears, **click CANCEL** (quickly) to exit the SPID Wizard and enter the manual configuration mode.
3. A message should appear on the screen that says *Configuration Wizard cancelled. You need to enter and update Phone number and SPID before using your modem*. Click OK.
4. The modem configuration screen should appear. At the top of the screen, locate the area called Switch Type. From the Switch Type pull-down menu, select the NI1 NT DMS 100 switch type.
5. Moving down the screen, the next region to be configured is the area called Number 1. In the Telephone Number box enter the telephone number for the first device attached to the simulator's Port 1. This number is 800-853-8661 (the leading 1 is not used here).
6. In the Service Profile Identifier:SPID box enter the corresponding SPID for the phone number you entered above. In this case, the SPID is 0835866101.
7. On the next line down , make sure that Phone Port 1 is selected (remember, the telephone is hooked to Port 1 on the modem).
8. On the right side of the configuration box, under B Channel Rate, make sure that 64Kbps is selected.
9. Just below B Channel Rate, make sure that PPP Multilink is selected.
10. Once you are sure that all of the settings are correct, save the new configuration to the modem's NVRAM by clicking the UPDATE button.
11. A message will appear asking you if you are sure that you want to change the modem's provisioning. Click Yes.

A message should appear telling you that the new configuration is being downloaded. If the Modem is properly configured, the D LED light on the front of the modem should be unlit.

Installation of the Second Modem

You will use the configuration software that is already installed on the PC to configure the second modem. Start at the section above titled "Installing the Serial Cable to the Modem," and make the same types of physical connections to the second modem that you did to the first modem. Start the configuration software and configure the second modem in the same manner that you configured the first modem, with the following changes:

Physical Connections

The ISDN cable should be connected to the U interface of Port 2 on the simulator.

Configuration Changes

The telephone number used should be the number for the first device attached to Port 2 of the simulator: 800-835-8662. The corresponding SPID is 0835866201.

Note: The second modem will still be configured for Number 1, Phone Port 1.

Installing Windows NT Server 4.0

Beginning Installation

This section describes Windows NT Setup, the program used to install Windows NT on your computer. Installing a new operating system can involve many choices, and Setup is designed to guide you through these choices as smoothly as possible.

Installing Windows NT consists of three main steps:

What You Should Know Before Running Setup

Use the following checklist to organize your information before running Setup.

❑	Have you read the Windows NT Workstation readme files?	If possible, read the file Setup.txt on your compact disc for late-breaking information pertaining to hardware and configuration. After you finish installing, read the file Readme.doc for any new information not included in this book.
❑	If possible, have you backed up all of the files currently on your computer to either a network share or a tape storage device?	

❑	Have you checked all of your hardware (network adapter cards, video drivers, sound cards, CD-ROM drives, etc.) against the Windows NT Hardware Compatibility List? A copy of this list is included in your package.	Up-to-date versions are available on the World Wide Web at	`http://www.microsoft.com/ntserver/hcl/hclintro.htm`
❑	Do you have all the device driver disks and configuration settings for your third-party hardware?		
❑	Do you have ready a formatted disk for the Emergency Repair Disk (ERD)?	Make sure to use a 3.5-inch 1.44 megabyte (MB) disk for the ERD. Label it "Emergency Repair Disk" and set it aside until Setup asks you to insert it.	**Note** Although the ERD is optional for running Windows NT, Microsoft strongly recommends that you create one during installation and update it every time you make changes to your configuration, such as restructuring partitions, adding new disk controllers and other software, or installing new applications.
❑	Do you have your Windows NT Workstation compact disc?	-- or --	
❑	Do you have network access to the Windows NT Workstation files?		

Please record the following information here:

Product ID: _____

(20 digit number that appears on the inside back cover of the book)

or CD Key:
(10 digit number that appears on the CD case)

Previous operating system (if any):
Windows 95 cannot be upgraded to Windows NT 4.0. If your computer is running Windows 95, you must install Windows NT 4.0 in a separate directory, and your computer will dual-boot. For more information, see "Choosing a Directory for the Windows NT Workstation Files" later in this chapter.

If you will be using this computer on a network:

Computer name:
Workgroup/domain name:
IP address:
(if your network does not have a DHCP server)

System Requirements

The following table describes the system requirements for Windows NT Workstation.

Category	Requirement
Hardware	32-bit x86-based microprocessor (such as Intel 80486/25 or higher), Intel Pentium, or supported RISC-based microprocessor such as the MIPS R4x00™, Digital Alpha Systems, or PowerPC™. VGA, or higher resolution, monitor One or more hard disks, with 117 MB minimum free disk space on the partition that will contain the Windows NT Workstation system files (148 MB minimum for RISC-based computers) For x86-based computers, a high density 3.5-inch disk drive plus a CD[hyph]ROM drive (for computers with only a 5.25-inch drive, you can only install Windows NT Workstation over the network) For any computer not installing over a network, a CD-ROM drive
Memory	12-MB RAM minimum for x86-based systems; 16 MB recommended 16-MB RAM minimum for RISC-based systems
Optional components	Mouse or other pointing device
	One or more network adapter cards, if you want to use Windows NT Workstation with a network

Windows NT Workstation supports computers with up to two microprocessors. Support for additional microprocessors is available from your computer manufacturer.

Starting Setup

The procedure for starting Setup varies slightly according to:

- your computer platform (Intel x86-based or RISC-based)
- how you gain access to the Setup files (from the boot media or over a network)

The procedures described here pertain to both Intel x86-based and RISC-based computers. If your computer is RISC-based, notice the special instructions in some of the steps.

Note If you are installing Windows NT on a portable computer with a Personal Computer Memory Card International Association (PCMCIA) port and you want Setup to configure a device connected to that port, you must insert the device and start or restart your computer before running Setup.

Make sure that any device you use is approved on the Windows NT Hardware Compatibility List. For ways of finding this list, see "What You Should Know Before Running Setup" earlier in this chapter.

The Setup disks included with your package (labeled "Setup Boot Disk," "Setup Disk 2," and "Setup Disk 3") are required if you are installing Windows NT for the first time on an Intel x86-based computer. If you are installing over a network and do not have your package at hand, the Setup disks are created during Setup when you use the **winnt** or **winnt32** command. Also, the Setup disks let you start Windows NT at a later time when it might not be able to start on its own due to a system error. You can use the Setup disks together with the Emergency Repair Disk, as described in Help, to recover your system when it is unable to start.

If your computer's BIOS supports the El Torito Bootable CD-ROM (no-emulation mode) format, you can skip over using the Setup disks during a new installation of Windows NT 4.0 and start Setup directly from the Windows NT Workstation compact disc.

If you are installing on a RISC-based computer, this is the appropriate method for starting Setup as well. Check the documentation for your computer to learn whether this option is available to you.

To install Windows NT Workstation on your computer using the Setup disks and/or the Windows NT Workstation compact disc

- With your computer turned off, insert the disk labeled "Windows NT Setup Boot Disk" into drive A of your computer.

  Or, if your computer's BIOS supports the El Torito Bootable CD-ROM (no-emulation mode) format, insert the Windows NT Workstation 4.0 compact disc with your computer turned off.

- Turn on your computer.

  If you are installing on an Intel x86-based computer, Setup will start automatically.

  If you are installing on a RISC-based computer, follow these additional steps:

- At the ARC screen, choose **Run A Program** from the menu.

- At the prompt, type **cd:**\system**setupldr** and press ENTER, where system is the directory name matching your system type: MIPS, PPC (for PowerPC computers), or ALPHA.

  For some RISC-based computers, you might need to supply a full device name instead of typing **cd:**. See your computer documentation for more information.

Once Setup is started, follow the instructions on the screen. Refer to the appropriate sections in this book when you need assistance.

To install Windows NT Workstation 4.0 using a network connection to the Setup files on a remote server

- Using your existing operating system or a MS-DOS disk, establish your connection to the share containing the Setup files.

- If your computer is currently running a previous version of Windows NT, type **winnt32** at the command prompt. For all other installations, type **winnt**.

Setup begins with a brief welcoming screen asking you the process by which you want to proceed with installation. If you are installing Windows NT Workstation 4.0 on your machine for the first time, press ENTER to begin the Setup process.

On this and the other opening Setup screens, Help is available by pressing F1. These Help screens contain useful background information and suggestions to follow while running Setup.

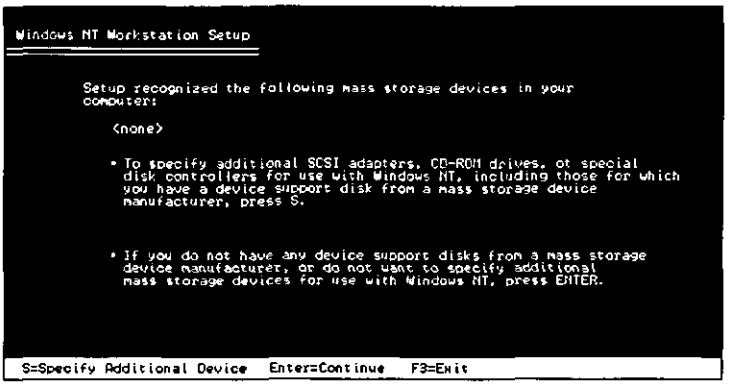
If you are continuing an earlier failed attempt to install Windows NT, certain repair options are available by pressing R. For guidance in using these screens, refer to the available Help by pressing F1.

You can cancel Setup entirely at any point on these screens by pressing F3.

Configuring a Mass Storage Device

Next, Setup scans your computer to detect the mass storage devices, such as CD[hyph]ROM drives and SCSI adapters. Hard disks are not included in this scan.

Note Setup automatically detects all integrated device electronics (IDE) and enhanced small device interface (ESDI) drives. These drives are not displayed on this screen.



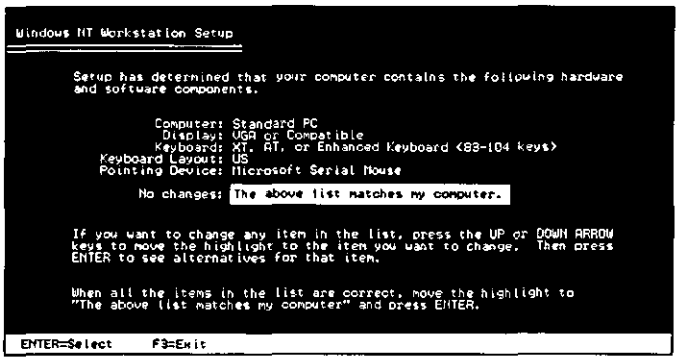
Setup lists all the mass storage devices it finds. You can accept this list, or you can choose to add to it if you have a disk with device drivers from the manufacturer of your device. You can also wait and install additional mass storage devices after Setup is complete.

If any of your mass storage devices were not detected, press S to install them at this time.

Tip To install additional mass storage devices after Setup is complete, click the **Start** button, point to **Settings**, and then click **Control Panel**. Double-click the **SCSI Adapters** icon. For information, see Help.

Verifying Your Hardware

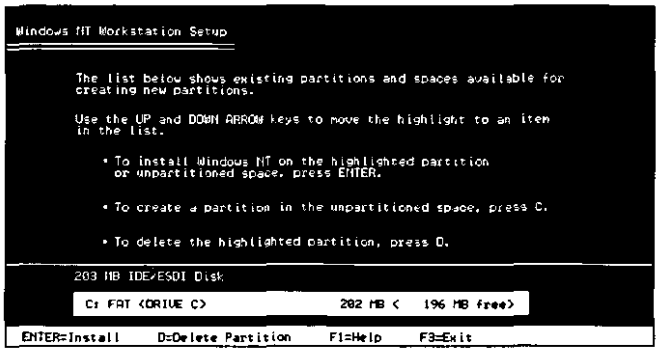
Next, Setup displays the list of hardware and software components it finds on your computer.



Use the UP ARROW and DOWN ARROW keys to move to a setting on the list that needs to be changed. Then, press ENTER to see alternatives for that item.

Configuring the Disk Partitions

Disk space on your hard drive(s) is divided into usable areas called partitions. Before it can install Windows NT, Setup must know the appropriate disk partition for installing the system files.



A disk partition can be any size from 1 MB to the entire hard disk. But the partition where you store Windows NT files must be on a permanent hard disk and must have enough unused disk space to hold all the files. Refer to the section "System Requirements" earlier in this chapter to double-check that your computer has adequate disk space for installing the Windows NT files.

The system partition is the partition that has the hardware-specific files needed to load Windows NT. On an x86-based computer, Windows NT looks for certain files in the root directory of drive C (Disk 0) when you start your computer. This partition must be formatted with either the NT File System (NTFS) or the File Allocation (FAT) file system in order for Windows NT to start. It must be formatted with the FAT file system if you want to run both Windows NT and MS[hyph]DOS or if you are dual-booting with Windows 95. For more information, see the next section, "Choosing a File System for the Windows NT Partition."

Tip A RISC-based computer can have several system partitions that are configurable by the manufacturer's configuration program, and each system partition must be formatted for the FAT file system. If you want to use NTFS, you need to create at least one FAT system partition of at least 2 MB plus a second partition large enough to contain all the files you want to protect with NTFS. For information about setting up more than one system partition on a RISC-based computer, see your hardware documentation.

If you are installing Windows NT on a mirrored partition, you must disable mirroring before running Setup and then reestablish mirroring after installation is complete.

Caution If your hard disk contains stripe sets, volume sets, or mirrors, these elements appear on the Setup screen as "Windows NT Fault Tolerance." Be careful not to delete any of these elements. Also, do not delete partitions that contain data you want to keep.

Use the following guidelines when making decisions about your hard disk partitions.

If you will use only the Windows NT Workstation operating system:

- On a new x86-based computer, make a single partition and format it with NTFS, as described in the following section, "Choosing a File System for the Windows NT Partition."
- On an existing system containing files you want to keep, maintain all existing partitions. You can install the Windows NT Workstation files on any partition with sufficient free space: 117 MB for x86-based machines, or 148 MB for RISC-based computers.

If you plan to use another operating system, such as MS[hyph]DOS or Windows 95, in addition to Windows NT:

- To run both MS[hyph]DOS and Windows NT on the same computer, you must first install MS[hyph]DOS. Installing it later might overwrite the boot sector on the hard disk, making it impossible to start Windows NT without using the Emergency Repair Disk.
- Make sure the system partition (for example, drive C) is formatted as FAT. For example, if you already have MS[hyph]DOS installed and want to keep it, preserve the system partition and keep the file system as FAT, as described in the following section, "Choosing a File System for the Windows NT Partition." You can install the Windows NT files on any uncompressed partition with sufficient free space, as listed in the section "System

Requirements" earlier in this chapter. You cannot install Windows NT on a compressed drive created with any utility other than NTFS compression.

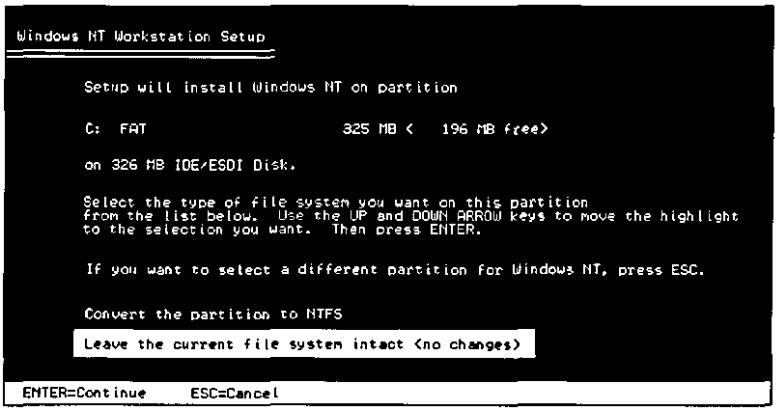
- To use NTFS and have access to another operating system, you must have at least two disk partitions. Format drive C with a file system that Windows NT and your other operating system can use, such as FAT. Format the other partition for NTFS. You can place the Windows NT files on any uncompressed (or NTFS-compressed) partition with sufficient free space.

If you are installing Windows NT on a computer currently configured to start either OS/2 or MS[hyph]DOS using the **boot** command, Windows NT Setup sets up your system so that you can run Windows NT or whichever of the two operating systems (MS[hyph]DOS or OS/2) you last started before running Windows NT Setup.

If you have OS/2 Boot Manager installed on your computer and want to continue to use it after Windows NT Workstation installation is complete, you need to re-enable it. After Setup is complete, click the **Start** button and point to **Programs** and then **Administrative Tools**. Click **Disk Administrator**. Select the OS/2 Boot Manager partition, and then select **Mark Active** from the **Partition** menu.

Choosing a File System for the Windows NT Partition

Once you have selected a partition for installing Windows NT, you must instruct Setup which file system, NTFS or FAT, to use with the partition. Make sure you know all the considerations when choosing one file system over another.



Use the following information when choosing to format or convert the partition where the Windows NT files will be installed:

- For an unformatted partition, you can choose to format it with either the NTFS or FAT file system. Choose the FAT option if you want to access files on that partition when running Windows NT, MS[hyph]DOS, Windows 95, or OS/2 on this computer. Choose the NTFS option if you want to take advantage of the features in NTFS.

- For an existing partition, the default option keeps the current file system intact, preserving all existing files on that partition.

You might choose to convert an existing partition to NTFS so as to make use of Windows NT security. This option preserves existing files, but only Windows NT has access to files on that partition.

Or, you might instead choose to reformat an existing partition to either the NTFS or FAT file system, which erases all existing files on that partition. If you choose to reformat the partition as NTFS, only Windows NT will have access to files created on that partition.

Note After running Setup, you can convert file systems from FAT to NTFS. If you want to convert an NTFS partition to FAT, you must first back up all the files, reformat the partition (which erases all files), and then restore the files from the backup version. You must also back up data before

repartitioning a hard disk. For more information on this process, see the Microsoft Windows NT Workstation Resource Kit Version 4.0.

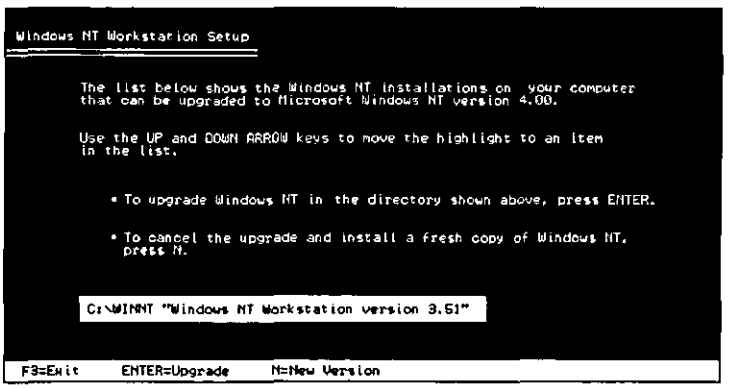
The following table summarizes the main criteria for choosing a file system for a Windows NT partition.

Windows NT File Systems

	NTFS Considerations	FAT Considerations
Security	Supports complete Windows NT security, so you can specify who is allowed various kinds of access to a file or directory.	Files are not protected by the security features of Windows NT.
Activity log	Keeps a log of activities to restore the disk in the event of power failure or other problems.	FAT file systems do not keep a log.
File sizes	Maximum file size is 4 GB to 64 GB, depending on the size of your clusters.	Maximum file size is 4 GB.
File compression	Supports flexible per-file compression.	File compression is not supported.
Operating system compatibility	Recognized only by Windows NT. When the computer is running another operating system (such as MS[hyph]DOS or OS/2), that operating system cannot access files on an NTFS partition on the same computer.	Allows access to files when your computer is running another operating system, such as MS[hyph]DOS or OS/2.
MS[hyph]DOS data sharing	Cannot share data with MS[hyph]DOS on the same partition.	Enables you to share data with MS[hyph]DOS on the same partition.

Choosing a Directory for the Windows NT Workstation Files

After Setup accepts your partition and file system choices, it displays the name of the directory where it will install the Windows NT files. You can accept the directory that Setup suggests or type the name of the directory you prefer. For most installations, the proposed directory is appropriate.



Setup displays a special screen if it detects one or more of the following operating systems on your computer:

- Windows NT (versions 3.1, 3.5, or 3.51)
- Windows 95
- Windows 3.x

In such a case, your decision to install in the directory Setup has chosen or to specify a new directory should be based on the following considerations:

- Do you want Setup to migrate the registry settings from your existing operating system?
- Do you want the ability to choose among your operating systems every time you start your computer?

Note If your computer is running Windows 95, it is not possible to install the Windows NT 4.0 files in the same directory. You must specify a new directory. Your Windows 95 settings will not be migrated, and you will need to reinstall your applications under Windows NT.

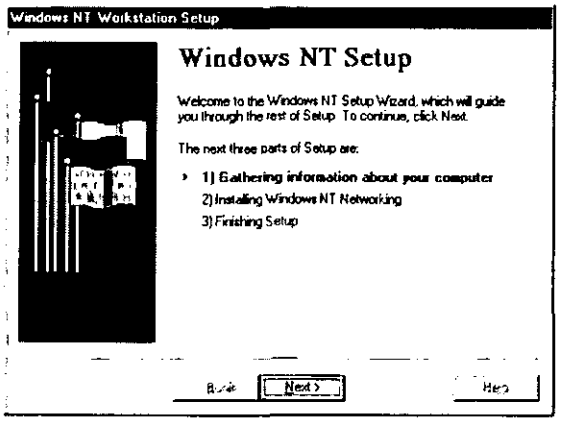
Use the following chart to decide which directory option is best for your installation.

Previous Operating System and Installation Directory	Migrates settings?	Supports multiple-boot?
Windows NT		
Same directory	Yes	No
New directory	No	Yes
Windows 95		
Same directory	N/A	N/A
New directory	No	Yes
Windows 3.x		
Same directory	Yes	Yes
New directory	No	Yes

Gathering Information About Your Computer

When all options have been decided on the first several Setup screens, Setup copies all of the appropriate files to your computer and then tells you it is ready to restart.

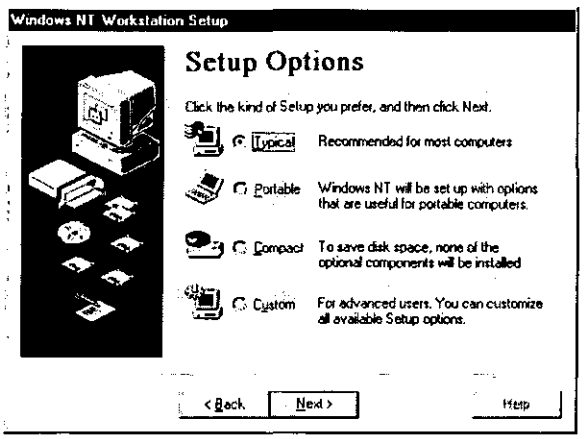
Once this restart takes place, you will be in the next portion of Setup, called the Windows NT Setup wizard. Screens in this portion look different from the ones you have seen thus far, but they perform a similar purpose: to customize your installation of Windows NT.



During the Setup wizard, you have the ability to skip among screens using the **Back** and **Next** buttons. This allows you to change information entered on previous screens in case you discover that the information you entered was not appropriate.

Choosing a Setup Type

Setup offers four types of installation: Typical, Portable, Compact, and Custom.



- Typical Setup is the easiest way to install Windows NT Workstation and is recommended for most standard installations. Typical Setup asks you the minimum number of questions and installs all optional Windows NT Workstation components, such as Windows Messaging and HyperTerminal. Wherever possible, Typical Setup automatically configures the settings for your hardware and other components.
- Portable Setup installs options that are useful for portable computers.
- Compact Setup is designed for computers where disk space is at a premium. No optional components are installed.
- Custom Setup is designed for experienced users who want or need more control over how Windows NT Workstation is installed on their computers.

Note Windows NT Setup lets you choose a basic video display mode for running Setup. At the end of Setup, you have the opportunity to configure and test the actual video display mode to be used with Windows NT. For information, see "Setting the Time and Configuring the Video Display" in Chapter 8, "Finishing Installation."

To change the keyboard or mouse configuration after Setup is complete, point to **Settings** on the **Start** menu and click **Control Panel**. For more information, see Help.

Entering Your Personal Information

The next few screens of the Setup Wizard ask for information that will uniquely identify your computer.

Supply the following information:

- A user name and company name that Windows NT will use to identify you for various operations. You must type a response in order for Setup to continue.

- A Product Identification number or CD Key, which a Microsoft technical support representative can use to identify your system. This dialog box might not appear if you are installing Windows NT Workstation from the network, depending on the requirements at your site.

  The Product Identification number, if you have one, can be found on the inside back cover of this book as well as on your registration card. The CD Key, if you have one, is printed on your CD case.

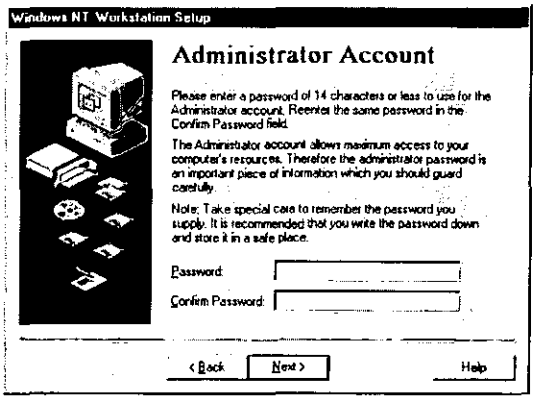
  You must type a response in order for Setup to continue. After Setup is complete, you can see this Product ID number by pointing to **Settings** on the **Start** menu, clicking **Control Panel**, and then double-clicking the **System** icon.

- A name that will identify your computer on the network. This name must be 15 characters or fewer and must not be the same as any other computer name, domain name, or workgroup name on the network. You can invent a computer name, or ask your network administrator if a specific name has been assigned to your computer. If you need to change the computer name after Setup is complete, double-click the **Network** icon in **Control Panel**.

For Custom Setup, a dialog box asks you to select optional tasks to be performed, including installing optional components such as accessories and games, or setting up locally connected printers.

Setting the Administrator Account Password

Setup creates a default account, called the Administrator account, which grants administrative privileges for managing the overall configuration of your computer, such as managing security policies and working with user accounts. The Administrator account is intended for use by the person who manages this computer. On this screen in the Setup Wizard, you can specify a password for the Administrator account, or leave the screen blank to indicate no password for the account.



If you choose not to join a domain, this account is the one you will use initially to manage your computer after Setup is complete. See "Joining a Workgroup or Domain" in Chapter 7, "Connecting to the Network."

This account is built in to your computer once Setup is complete, and is a member of the built-in **Administrators** group in **User Manager**. It cannot be removed from that group. For information on using **User Manager**, see Help, or see the section "Managing User Accounts, Groups, and Security Policies" in Chapter 4, "Learning Networking Basics."

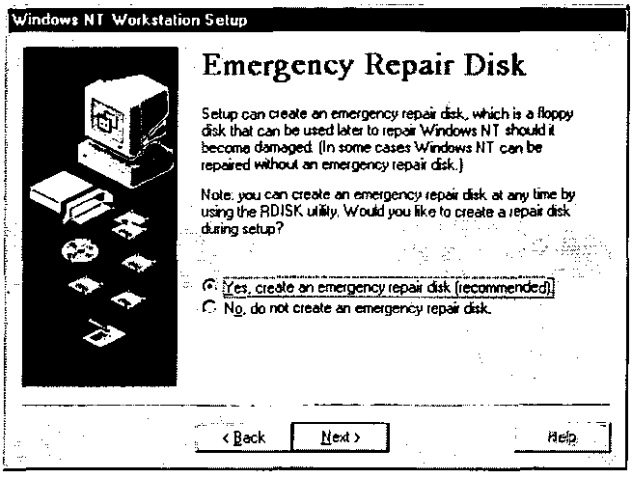
To set a password for the Administrator account, type a password of 14 characters or less in the first box, then retype the same password in the second box to confirm your choice. Take special care to remember the password you supply.

Note Some Intel Pentium-based computers have a faulty module for performing floating-point division. These computers will sometimes give inaccurate results when dividing certain very specific values. If Setup detects that you are installing Windows NT on such a computer, the next screen you see gives you the option of working around this fault.

This workaround turns off your computer's floating-point module and lets Windows NT perform these floating-point operations instead. Choosing this option will slow these operations considerably. However, if you plan to use programs which make extensive use of floating-point math, this option may be desirable.

Creating the Emergency Repair Disk

The Setup Wizard next gives you the option of creating an Emergency Repair Disk. This disk can be used to save the current system settings and restore your computer if files become damaged.



Microsoft strongly recommends that you create the Emergency Repair Disk during Setup and update it or create a new disk every time you make a significant change to your hardware or software setup, such as changing your partition structure, changing device drivers or other hardware, or installing new applications. Repair information is saved on your hard disk even if you do not create an Emergency Repair Disk. However, in many cases, system errors will not allow you to have access to this information at the time you need it.

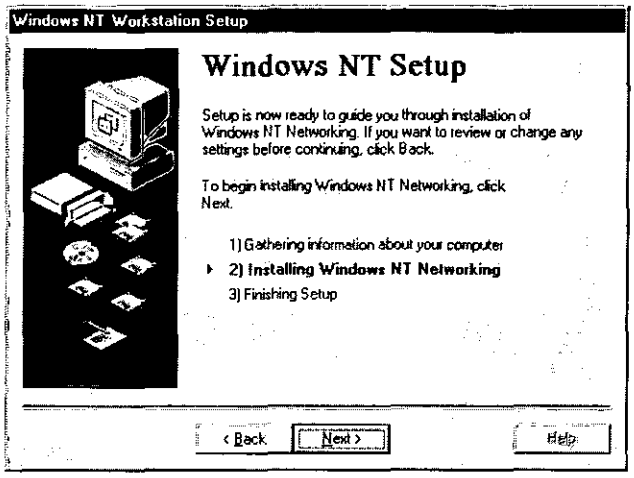
Note Using the Emergency Repair Disk to recover from a system error requires having your three Setup disks at hand, unless your computer's BIOS supports the El Torito Bootable CD-ROM (no-emulation mode) format (see your computer's documentation). If you do not have the Setup disks that came with your package and you chose to override creating them when starting Setup, you will need to create them after installation is complete in order to use the Emergency Repair Disk. For more information, see Help.

For information on using the Emergency Repair Disk to restore damaged files and on creating an Emergency Repair Disk after Setup is complete, see the Microsoft Windows NT Workstation Resource Kit.

Note You may experience difficulty creating the Emergency Repair Disk if drive A of your computer is a 2.88 MB drive and your disk is formatted to 2.88 MB. If you experience problems, supply a disk formatted for 1.44 MB.

To create an Emergency Repair Disk, choose the **Yes** option on this screen. You will be prompted to insert the disk at a later point during Setup.

When you have finished with this screen, Setup reports that it is ready to install networking on your computer. If you need to review or change any of the information you previously entered, you must click **Back** to go to the appropriate screen(s) and you can only do so now.

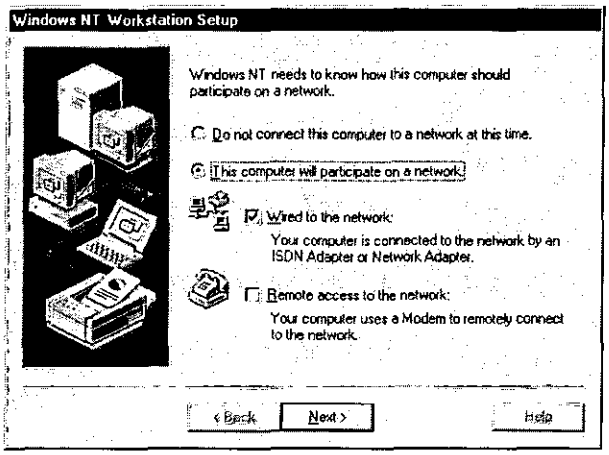


Click **Next** when you are ready to continue.

Connecting to the Network

This section relates information about configuring your computer to use the networking features of Windows NT. If you are not installing these features, Setup automatically skips the screens shown in this chapter and jumps to the end of installation. See the next chapter, "Finishing Installation," for more information.

Your first network Setup choice is to indicate the type or types of network, if any, in which your computer will participate.

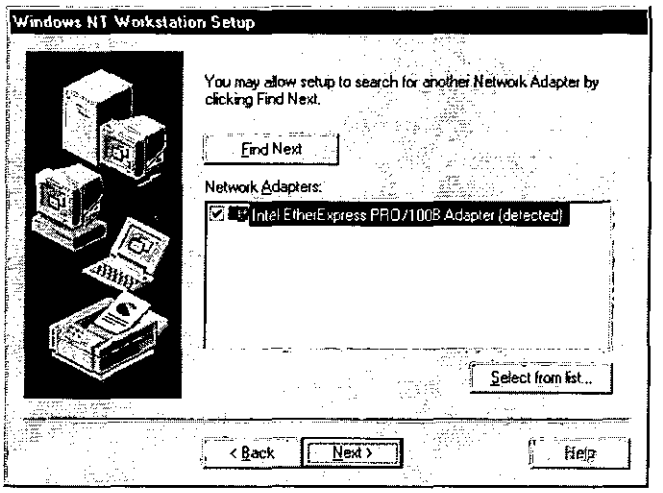


Check the **Remote access to the network** option if you will use a modem to connect to the network.

For all other network connection types, check the **Wired to the network** option. You can check both options if both scenarios apply to your computer. If you do not want access to a network, select the **Do not connect this computer to a network at this time** option. You can install or modify your network connections after Setup is complete by double-clicking **Network** in **Control Panel**.

Detecting and Selecting Network Adapters

If your computer is wired directly to a network, the next step is to identify the network adapter(s) in your computer.



Setup uses an automated method of detecting adapters, but if you plan to use a type other than what is detected, you must do both of the following:

- Check the Windows NT Hardware Compatibility List to verify whether your adapter will work successfully with Windows NT. For ways of finding this list, see "What You Should Know Before Running Setup" in Chapter 5, "Beginning Installation."
- Have the adapter manufacturer's disk handy for loading the appropriate driver files.

When you click **Start Search**, Setup checks for network adapter cards in your computer and displays the first network adapter it finds. Click **Find Next** to search for additional adapters.

Setup cannot recognize some types of network adapters, and as a result one or more of your adapters might not be detected and added to the list. If Setup cannot identify your adapter, or if you have the disk from the manufacturer of an additional adapter you wish to install, click **Select from list...** and click the name of the adapter you want to install.

If you do not know the name and model of your adapter, use one of the following methods to find it out:

- Ask your network administrator
- Check your network adapter documentation
- Run a hardware query tool

You can install additional adapters after running Setup by double-clicking the **Network** icon in **Control Panel**.

Configuring Network Adapters

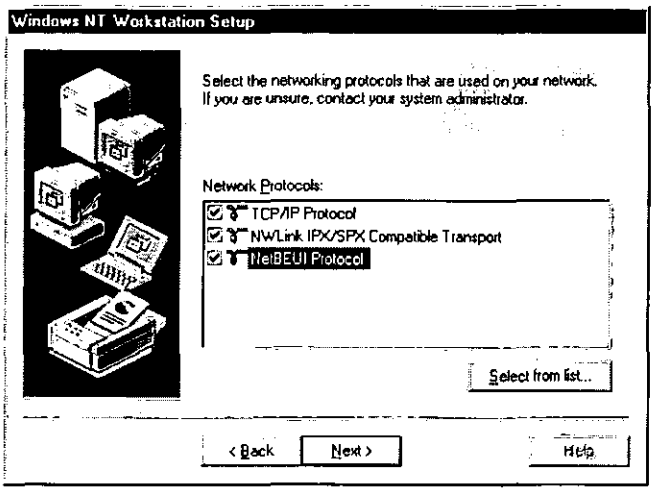
Depending on the manufacturer of your network adapter, Setup might display an **Adapter Card Setup** dialog box, letting you select the correct IRQ number, I/O base port address, memory buffer address, and other settings. For many adapters, these settings are configured automatically. In these cases, we recommend that you accept the manufacturer's proposed settings.

Note Make sure to double-check all adapter settings before continuing with Setup. If your network adapter is set improperly, Windows NT won't be able to run network services.

If you are an experienced user and know that you need to change adapter settings, see the documentation for your network adapter or ask your network administrator for the correct values.

Selecting Network Protocols

Next, Setup asks you to select one or more network protocols to install.



Protocols are the software that enable the exchange of information among computers. Common network protocols include the following:

- TCP/IP. This suite of networking protocols provides communication across interconnected networks. Choose this option if your computer is on an interconnected network with diverse hardware and operating systems, or if you want to communicate with non-Microsoft systems such as UNIX. TCP/IP is required for Internet communications.

- NWLink IPX/SPX Compatible Transport. For many sites, this is the standard network protocol. It supports routing, and it can support NetWare client-server applications, where NetWare-aware, Sockets-based applications communicate with IPX/SPX Sockets-based applications. Choose this option if your computer is connected to or communicates with a NetWare network.

- NetBEUI. This protocol is usually used in small, department-size, local area networks of 1 to 200 clients. It can use Token Ring source routing as its only method of routing. Choose this option if your network uses NetBEUI as a transport protocol.

  NetBEUI is selected automatically if you install Remote Access Service and do not configure a network adapter card.

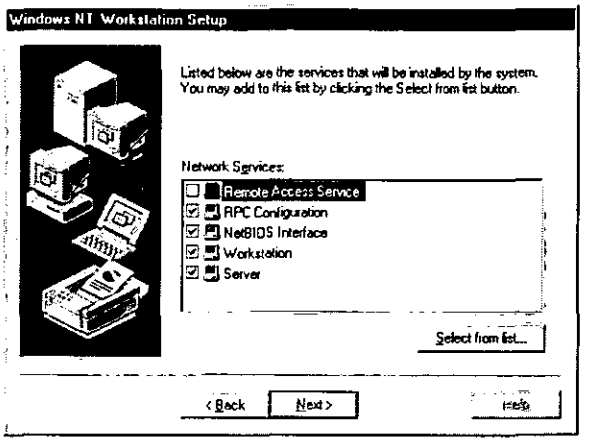
Caution You must select NetBEUI if your computer communicates with other computers on an existing Microsoft network that uses NetBEUI for Windows NT 3.1 or later, Windows for Workgroups 3.11, or LAN Manager 2.x.

If you do not install NetBEUI and your network requires it, your computer will not be able to communicate with other computers on your network.

If you are unsure about which network protocol to choose, accept the default or ask your network administrator. After Setup is complete, you can add or remove any transports for your system by double-clicking the **Network** icon in **Control Panel**.

Selecting Network Services

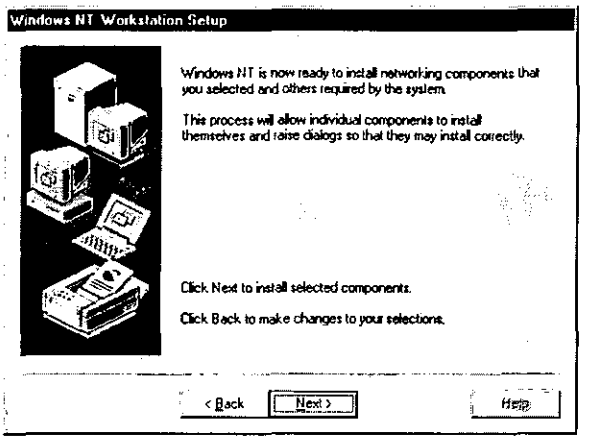
For Custom Setup, the **Network Services** dialog box appears after you configure the first network adapter so that you can install additional supporting software.



If you choose to install additional network components, you might be asked to insert additional disks supplied by the component manufacturer.

Confirming Your Network Component Settings

Setup is now ready to copy the necessary files for installing your network options and start the network. If you want to make any changes to your network choices, click the **Back** button to do so now.

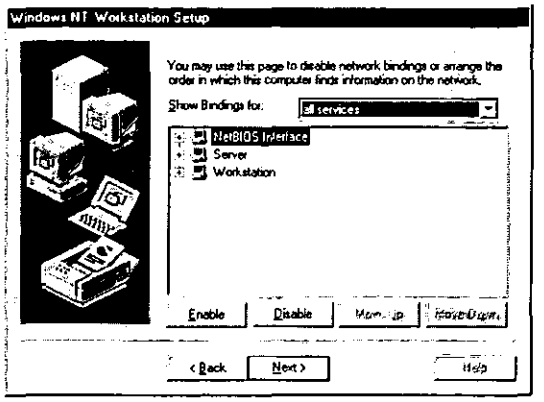


Click the **Next** button to begin installing the networking components.

While Setup is copying the needed files to your computer, dialog boxes might appear for the various adapters, protocols, and services you have chosen to install. Accept the default values in each dialog box or type the settings required for your computer.

Adjusting the Network Bindings

Next, Setup lets you adjust your network bindings.



Network bindings are the series of paths that enable communication among the network services, protocols, and adapters in your computer. In some cases, you can adjust the bindings on your computer to increase the performance of certain network services among multiple network adapters.

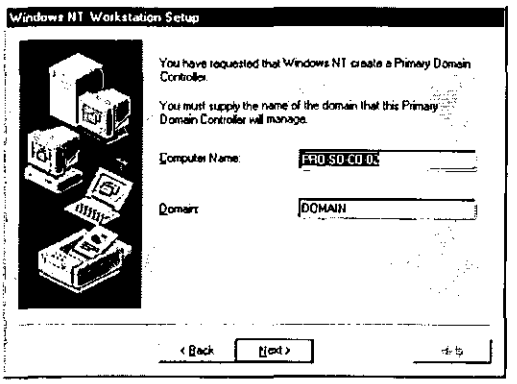
Warning Do not attempt to change the binding settings unless you are an experienced network administrator familiar with the requirements of your network software.

To adjust the bindings for a network service, double-click the service name and click the adapter or protocol to which it is connected. Then, click the **Enable** and **Disable** buttons to allow or disallow communications along the selected path.

By default, Setup displays all bindings as they are associated with the network services. To change the view on this screen, click the drop-down menu arrow and choose **All protocols** or **All adapters**.

Joining a Workgroup or Domain

Next, Setup displays the **Domain Settings** dialog box.



In Windows NT, a workgroup is a collection of computers that appears, for convenience, under the same workgroup name when you browse network resources. Belonging to a common workgroup is a way for coworkers to quickly find each other's computers on the network. When you browse the network, the names of all the computers in your workgroup appear first in the browsing directory.

Any computer can join any single workgroup. You can join an existing workgroup or create a new one simply by typing a workgroup name. Windows NT Setup will accept almost any workgroup name you choose, including the default WORKGROUP. The only workgroup name you cannot use is the name you gave to your computer, as described in "Entering Your Personal Information" in Chapter 6, "Gathering Information About Your Computer."

A domain is a collection of computers defined by the administrator of a Windows NT Server network. A domain provides the same convenience for network browsing and also provides access to the centralized user accounts and group accounts maintained by the domain administrator.

Unlike a workgroup, a domain must already exist for you to join it. Joining a domain usually requires that the domain administrator add an account for your computer to the domain. If the administrator has given you the correct privileges, however, you can create your computer account during installation. Check with your administrator to see how your account will be created.

If you do not know the domain name for your computer and you want to finish running Setup without this information, you can select the **Workgroup** option and then type any workgroup name. After running Setup, you can join a domain or change the workgroup name by double-clicking the **Network** icon in **Control Panel**.

Note If you have recently removed an older version of Windows NT Workstation and are reinstalling on a computer that previously belonged to a domain, you must ask your network administrator to delete your machine account and create a new one. Otherwise, you will not be able to log on to the domain after the reinstallation.

You cannot change the machine account when you are upgrading your original Windows NT Workstation installation.

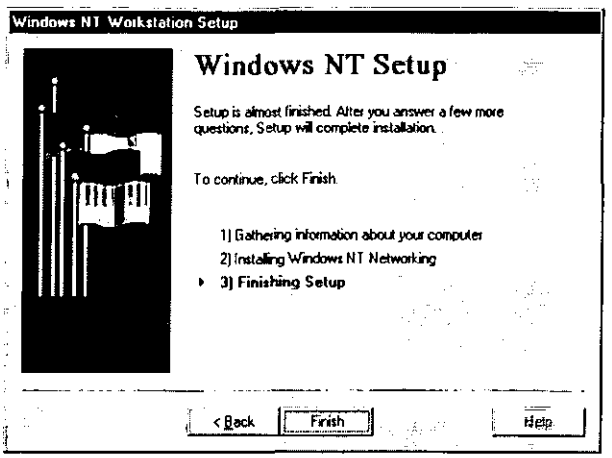
The **Domain Settings** dialog box can be used in two ways, depending on your network configuration:

- If the network started successfully, you can specify whether this computer is a member of a workgroup or a member of a Windows NT Server domain.
- If the network did not start, you are given a chance to reconfigure the network and attempt to start it again. If the network still does not start, you can accept or change the default Workgroup entry in this dialog box, and then click **OK** to continue Setup. This sets up a temporary workgroup to which your computer can belong.

At this point in Setup, dialog boxes might appear for the various adapters, protocols, and services you have chosen to install. Accept the default values in each dialog box or type the settings required for your computer.

Finishing Installation

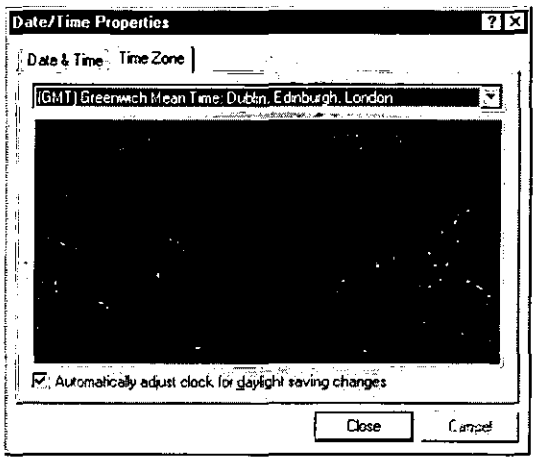
Setup is now ready to finish your installation.



Before Setup can reboot and start your new operating system, however, it needs you to review and approve a few settings for the new operating system.

Setting the Time and Configuring the Video Display

The first screen shows the **Date and Time** utility. Adjust these settings for your local time and time zone.



Next, the **Display** utility appears so that you can configure your video display. Be sure to test your display before clicking **OK**.

The display settings can be changed after Setup is complete by using the **Display** icon in **Control Panel**. For information, see Help after Windows NT has been successfully installed.

Starting Windows NT Server

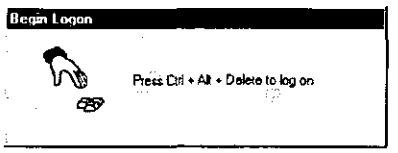
After you complete the last screen of the Setup Wizard, Setup is ready to complete the final installation tasks.

To complete Setup and start Windows NT Server

1. When the Setup Wizard is finished and a message asks you to restart your computer, remove any disks from the floppy disk drives and choose the **Reboot** button.

2. A boot loader menu appears. If you have a dual or multiple boot, the Windows NT installation you just completed is highlighted at the top of the list. Press ENTER.

3. When the Begin Logon message appears, press CTRL+ALT+DEL to log on.



4. In the **Logon Information** dialog box, type and confirm your password, and then click **OK**. If your computer is already a member of a domain, you must choose a domain in the **From...** box in order to log on.

Caution For an x86-based computer, the following files are copied to the root directory on drive C: BOOT.INI, BOOTSECT.DOS (if another operating system is on your computer), NTLDR, and NTDETECT.COM. Also, if you have a SCSI disk that is not visible from MS-DOS (that is, not seen by the BIOS), the NTBOOTDD.SYS file is copied. These files should never be deleted because your system will not start without them.

For a RISC-based computer, HAL.DLL and OSLOADER.EXE are copied to the \OS\WINNT directory on your system partition. These files should never be deleted.

Note that these files are all read-only, hidden system files. If any of these files is missing on your system, you can use the Emergency Repair Disk to restore them.

Red Hat Linux

Starting the Installation

This explains how to start the Red Hat Linux installation process. We'll cover the following areas:

- Getting familiar with the installation program's user interface;
- Starting the installation program;
- Selecting an installation method;
- Beginning the installation.

By the end of this set of instructions, the installation program will be running on your system, and you will have begun the process of either installing or upgrading to Red Hat Linux 6.2.

The Installation Program User Interface

If you've used a *graphical user interface (GUI)* before, you'll be familiar with this process. If not, simply use your mouse to navigate the screens, "click" buttons or enter text fields. You can also navigate through the installation using the **Tab** and **Enter** keys.

Please Note

If you do not wish to use the GUI installation program, the text mode installation program is also available. To enter text mode, enter the following boot command:

```
boot: text
```

For text mode installation instructions, please refer to the *Official Red Hat Linux Reference Guide*.

A Note about Virtual Consoles

The Red Hat Linux installation program offers more than the dialog boxes of the installation process. Several different kinds of diagnostic messages are available to you, in addition to giving you a way to enter commands from a shell prompt. It presents this information on five *virtual consoles*, among which you can switch using a single keystroke.

These virtual consoles can be helpful if you encounter a problem while installing Red Hat Linux. Messages displayed on the installation or system consoles can help pinpoint a problem. Please see Table 3-1 for a listing of the virtual consoles, keystrokes to switch to them, and their contents.

Table 3-1. Console, Keystrokes, and Contents

Console	Keystrokes	Contents
1	**Ctrl-Alt-F1**	installation dialog
2	**Ctrl-Alt-F2**	shell prompt
3	**Ctrl-Alt-F3**	install log (messages from installation program)
4	**Ctrl-Alt-F4**	system-related messages
5	**Ctrl-Alt-F5**	other messages
7	**Ctrl-Alt-F7**	X graphical display

Generally, there's no reason to leave the default console (virtual console #7) unless you are attempting to diagnose installation problems. But if you get curious, feel free to look around.

Starting the Installation Program

Now it's time to begin installing Red Hat Linux. To start the installation, you must first boot the installation program. Please make sure you have all the resources you'll need for the installation. If you've already read through Chapter 2, and followed the instructions, you should be ready to begin.

Booting the Installation Program

Please Note

If you need to create a boot disk, please refer to the section called *Step 6 - How Do You Want to Start the Installation?*

Insert the boot disk into your computer's first diskette drive and reboot (or boot using the CD-ROM, if your computer supports this). Your BIOS settings may need to be changed to allow you to boot from the diskette or CD-ROM.

Tip

To change your BIOS settings, you will need to take note of the instructions given when your computer first begins to boot. Often you will see a line of text telling you to press the **Del** key to enter the BIOS settings. Once you have done whatever process is needed to enter your computer's BIOS, you can then change the boot order to allow your computer to boot from the CD-ROM drive or diskette drive first when bootable software is detected. For more information, please refer to the documentation that came with your system.

There are four possible boot methods:

- *Bootable CD-ROM* -- your machine supports a bootable CD-ROM drive and you want to perform a local CD-ROM installation.
- *Local boot disk* -- your machine will not support a bootable CD-ROM and you want to install from a local CD-ROM or a hard drive.

- *Network boot disk* -- use to install from NFS, FTP and HTTP installation methods.
- *PCMCIA boot disk* -- use in cases where you need PCMCIA support, but your machine does not support booting from the CD-ROM drive *or* if you need PCMCIA support in order to make use of the CD-ROM drive on your system. This boot disk offers you all installation methods (CD-ROM, hard drive, NFS, FTP, and HTTP).

After a short delay, a screen containing the `boot:` prompt should appear. The screen contains information on a variety of boot options. Each boot option also has one or more help screens associated with it. To access a help screen, press the appropriate function key as listed in the line at the bottom of the screen.

You should keep two things in mind:

- The initial screen will automatically start the installation program if you take no action within the first minute. To disable this feature, press one of the help screen function keys.
- If you press a help screen function key, there will be a slight delay while the help screen is read from diskette.

Normally, you'll only need to press **Enter** to boot. Watch the boot messages to see whether the Linux kernel detects your hardware. If it does not properly detect your hardware, you may need to restart the installation in "expert" mode. If your hardware is properly detected, please continue to the next section.

Expert mode can be entered using the following boot command:

```
boot: linux expert
```

Please Note

If you do not wish to perform a CD-ROM GUI installation, you can choose to perform a text mode installation by using the following boot command:

```
boot: text
```

For text mode installation instructions, please refer to the *Official Red Hat Linux Reference Guide* on the documentation CD-ROM.

The command to start a *serial installation* has changed. If you need to perform the installation in serial mode, type:

```
boot: linux console=<device>
```

Where `<device>` should be the device you are using (such as ttyS0 or ttyS1).

Please Note

The initial boot messages will not contain any references to SCSI or network cards. This is normal, since these devices are supported by modules that are loaded during the installation process.

Options can also be passed to the kernel.

For example, to instruct the kernel to use all the RAM in a 128MB system, enter:

```
boot: linux mem=128M
```

After entering any options, press **Enter** to boot using those options.

If you do need to specify boot options to identify your hardware, please make note of them -- they will be needed during the LILO configuration portion of the installation (please see the section called *Installing LILO* for more information).

Booting without diskettes

The Red Hat Linux/Intel CD-ROM can also be booted by computers that support bootable CD-ROMs. Not all computers support this feature, so if yours can't boot from the CD-ROM, there is one other way to start the installation without using a boot disk. The following method is specific to Intel-based computers only.

If you have MS-DOS installed on your system, you can boot directly from the CD-ROM drive without using a boot disk.

To do this (assuming your CD-ROM is drive `d:`), use the following commands:

```
C:\> d:
D:\> cd \dosutils
D:\dosutils> autoboot.bat
```

This method will not work if run in a DOS window -- the `autoboot.bat` file must be executed with DOS as the only operating system. In other words, Windows cannot be running.

If your computer can't boot directly from CD-ROM (and you can't use a DOS-based autoboot), you'll have to use a boot diskette to get things started.

Selecting an Installation Method

Next, you will be asked what type of installation method you wish to use. You can install Red Hat Linux via the following basic methods:

CD-ROM

If you have a CD-ROM drive and the Red Hat Linux CD-ROM. Requires a boot disk, a bootable CD-ROM or a PCMCIA boot disk.

Hard Drive

If you copied the Red Hat Linux files to a local hard drive. Refer to the *Official Red Hat Linux Reference Guide* for hard drive installation instructions. Requires a boot disk or a PCMCIA boot disk.

NFS Image

If you are installing from an NFS Image server which is exporting the Red Hat Linux CD-ROM or a mirror image of Red Hat Linux. Requires a network or PCMCIA boot disk. Refer to the *Official Red Hat Linux Reference Guide* for network installation instructions. Please note: NFS installations may also be performed in GUI mode.

FTP

If you are installing directly from an FTP server. Requires a network or PCMCIA boot disk. Refer to the *Official Red Hat Linux Reference Guide* for FTP installation instructions.

HTTP

If you are installing directly from an HTTP Web server. Requires a network or PCMCIA boot disk. Refer to the *Official Red Hat Linux Reference Guide* for HTTP installation instructions.

Beginning the Installation

If you are planning to install via CD-ROM using the graphical interface, please read on.

Please Note

If you'd rather perform a text mode installation, reboot your system and at the `boot:` prompt, type `text`. Refer to the *Official Red Hat Linux Reference Guide* on the documentation CD-ROM for further instructions.

Installing from CD-ROM

To install Red Hat Linux from CD-ROM, choose "CD-ROM" and select **OK**. When prompted, insert the Red Hat Linux CD into your CD-ROM drive (if you did not boot from the CD-ROM). Once done, select **OK**, and press **Enter**.

The installation program will then probe your system and attempt to identify your CD-ROM drive. It will start by looking for an IDE (also known as ATAPI) CD-ROM drive. If found, you will continue to the next stage of the installation process (see the section called *Language Selection*).

If a drive is not detected, you'll be asked what type of CD-ROM drive you have. Choose from the following types:

SCSI

Select this if your CD-ROM drive is attached to a supported SCSI adapter; the installation program will then ask you to choose a SCSI driver. Choose the driver that most closely resembles your adapter. You may specify options for the driver if necessary; however, most drivers will detect your SCSI adapter automatically.

Other

If your CD-ROM drive is neither an IDE nor a SCSI, it's an "other." Sound cards with proprietary CD-ROM interfaces are good examples of this CD-ROM type. The installation program presents a list of drivers for supported CD-ROM drives -- choose a driver and, if necessary, specify any driver options.

Tip

A partial list of optional parameters for CD-ROM drives can be found in the *Official Red Hat Linux Reference Guide*, in the *General Parameters and Modules* appendix.

What If the IDE CD-ROM Was Not Found?

If the installation program fails to find your IDE (ATAPI) CD-ROM (it asks you what type of CD-ROM drive you have), restart the installation, and at the `boot:` prompt enter `linux hdX=cdrom`. Replace the *x* with one of the following letters, depending on the interface the unit is connected to, and whether it is configured as master or slave:

- **a** - First IDE controller, master
- **b** - First IDE controller, slave
- **c** - Second IDE controller, master
- **d** - Second IDE controller, slave

(If you have a third and/or fourth controller, simply continue assigning letters in alphabetical order, going from controller to controller, and master to slave.)

Once identified, you will be asked to insert the Red Hat Linux CD into your CD-ROM drive. Select `OK` when you have done so. After a short delay, the next dialog box will appear.

After booting, the installation program begins by displaying the language screen.

Please Note

If you wish to abort the installation process at this time, simply reboot your machine then eject the boot diskette or CD-ROM. You can safely cancel the installation at any point before the `About to Install` screen, see the section called *Preparing to Install*.

Language Selection

Using your mouse, select the language you would prefer to use for the installation and as the system default (see Figure 3-1).

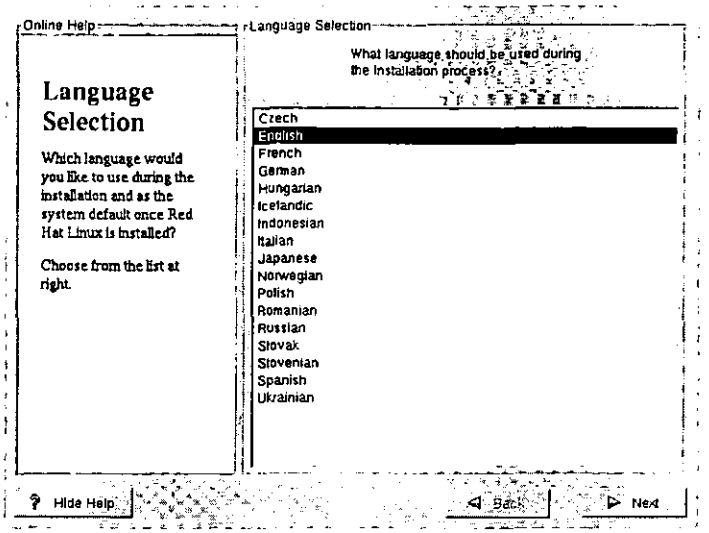


Figure 3-1. Language Selection

Keyboard Configuration

Choose the model that best fits your system (see Figure 3-2). If you cannot find an exact match, choose the best **Generic** match for your keyboard type (for example, **Generic 101-key PC**).

Next, choose the correct layout type for your keyboard (for example, U.S. English).

Creating special characters with multiple keystrokes (such as Ñ, Ô, and Ç) is done using "dead keys" (also known as compose key sequences). Dead keys are enabled by default. If you do not wish to use them, select **Disable dead keys**.

To test your keyboard configuration, use the blank text field at the bottom of the screen to enter text.

Tip

To change your keyboard type post-installation, become *root* and use the **/usr/sbin/kbdconfig** command, or you can type **setup** at the `root` prompt.

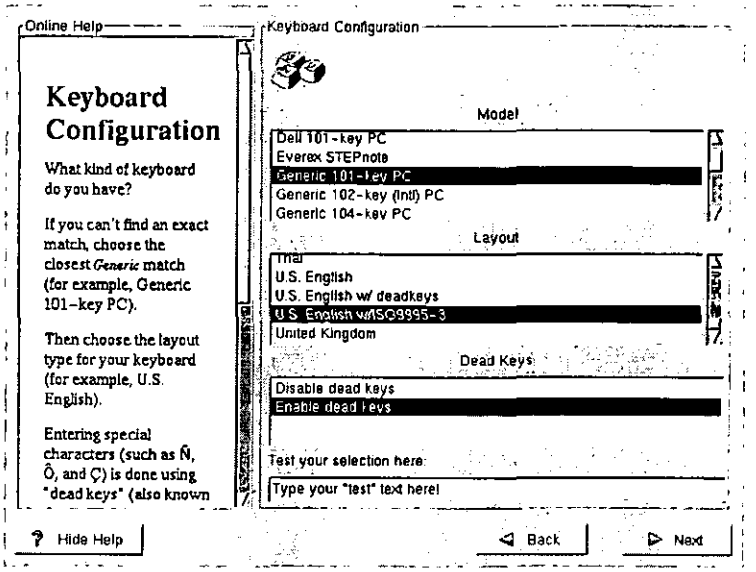


Figure 3-2. Keyboard Configuration

Mouse Configuration

Choose the correct mouse type for your system. If an exact match cannot be found, choose a mouse type that you are sure is compatible with your system (see Figure 3-3).

To determine your mouse's interface, follow the mouse cable back to where it plugs into your system. If the connector at the end of the mouse cable plugs into a rectangular connector, you have a serial mouse; if the connector is round, you have a PS/2 mouse. If you are installing Red Hat Linux on a laptop computer, in most cases the pointing device will be PS/2 compatible.

If you cannot find a mouse that you are sure is compatible with your system, select one of the **`Generic`** entries, based on your mouse's number of buttons, and its interface.

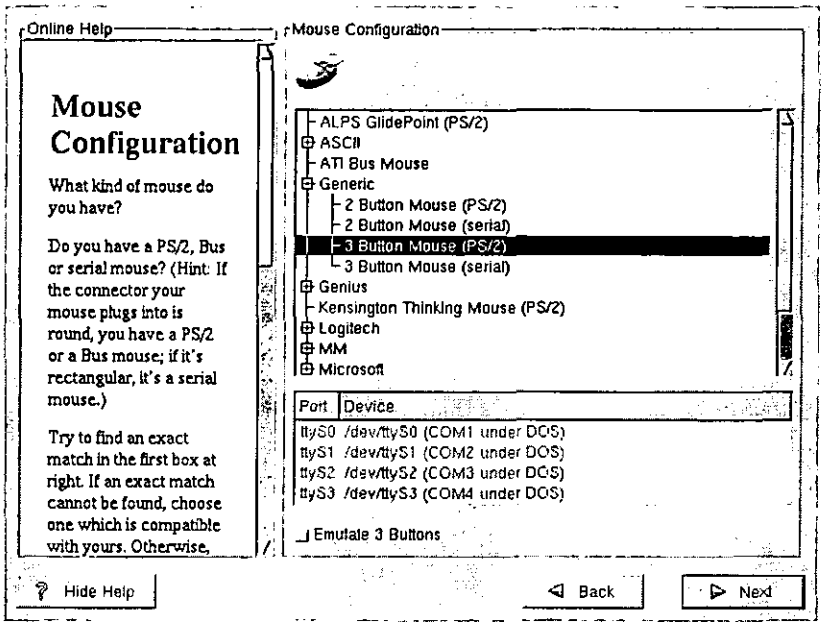


Figure 3-3. Mouse Configuration

If you have a PS/2 or a Bus mouse, you do not need to pick a port and device. If you have a serial mouse, you should choose the correct port and device that your serial mouse is on.

The **`Emulate 3 Buttons`** check box allows you to use a two-button mouse as if it had three buttons. In general, it's easiest to use the X Window System if you have a three-button mouse. If you select this check box, you can emulate a third, "middle" button by pressing both mouse buttons simultaneously.

Tip

To change your mouse configuration post-installation, become root. You can then use the **/usr/sbin/mouseconfig** command from the shell prompt.

To configure your mouse as a left-handed mouse, you can reset the order of the mouse buttons. This can be done after you have booted your Red Hat Linux system, by typing `gpm -B 321` at the shell prompt.

Welcome to Red Hat Linux

The "Welcome" screen (see Figure 3-4) does not prompt you for any installation input. Please read over the help text in the left panel for additional instructions and information on where to register your Official Red Hat Linux product.

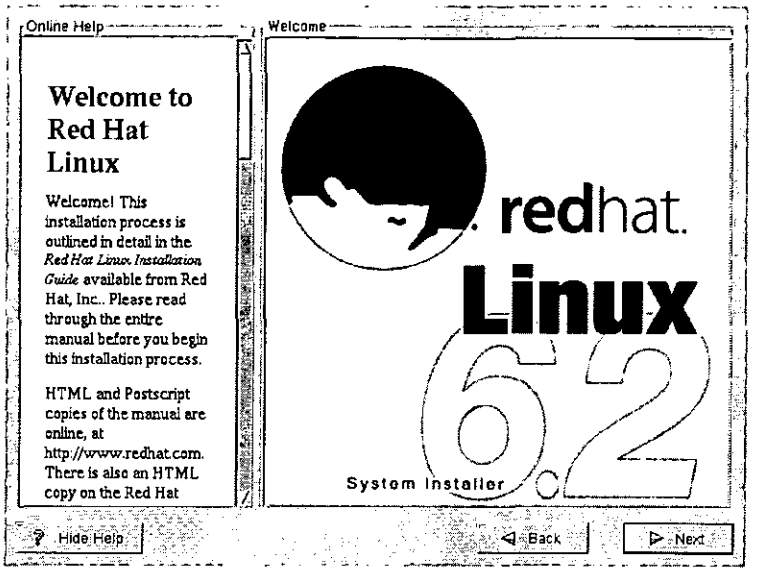


Figure 3-4. Welcome to Red Hat Linux

Please notice the **Hide Help** button at the bottom left corner of the screen. The help screen is open by default, but if you do not want to view the help information, click on the **Hide Help** to minimize the screen.

Click on the **Next** button to continue.

Install Options

Please Note

> **New Feature:** Red Hat Linux 6.2 has a new installation method known as a "partitionless" installation. If your system has a FAT (DOS/Windows) partition with sufficient free space, you can install Red Hat Linux without repartitioning your hard drive. This method is perfect for people who are new to Linux, and would like to try Red Hat Linux with a minimum of disruption to their computer.

Choose whether you would like to perform a full installation or an upgrade (see Figure 3-5).

In the top right-hand corner of the `Install Type` screen there is a box you may select if you wish to partition using `fdisk`. Note that `fdisk` is not as intuitive to use as `Disk Druid` and is not selected by default. If you have not used `fdisk` before, you should read about both `fdisk` and `Disk Druid` to determine which will best suit your needs.

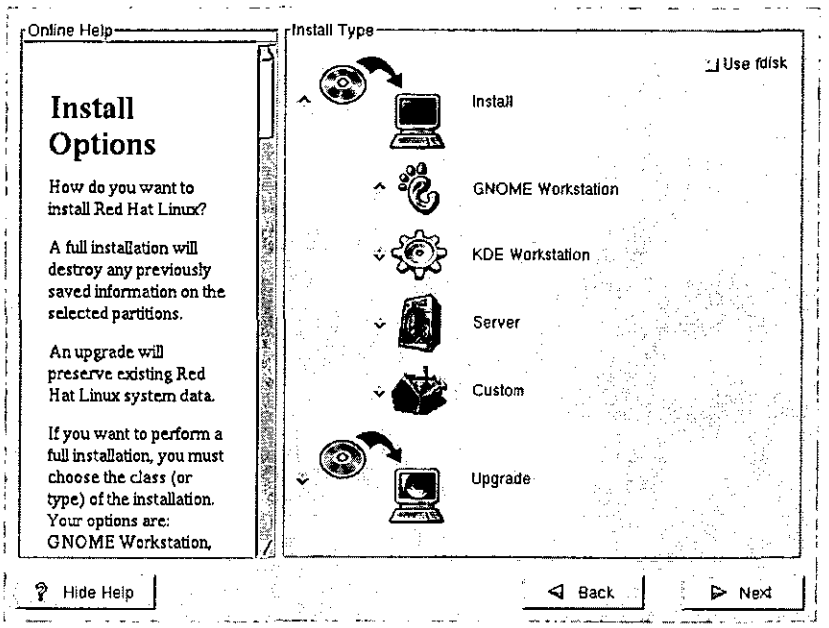


Figure 3-5. Choosing Install or Upgrade

To perform a full GUI installation, please refer to "Help Files" for those instructions.

Installing Red Hat Linux 6.2

Once you have finished this chapter, you will have completed a full installation of Red Hat Linux 6.2.

Continuing the Installation

You usually install Red Hat Linux on a clean disk partition or set of partitions, or over another installation of Linux.

Warning

Installing Red Hat Linux over another installation of Linux (including Red Hat Linux) does *not* preserve any information (files or data) from a prior installation. Make sure you save any important files! If you are worried about saving the current data on your existing system (without making a backup on your own), you should consider performing an upgrade instead.

In choosing a full installation, you must also choose the class of the installation. Your options include: `GNOME Workstation`, `KDE Workstation`, `Server` or `Custom`.

Most suitable for new users, the workstation-class installation will install your choice of a GNOME or KDE desktop environment, and the X Window System.

Warning

Do not choose this method if you're sharing a disk with Windows NT; if you do, you will be unable to boot Windows NT. LILO will write over NT's boot loader and you will be unable to boot NT. You must perform a custom-class installation and configure LILO so that it is not installed on the Master Boot Record (MBR).

To create a dual-boot environment on a system that currently has NT, you must install LILO on the first sector of the root partition, not the MBR. Please be sure to create a boot disk. In a case such as this, you will either need to use the boot disk, or configure the NT system loader to boot LILO from the first sector of the root partition. Be sure to check out http://www.linuxdoc.org/HOWTO/mini/Linux+NT-Loader.html for more information on setting up LILO and NT.

Warning

A workstation-class installation will erase *all information* in *all Linux-related partitions* from *every one* of your computer's hard drive(s).

Please Note

Unlike previous workstation-class installations, performing a Red Hat Linux 6.2 workstation-class installation will not install the network daemon `inetd`. Not installing `inetd` results in a more secure installation; however, network-related services such as `finger`, `telnet`, `talk`, and `FTP` will not work. If you require these types of services, please go back and choose a server- or a custom-class installation.

A server-class installation is most appropriate for you if you'd like your system to function as a Linux-based server, and you don't want to heavily customize your system configuration.

Warning

A server-class installation will erase *all partitions* (both Linux and non-Linux) from *every one* of your computer's hard drive(s).

The *custom-class installation* allows you the most flexibility during your installation. The workstation-class and server-class installations automatically go through the installation process for you and omit certain steps. During a custom-class installation, it is up to *you* how disk space should be partitioned. You have complete control over the packages that will be installed on your system. You can also determine whether you'll use LILO (the LInux LOader) to boot your system. Unless you have prior Linux experience, you should not select the custom-class installation method.

If you would like to know what steps are omitted by not performing a custom-class installation please refer to the section called *Behind the Scenes of a Custom-Class Installation*.

Partitioning with `fdisk`

Caution

Unless you have previously used `fdisk` and understand how it works, we do not recommend that you use it. `Disk Druid` is an easier and friendlier partitioning tool

for those new to partitioning their system. To exit `fdisk` click **`Back`** to return to the previous screen, deselect `fdisk`, and then click **`Next`**.

This section applies only if you chose to use `fdisk` to partition your system. If are not using `fdisk`, please skip to the section called *Automatic Partitioning* for automatic partitioning or the section called *Partitioning Your System* for partitioning with `Disk Druid`.

If you have chosen to use `fdisk`, the next screen (see Figure 4-1) will prompt you to select a drive to partition using `fdisk`.

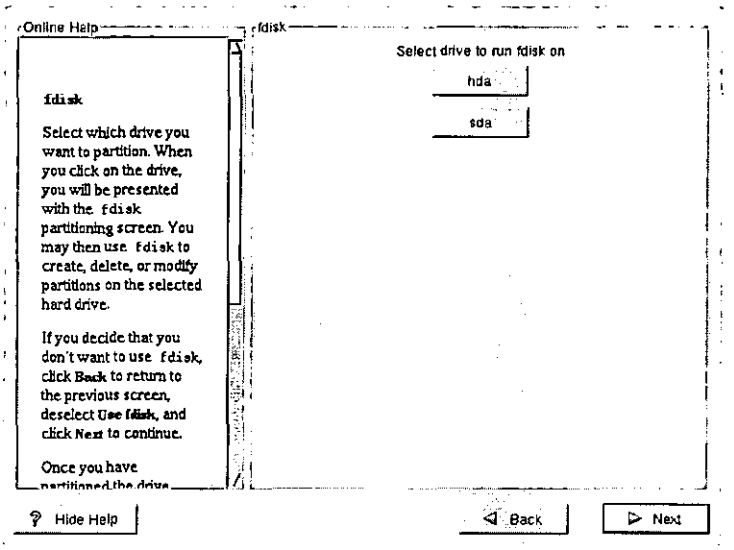


Figure 4-1. `fdisk`

Once you have chosen which drive to partition, you will be presented with the `fdisk` command screen (see Figure 4-2). If you are unsure as to what command you should use, type **m** at the prompt for help. Please refer to the *Official Red Hat Linux Reference Guide* for an overview of `fdisk`. When you've finished making partitions, type **w** to save your changes and quit. You will be taken back to the original `fdisk` screen where you can choose to partition another drive or continue with your installation.

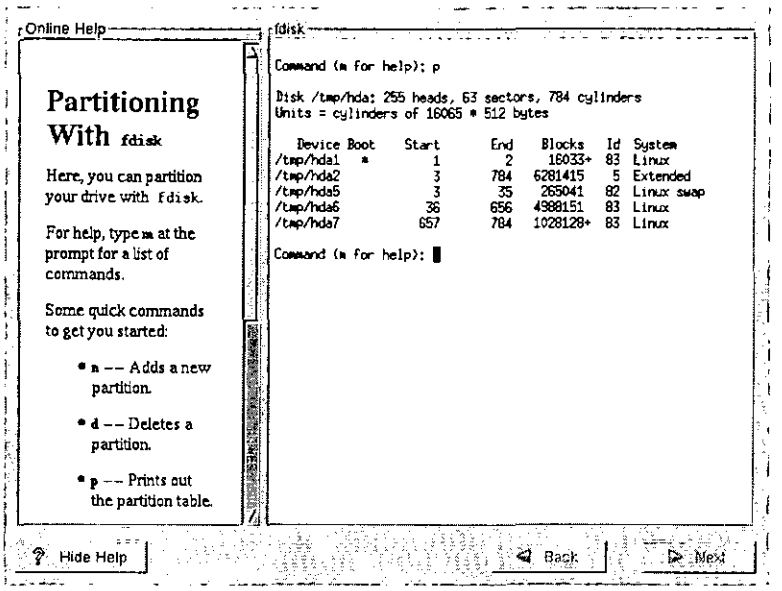


Figure 4-2. Partitioning with `fdisk`

After you have partitioned your drive(s), click **Next**. You will then use `Disk Druid` to assign *mount points* to your partitions.

You will not be able to add new partitions using `Disk Druid`, but you will be able to edit those you have already created.

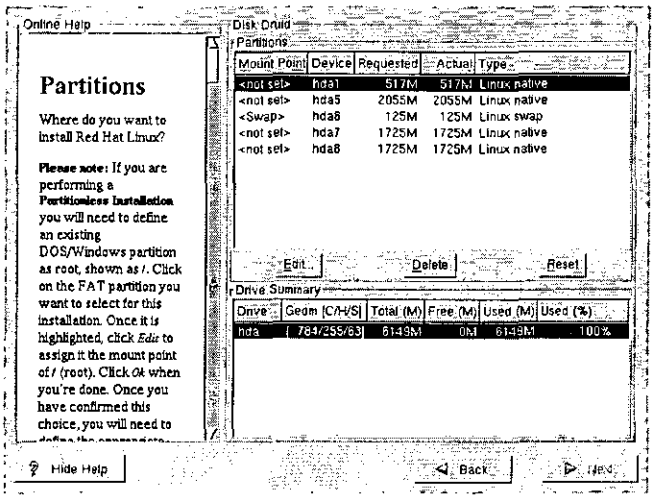


Figure 4-3. Editing with `Disk Druid`

Skip to the section called *Choose Partitions to Format* for further installation instructions.

Automatic Partitioning

Automatic Partitioning allows you to perform an installation without having to partition your drive(s) yourself. If you do not feel comfortable with partitioning your system, it is

recommended that *do not* choose to partition manually and instead let the installation program partition for you.

The **Automatic Partitioning** screen is only seen when performing a workstation- or server-class installation. If you are performing a custom-class installation, or choose to manually partition, please refer to the section called *Partitioning Your System*.

In this screen, you can choose to continue with this installation, to partition manually, or use the **Back** button to choose a different installation method (see Figure 4-4).

If you do *not* want to lose some or all of your data, you should either choose to partition manually or choose a different installation class.

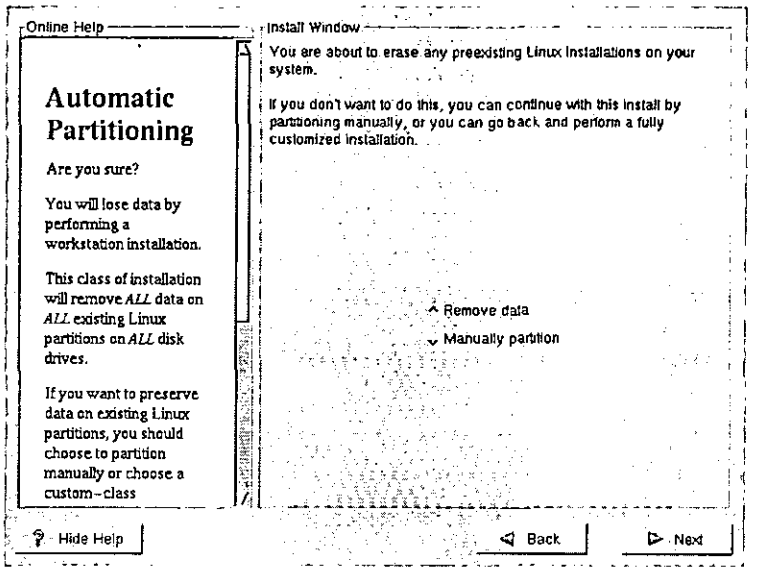


Figure 4-4. Automatic Partitioning

Caution

A workstation-class installation will remove all data on all currently existing Linux partitions.

If you do not want Red Hat Linux to be installed on your master boot record (MBR) or if you want to use a boot manager other than LILO, do not choose this installation method.

Caution

A server-class installation will remove all data on all partitions of all hard drives.

If you have another OS on your system that you wish to keep installed, if you do not want Red Hat Linux to be installed on your master boot record (MBR), or if you want to use a boot manager other than LILO, do not choose this installation method.

If you are unsure how you want your system to be partitioned, please read the chapter on partitioning in the *Official Red Hat Linux Reference Guide*.

Partitioning Your System

If you are performing a workstation- or server-class installation and you chose *not* to partition manually, please skip to the section called *Network Configuration*.

At this point, it's necessary to let the installation program know where it should install Red Hat Linux. This is done by defining mount points for one or more disk partitions in which Red Hat Linux will be installed. You may also need to create and/or delete partitions at this time (refer to Figure 4-5).

Please Note

If you have not yet planned how you will set up your partitions, refer to the partitioning appendix in the *Official Red Hat Linux Reference Guide*. As a bare minimum, you'll need an appropriately-sized root partition, and a swap partition of at least 16 MB.

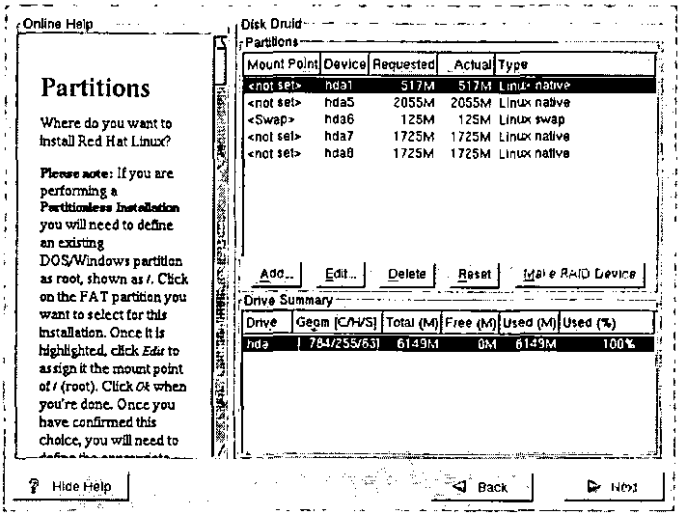


Figure 4-5. Partitioning with Disk Druid

The partitioning tool used in Red Hat Linux 6.2 is `Disk Druid`. With the exception of certain esoteric situations, `Disk Druid` can handle the partitioning requirements for a typical Red Hat Linux installation.

Partition Fields

Each line in the "Partitions" section represents a disk partition. Each line in this section has five different fields:

Mount Point:

A mount point is the location within the directory hierarchy at which a volume exists. The volume is said to be mounted at this location. This field indicates where the partition will be mounted. If a partition exists, but is "not set" you need to define its mount point. Double-click on the partition or use the **Edit** key.

Unless you have a reason for doing otherwise, we recommend that you create the following partitions:

- A swap partition (at least 16MB) -- Swap partitions are used to support virtual memory. In other words, data is written to a swap partition when there is not enough RAM to store the data your system is processing. If your computer has 16MB of RAM or less, you *must* create a swap partition. Even if you have more memory, a swap partition is still recommended. The minimum size of your swap partition should be equal to your computer's RAM, or 16MB (whichever is larger).

- A `/boot` partition (16MB, maximum) -- The partition mounted on `/boot` contains the operating system kernel (which allows your system to boot Red Hat Linux), along with files used during the bootstrap process. Due to the limitations of most PC BIOSes, creating a small partition to hold these files is a good idea. This partition should be no larger than 16MB.

- A `root` partition (850MB-1.7GB) -- This is where "/" (the root directory) resides. In this setup, all files (except those stored in `/boot`) reside on the root partition. A 850MB root partition will permit the equivalent of a workstation-class installation (with *very* little free space), while a 1.7GB root partition will let you install every package.

Device:

This field displays the partition's device name.

Requested:

This field shows the partition's original size. To re-define the size, you must delete the current partition and recreate it using the **Add** button.

Actual:

This field shows the space currently allocated to the partition.

Type:

This field shows the partition's type (such as Linux Native or DOS).

Problems When Adding a Partition

If you attempt to add a partition and `Disk Druid` can't carry out your request, you'll see a dialog box listing partitions that are currently unallocated, along with the reason they could not be allocated. Unallocated partition(s) are also displayed on `Disk Druid's` main screen (though you may have to scroll through the "Partitions" section to see them).

As you scroll through the **Partitions** section, you might see an "Unallocated Requested Partition" message (in red text), followed by one or more partitions. A common reason for this is a lack of sufficient free space for the partition. In any case, the reason the partition remains unallocated will be displayed after the partition's requested mount point.

To fix an unallocated requested partition, you must move the partition to another drive which has the available space, resize the partition to fit on the current drive, or delete the partition entirely. Make changes using the **Edit** button or by double clicking on the partition.

Drive Summaries

Each line in the **Drive Summaries** section represents a hard disk on your system. Each line has the following fields:

Drive:

This field shows the hard disk's device name.

Geom [C/H/S]:

This field shows the hard disk's **geometry**. The geometry consists of three numbers representing the number of cylinders, heads and sectors as reported by the hard disk.

Total:

This field shows the total available space on the hard disk.

Free:

This field shows how much of the hard disk's space is still unallocated.

Used:

These fields show how much of the hard disk's space is currently allocated to partitions, in megabytes and percentage.

The **Drive Summaries** section is displayed only to indicate your computer's disk configuration. It is not meant to be used as a means of specifying the target hard drive for a given partition. That is done using the **Allowable Drives** field in the section called *Adding Partitions*.

Disk Druid's Buttons

These buttons control Disk Druid's actions. They are used to add and delete partitions, and to change partition attributes. There are also buttons that are used to accept the changes you've made, or to exit Disk Druid. Let's take a look at each button in order.

Add:

used to request a new partition. When selected, a dialog box will appear containing fields (such as mount point and size) that must be filled in.

Edit:

used to modify attributes of the partition currently selected in the "Partitions" section. Selecting **Edit** will open up a dialog box. Some or all of the fields can be edited, depending on whether the partition information has already been written to disk.

Delete:

used to remove the partition currently highlighted in the **Current Disk Partitions** section. You'll be asked to confirm the deletion of any partition.

Reset:

used to restore Disk Druid to its original state. All changes made will be lost if you **Reset** the partitions.

Make RAID Device:

Make RAID Device can be used if you want to provide redundancy to any or all disk partitions. *It should only be used if you have experience using RAID.* To read more about RAID, please refer to the *Official Red Hat Linux Reference Guide.*

Adding Partitions

To add a new partition, select the **Add** button. A dialog box will appear (see Figure 4-6).

Please Note

You will need to dedicate at least one partition to Red Hat Linux, and optionally more. This is discussed more completely in Appendix C in the *Official Red Hat Linux Reference Guide.*

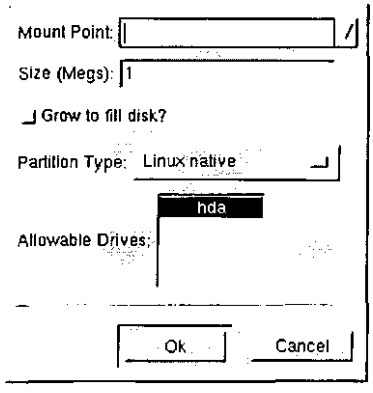


Figure 4-6. Adding a Partition

- **Mount Point**: Highlight and enter the partition's mount point. For example, if this partition should be the root partition, enter /; enter **/boot** for the **/boot** partition, and so on. You can also use the pull-down menu to choose the correct mount point for your partition.

- **Size (Megs)**: Enter the size (in megabytes) of the partition. Note this field starts with a "1" in it; unless changed you'll end up with a 1 MB partition.

- **Grow to fill disk**: This check box indicates if the size you entered in the previous field is to be considered the partition's exact size, or its minimum size. When selected, the partition will grow to fill all available space on the hard disk. The partition's size will expand and contract as other partitions are modified. You can make multiple partitions growable; if you do, the additional free space will be shared among all growable partitions.

- **Partition Type**: This field contains a list of different partition types (such as Linux Native or DOS). Select the appropriate partition type by using the mouse.
- **Allowable Drives**: This field contains a list of the hard disks installed on your system. If a hard disk's box is highlighted, then a desired partition can be created on that hard disk. If the box is *not* checked, then the partition will *never* be created on that hard disk. By using different check box settings, you can direct `Disk Druid` to place partitions as you see fit, or let `Disk Druid` decide where partitions should go.
- **Ok**: Select **Ok** once you're satisfied with the settings, and wish to create the partition.
- **Cancel**: Select **Cancel** if you don't want to create the partition.

Editing Partitions

To edit a partition, select the **Edit** button or double-click on the existing partition (see Figure 4-7).

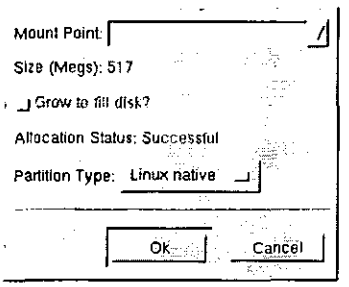


Figure 4-7. Editing a Partition

Please Note

If the partition already existed on your hard disk, you will only be able to change the partition's mount point. If you want to make any other changes, you will need to delete the partition and recreate it.

Deleting a Partition

To delete a partition, highlight it in the "Partitions" section and double-click the **Delete** button. You will be asked to confirm the deletion.

Choose Partitions to Format

Choose the partitions that you would like to format. All newly created partitions should be formatted. In addition, any existing partitions that contain data you no longer need should be formatted. However, partitions such as `/home` or `/usr/local` must not be formatted if they contain data you wish to keep (see Figure 4-8).

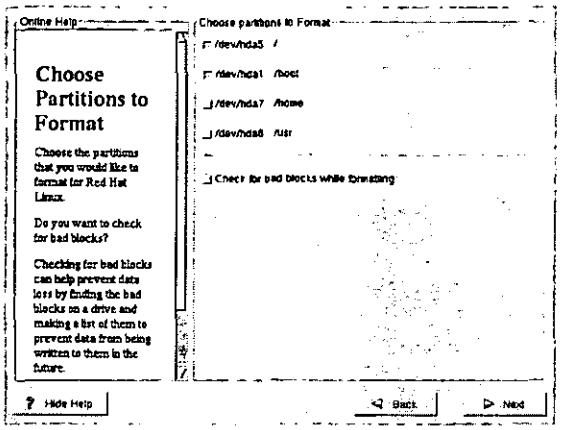


Figure 4-8. Choosing Partitions to Format

If you wish to check for bad blocks while formatting each filesystem, please make sure to select the **`check for bad blocks`** option.

Checking for bad blocks can help prevent data loss by locating the bad blocks on a drive and making a list of them to prevent using them in the future.

Installing LILO

If you're performing a workstation- or server-class installation, please skip ahead to the section called *Time Zone Configuration*.

In order to be able to boot your Red Hat Linux system, you usually need to install LILO (the LInux LOader). You may install LILO in one of two places:

The master boot record (MBR)

> The recommended place to install LILO, unless the MBR already starts another operating system loader, such System Commander or OS/2's Boot Manager. The master boot record is a special area on your hard drive that is automatically loaded by your computer's BIOS, and is the earliest point at which LILO can take control of the boot process. If you install LILO in the MBR, when your machine boots, LILO will present a `boot:` prompt. You can then boot Red Hat Linux or any other operating system you configure LILO to boot.

The first sector of your root partition

> Recommended if you are already using another boot loader on your system (such as OS/2's Boot Manager). In this case, your other boot loader will take control first. You can then configure that boot loader to start LILO (which will then boot Red Hat Linux).

If you choose to install LILO, please select where you would like LILO to be installed on your system (see Figure 4-9). If your system will use only Red Hat Linux you should choose the master boot record (MBR). For systems with Win95/98, you also should install LILO to the MBR so that LILO can boot both operating systems.

If you have Windows NT (and you want to install LILO) you should choose to install LILO on the first sector of the root partition, not the MBR. Please be sure to create a boot disk. In a case such as this, you will either need to use the boot disk, or configure the NT system loader to boot LILO from the first sector of the root partition. Be sure to check out http://www.linuxdoc.org/HOWTO/mini/Linux+NT-Loader.html for more information on setting up LILO and NT.

Caution

If you choose not to install LILO for any reason, you will not be able to boot your Red Hat Linux system directly, and will need to use another boot method (such as a boot diskette). Use this option only if you are sure you have another way of booting your Red Hat Linux system!

The **Use linear mode** button is selected by default. In most cases, linear mode should be enabled; if your computer cannot use linear mode to access your hard drives, deselect this option.

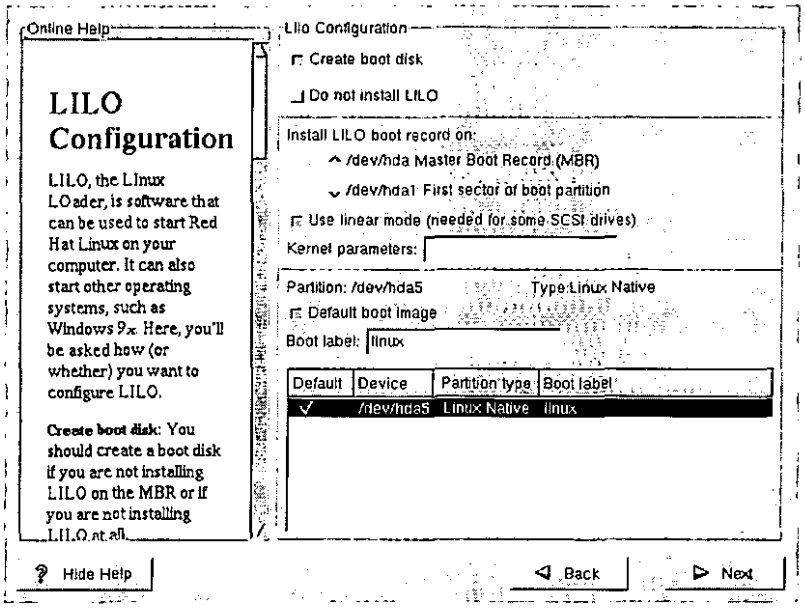


Figure 4-9. LILO Configuration

If you wish to add default options to the LILO boot command, enter them into the kernel parameters field. Any options you enter will be passed to the Linux kernel every time it boots.

Bootable Partition -- Every bootable partition is listed, including partitions used by other operating systems. The "Boot label" column will be filled in with the word **linux** on the partition holding your Red Hat Linux system's root filesystem. Other partitions may also have boot labels. If you would like to add boot labels for other partitions (or change an existing boot label), click once on the partition to select it. Once selected, you can change the boot label.

Please Note

The "Boot label" column lists what you must enter at LILO's `boot:` prompt in order to boot the desired operating system. However, if you forget the boot labels defined on your system, you can always press **Tab** at LILO's `boot:` prompt to display a list of defined boot labels.

Configuring LILO

- `Create boot disk` -- The `Create boot disk` option is checked by default. If you do not want to create a boot disk, you should deselect this option. However, we strongly urge you to create a boot disk. A boot disk can be handy for a number of reasons:
    - Use It Instead of LILO -- You can use a boot disk instead of LILO. This is handy if you're trying Red Hat Linux for the first time, and you'd feel more comfortable if the boot process for your other operating system is left unchanged. With a boot disk, going back to your other operating system is as easy as removing the boot disk and rebooting.
    - Use It If Another Operating System Overwrites LILO -- Other operating systems may not be as flexible as Red Hat Linux when it comes to supported boot methods. Quite often, installing or updating another operating system can cause the master boot record (originally containing LILO) to be overwritten, making it impossible to boot your Red Hat Linux installation. The boot disk can then be used to boot Red Hat Linux so you can reinstall LILO.
- `Do not install LILO` -- if you have Windows NT installed on your system, you may not want to install LILO. If you choose not to install LILO for this reason, make sure that you have chosen to create a boot disk; otherwise you will not be able to boot Linux. You can also choose to skip LILO if you do not want to write LILO to your hard drive.

Tip

To use the boot disk with rescue mode, you have several options:

- Using the CD-ROM to boot, type `linux rescue` at the `boot:` prompt.
- Using the network boot disk, type `linux rescue` at the `boot:` prompt. You will then be prompted to pull the rescue image from the network.
- Using the boot disk included with the Red Hat Linux boxed set, type `linux rescue` at the `boot:` prompt. You then pick an installation method and choose a valid installation tree to load from.

For more information regarding rescue mode, refer to the *System Administration* chapter of the *Official Red Hat Linux Reference Guide*.

Alternatives to LILO

If you do not wish to use LILO to boot your Red Hat Linux system, there are several alternatives:

Boot Disk

> As previously stated, you can use the boot disk created by the installation program (if you elected to create one).

LOADLIN

> You can load Linux from MS-DOS. Unfortunately, it requires a copy of the Linux kernel (and an initial RAM disk, if you have a SCSI adapter) to be available on an MS-DOS partition. The only way to accomplish this is to boot your Red Hat Linux system using some other method (e.g., from LILO on a diskette) and then copy the kernel to an MS-DOS partition. **LOADLIN** is available from ftp://metalab.unc.edu/pub/Linux/system/boot/dualboot/ and associated mirror sites.

SYSLINUX

> An MS-DOS program very similar to **LOADLIN**. It is also available from ftp://metalab.unc.edu/pub/Linux/system/boot/loaders/ and associated mirror sites.

Some commercial bootloaders

> For example, System Commander and Partition Magic, which are able to boot Linux (but still require LILO to be installed in your Linux root partition).

SMP Motherboards and LILO

This section is specific to SMP motherboards only. If the installer detects an SMP motherboard on your system, it will automatically create two *lilo.conf* entries, rather than the usual single entry.

One entry will be called *linux* and the other will be called *linux-up*. The *linux* will boot by default. However, if you have trouble with the SMP kernel, you can elect to boot the *linux-up* entry instead. You will retain all the functionality as before, but you will only be operating with a single processor.

Network Configuration

If you have a network card and have not already configured your networking information, you now have the opportunity to configure networking (as shown in Figure 4-10).

Choose your device type and whether you would like to configure using DHCP. If you have multiple Ethernet devices, each device will keep the information you have provided. You may switch between devices, for example eth0 and eth1, and the information you give will be specific to each device. If you select **Activate on boot**, your network interface will be started when you boot. If you do not have DHCP client access or are unsure as to what this information is, please contact your network administrator.

Next enter, where applicable, the **IP Address**, **Netmask**, **Network**, and **Broadcast** addresses. If you are unsure about any of these, please contact your network administrator.

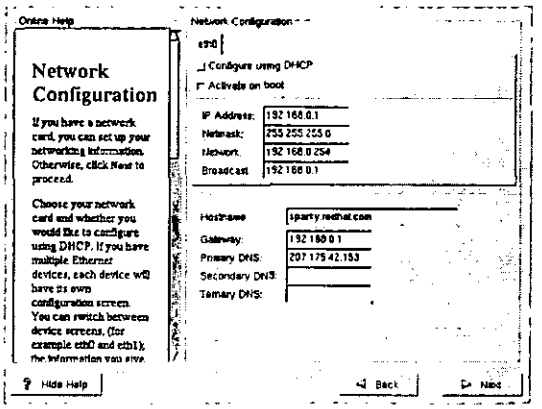


Figure 4-10. Network Configuration

Tip

Even if your computer is not part of a network, you can enter a hostname for your system. Take this opportunity to enter in a name, if you do not, your system will be known as `localhost`.

Finally, enter the **Gateway** and **Primary DNS** (and if applicable the **Secondary DNS** and **Ternary DNS**) addresses.

Time Zone Configuration

You can set your time zone either by selecting your computer's physical location, or by your time zone's offset from Universal Coordinated Time (also known as UTC).

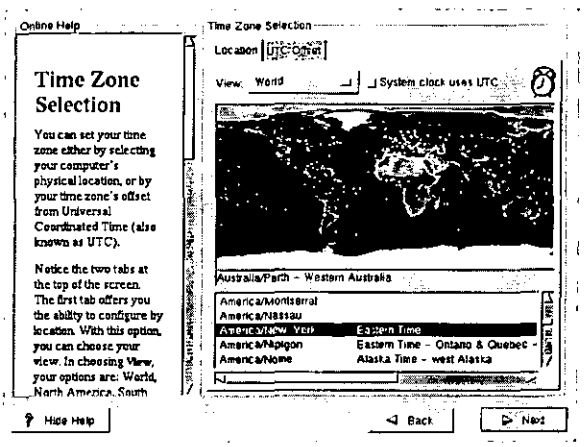


Figure 4-11. Configuring Time Zone

Notice the two tabs at the top of the screen (see Figure 4-11). The first tab offers you the ability to configure by location. With this option, you can choose your view. In choosing

view, your options are: **`World`**, **`North America`**, **`South America`**, **`Pacific Rim`**, **`Europe`**, **`Africa`**, and **`Asia`**.

From the interactive map, you can also click on a specific city, as indicated by the yellow dots; a red **`x`** will appear indicating your selection. You can also scroll through a list and choose your desired time zone.

The second tab offers you the ability to use the UTC offset. UTC presents you with a list of offsets to choose from, as well as an option to set daylight saving time.

For both tabs, there is the option of selecting **`System Clock uses UTC`**. Please select this if you know that your system is set to UTC.

Tip

If you wish to change your time zone configuration after you have booted your Red Hat Linux system, become root and use the **/usr/sbin/timeconfig** command.

Account Configuration

The *Account Configuration* screen allows you to set your root password. Additionally, you can set up user accounts for you to log into once the installation is complete (see Figure 4-12).

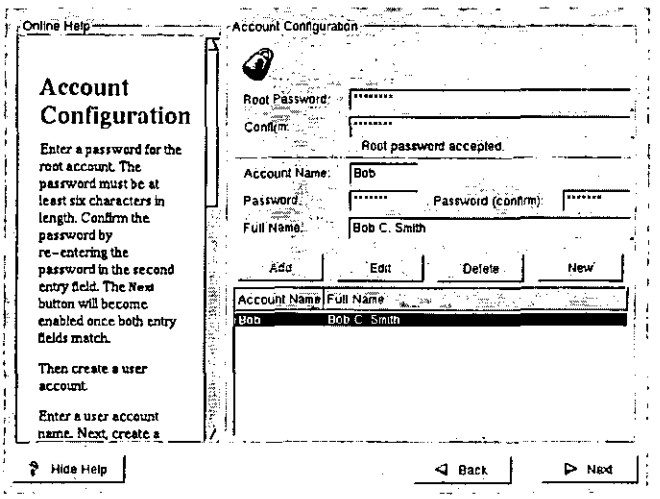


Figure 4-12. Account Creation

Setting the Root Password

The installation program will prompt you to set a **`root password`** for your system.

The root password must be at least six characters long; the password you type is not echoed to the screen. You must enter the password twice; if the two passwords do not match, the installation program will ask you to enter them again.

You should make the root password something you can remember, but not something that is easy for someone else to guess. Your name, your phone number, *qwerty*, *password*, *root*, *123456*, and *anteater* are all examples of poor passwords. Good passwords mix numerals with upper and lower case letters and do not contain dictionary words: *Aard387vark* or *420BMttNT*, for example. Remember that the password is case-sensitive. Write down this password and keep it in a secure place.

Please Note

The *root* user (also known as the *superuser*) has complete access to the entire system; for this reason, logging in as the root user is best done *only* to perform system maintenance or administration.

Setting Up User Accounts

If you choose to create a user account now, you will have an account to log in to once the installation has completed. This allows you to safely and easily log into your computer without having to be *root* to create other accounts.

Enter an account name. Then enter and confirm a password for that user account. Enter the full name of the account user and press **Enter**. Your account information will be added to the account list, clearing the user account fields so you can add another user.

You can also choose **New** to add a new user. Enter the user's information and use the **Add** button to add the user to the account list.

You can also **Edit** or **Delete** the user accounts you have created or no longer want.

Authentication Configuration

If you are performing a workstation-class installation, please skip ahead to the section called *GUI X Configuration Tool.*

If you are performing a server-class installation, please skip ahead to the section called *Preparing to Install.*

You may skip this section if you will not be setting up network passwords. If you are unsure as to whether you should do this, please ask your system administrator for assistance.

Unless you are setting up `NIS` authentication, you will notice that both `MD5` and `shadow` passwords are selected (see Figure 4-13). We recommend you use both to make your machine as secure as possible.

To configure the NIS option, you must be connected to an NIS network. If you are unsure whether you are connected to an NIS network, please ask your system administrator.

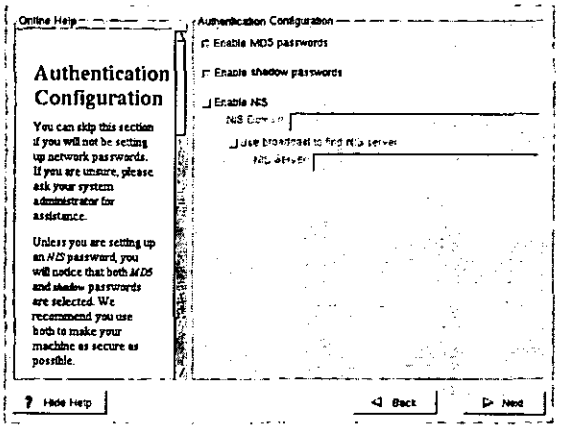


Figure 4-13. Authentication Configuration

- **`MD5 Password`** -- allows a long password to be used (up to 256 characters), instead of the standard eight letters or less.
- **`Shadow Password`** -- provides a secure method of retaining passwords. The passwords are stored in **/etc/shadow**, which is readable only by root.
- **`Enable NIS`** -- allows you to run a group of computers in the same Network Information Service domain with a common password and group file. There are two options to choose from here:
    - **`NIS Domain`** -- this option allows you to specify which domain or group of computers your system belongs to.
    - **`NIS Server`** -- this option causes your computer to use a specific NIS server, rather than "broadcasting" a message to the local area network asking for any available server to host your system.

Package Group Selection

After your partitions have been selected and configured for formatting, you are ready to select packages for installation.

You can select *components*, which group packages together according to function (for example, **C Development**, **Networked Workstation**, or **Web Server**), *individual packages*, or a combination of the two.

To select a component, click on the check box beside it (see Figure 4-14).

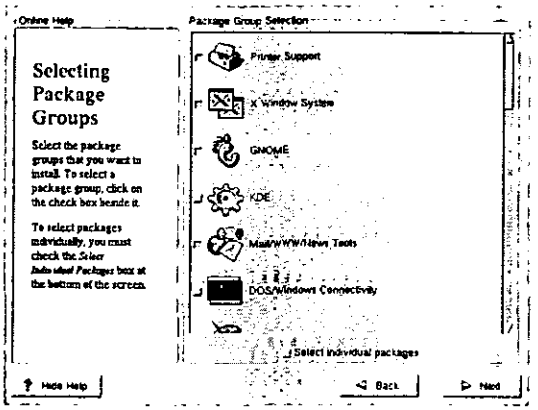


Figure 4-14. Package Group Selection

Select each component you wish to install. Selecting **Everything** (which can be found at the end of the component list) installs all packages included with Red Hat Linux. Selecting every package will require close to 1.7GB of free disk space.

To select packages individually, check the **`Select Individual Packages`** box at the bottom of the screen.

Selecting Individual Packages

After selecting the components you wish to install, you can select or deselect individual packages. The installation program presents a list of the packages in that group, which you can select or deselect using your mouse (see Figure 4-15).

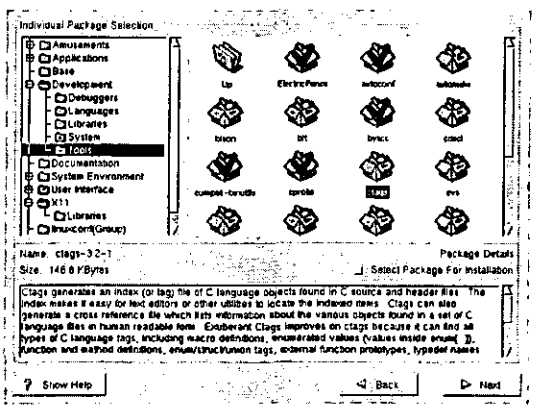


Figure 4-15. Selecting Individual Packages

On the left side of the screen you will see a directory listing of various package groups. When you expand this list (double-click to select it) and double-click on a single directory, the list of packages available for installation will appear on the right.

To select an individual package, double-click on it, or click on it once to highlight it and click on the **Select Package For Installation** button below. A red check mark will appear on any of the packages you have selected for installation.

To read information about a particular package before choosing it for installation, left-click on it once to highlight it, and the information will appear at the bottom of the screen along with the name and size of the package.

Please Note

Some packages (such as the kernel and certain libraries) are required for every Red Hat Linux system and are not available to select or deselect. These *base packages* are selected by default.

Unresolved Dependencies

Many software packages, in order to work correctly, depend on other software packages that must be installed on your system. For example, many of the graphical Red Hat system administration tools require the `python` and `pythonlib` packages. To make sure your system has all the packages it needs in order to be fully functional, Red Hat Linux checks these package *dependencies* each time you install or remove software packages.

If any package requires another package which you have not selected to install, the program presents a list of these *unresolved dependencies* and gives you the opportunity to resolve them (see Figure 4-16).

The **`Unresolved Dependencies`** screen will only appear if you are missing certain packages that are needed by your selected packages. Under the list of missing packages, there is an **`Install packages to satisfy dependencies`** check box at the bottom of the screen which is selected by default. If you leave this checked, the installation program will resolve package dependencies automatically by adding all required packages to the list of selected packages.

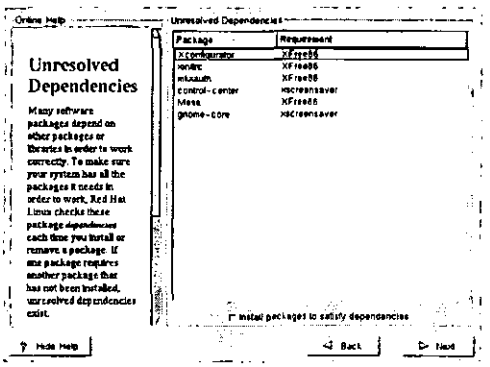


Figure 4-16. Unresolved Dependencies

GUI X Configuration Tool

If you decided to install the X Window System packages, you now have the opportunity to configure an X server for your system. If you did not choose to install the X Window System packages, skip ahead to the section called *Installing Packages*.

Configuring Your Monitor

`Xconfigurator`, the X Window System configuration tool, first presents a list of monitors for you to choose from. In the list, you can either use the monitor that is autodetected for you, or choose another monitor.

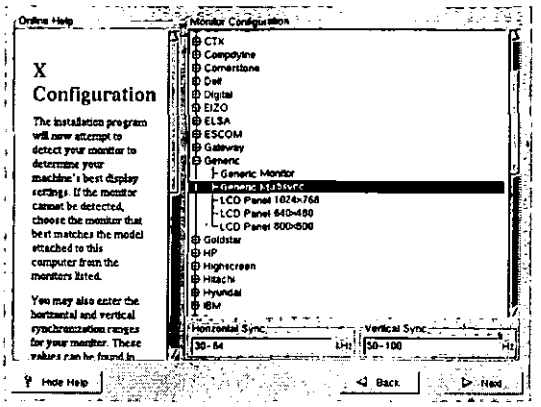


Figure 4-17. Monitor Selection

If your monitor does not appear on the list, select the most appropriate **`Generic`** model available. If you do select a **`Generic`** monitor, `Xconfigurator` will suggest horizontal and vertical sync ranges. These values are generally available in the documentation which accompanies your monitor, or from your monitor's vendor or manufacturer; please check your documentation to make sure these values are set correctly.

Caution

> Do not select a monitor *similar* to your monitor unless you are certain that the monitor you are selecting does not exceed the capabilities of your monitor. Doing so may overclock your monitor and damage or destroy it.

Also presented are the horizontal and vertical ranges that `Xconfigurator` suggests.

Click **Next** when you have finished configuration of your monitor.

Video Hardware Configuration

Next, `Xconfigurator` will probe for any video hardware you have (see Figure 4-18). Failing that, `Xconfigurator` will present a list of video cards and monitors for you to select from.

If your video card does not appear on the list, *XFree86* may not support it. However, if you have technical knowledge about your card, you may choose **`Unlisted Card`** and attempt to configure it by matching your card's video chipset with one of the available X servers.

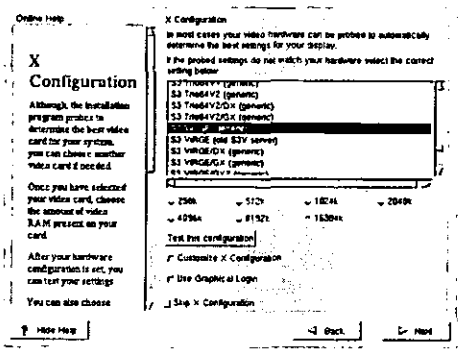


Figure 4-18. Videocard Setup

Next, `Xconfigurator` prompts you for the amount of video memory installed on your video card. If you are not sure, please consult the documentation accompanying your video card. You will not damage your video card by choosing more memory than is available, but the XFree86 server may not start correctly if you do.

Once your hardware has been determined, you can test the configuration settings. We recommend that you do test your configuration to make sure that the resolution and color is what you want to work with.

If you would like to customize the X configuration, please make sure the **Customize X Configuration** button is selected. If you choose to customize, you will be presented with another screen that lets you select what your resolution should be (see Figure 4-19). Again, you will have the option of testing the configuration.

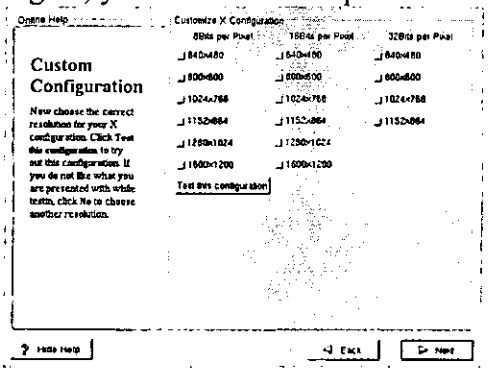


Figure 4-19. X Customization

You may also choose to **Skip X Configuration** if you would rather configure X after the install or not at all.

Preparing to Install

You will now see a screen preparing you for the installation of Red Hat Linux (see Figure 4-20).

Warning

If, for some reason, you would rather not continue with the installation process, this is your last opportunity to safely cancel the process and reboot your machine. Once you

press the **Next** button, partitions will be written and packages will be installed. If you wish to abort the installation, you should reboot now before your hard drive(s) are rewritten.

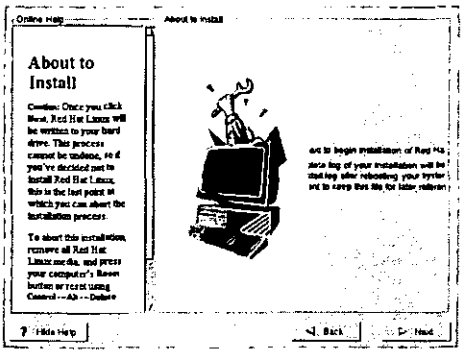


Figure 4-20. Ready to Install

Installing Packages

At this point there's nothing left for you to do until all the packages have been installed (see Figure 4-21). How quickly this happens depends on the number of packages you've selected, and your computer's speed.

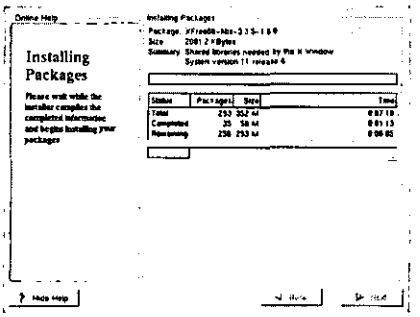


Figure 4-21. Installing Packages

Boot Disk Creation

If you chose to to create a boot disk, you should now insert a blank, formatted diskette into your floppy drive (see Figure 4-22).

After a short delay, your boot disk will be created; remove it from your floppy drive and label it clearly. Note that if you would like to create a boot disk after the installation, you'll be able to do so. For more information, please see the **mkbootdisk** man page, by typing **man mkbootdisk** at the shell prompt.

If you boot your system with the boot disk (instead of LILO), make sure you create a new boot disk if you make any changes to your kernel.

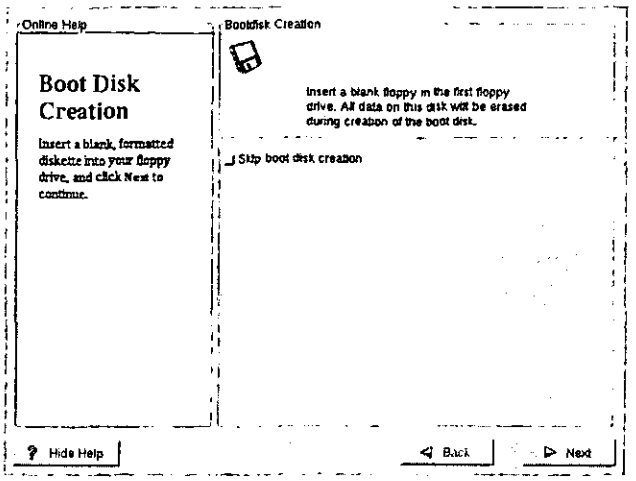


Figure 4-22. Creating Your Boot Disk

Installation Complete

Congratulations! Your Red Hat Linux 6.2 installation is now complete!

The installation program will prompt you to prepare your system for reboot (see Figure 4-23). Don't forget to remove any diskette in the floppy drive or CD in the CD-ROM drive. If you did not install LILO, you'll need to use your boot disk now.

After your computer's normal power-up sequence has completed, you should see LILO's standard prompt, which is `boot:`. At the `boot:` prompt, you can do any of the following things:

- Press **Enter** -- Causes LILO's default boot entry to be booted.
- Enter a Boot Label, followed by **Enter** -- Causes LILO to boot the operating system corresponding to the boot label. (Press **?** at the `boot:` for a list of valid boot labels.)
- Do Nothing -- After LILO's timeout period, (which, by default, is five seconds) LILO will automatically boot the default boot entry.

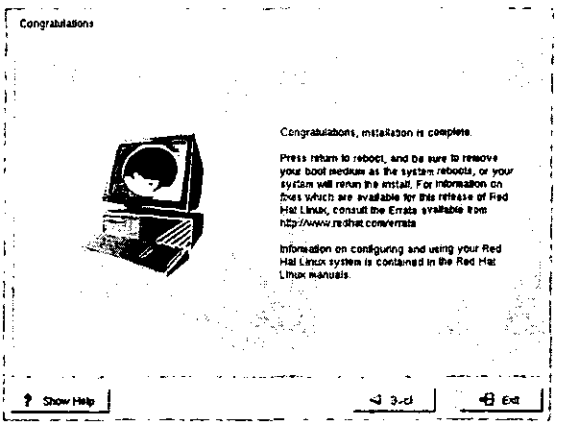


Figure 4-23. Installation Complete

Do whatever is appropriate to boot Red Hat Linux. You should see one or more screens of messages scroll by. Eventually, you should see a `login:` prompt or a GUI login screen (if you installed the X Window System and chose to start X automatically).

Tip

If you're not sure what to do next, we suggest you begin with the *Official Red Hat Linux Getting Started Guide* as an introduction to using Red Hat Linux. The *Official Red Hat Linux Getting Started Guide* covers topics relating to the basics of your system.

If you are a more experienced user looking for information on system configuration or administration topics, you may find the *Official Red Hat Linux*

NetWare 5.0 Server

Requirements

- To allow students to do the projects in this book, you will need a minimum of one classroom server with NetWare 5.0 installed. Each NetWare server should have a minimum of:
- Pentium 100Mhz processor (Pentium 166 or better recommended)
- 64MB RAM (128MB recommended as this allows faster performance for the Java-based applications on the server.)
- VGA or higher resolution display adapter (SVGA recommended). The adapter must be VESA compliant or the GUI install utility may not display.
- PS/2 or serial mouse

- 1GB hard drive (two drives optional)
- CD-ROM drive
- 10BaseT network board with drivers
- Both SYS and DATA volumes recommended
- 50 MB disk space on the SYS volume for the boot partition and DOS
- 650MB disk space on the SYS volume for the operating system and software (minimum of 350MB for the NetWare OS. 650MB with all options and documentation.)
- 3 MB disk space per student on the DATA volume
- NetWare 5.0 (both the Operating System and the Client CD-ROMs.
- NetWare 5 License diskette with sufficient licenses for the class size.
- DOS 3.3 or later (for the DOS partition. Do NOT use the DOS that ships with Windows—NT, 95, or 98.) The NetWare 5 License diskette includes DOS 7 for this purpose.
- Copy of the full version of Z.E.N.works recommended (for use with Chapter 14)
- Copy of Novell Groupwise (again for use in Chapter 14)
- IP address (if installing the default TCP/IP protocol)
- Server- or network-attached laser printer (This printer will need to support Novell Distributed Print Services, NDPS, in order to run the exercises in Chapter 12.)
- Server-installed tape backup device (optional for use in Chapter 14 Case Project 14-2)
- Copy of an office automation suite (such as MS Office) if one isn't installed already on each workstation for student use.

Student Lab Computer Requirements

To perform the hands on activities and projects in this book, you will need to attach the student lab to a classroom network system that allows them to access the NetWare 5.0 server. This book requires each student workstation run Windows 95/98 with the following minimum hardware:.

- 80486DX 66Mhz processor (Pentium recommended)
- 32 MB RAM (16 MBytes absolute minimum)
- 340 MB hard drive absolute minimum - size of hard drive needed depends upon software loaded on the drive (if you are using Windows 95/98 and Office 95/97/2000, at least a 540 MB hard drive is recommended as Windows 98 alone requires up to 250MB of free space)
- VGA monitor
- Access to a local printer for assignment output
- 33.6 modem for Internet access to download files (optional)

In addition to the hardware requirements, each lab computer should have the following software:

- Windows 95/98
- The latest version of the Novell Client for Windows 95/98 software (v3.1 or above) including the Z.E.N.works Starter Pack

NetWare Server Setup

STEP 1: Install NetWare 5

1). Server Software Installation

- Copy your server-to-be's CD-ROM drivers to a floppy diskette, if you do not have the ones that came with the system. (Or should have.)
- Examine both the CONFIG.SYS and AUTOEXEC.BAT files for the commands relating to the CD-ROM drive. (Usually the name of the driver is in the command.)
- Insert the Novell License Diskette into the server drive (or a non-Windows DOS boot diskette with FDISK and FORMAT on it.)
- Run FDISK from the diskette, then remove any existing partitions from the server hard drive(s).
- Use FDISK to reestablish a 50MB DOS partition on the primary hard drive. Make it bootable (ie: active) in FDISK.
- Use FORMAT to place DOS 7.0 on the drive (as in FORMAT C: /S).
- Remove the floppy and reboot the system.
- Copy the CD-ROM driver to the root of C:
- Recreate the AUTOEXEC.BAT and CONFIG.SYS files using only the commands for loading the CD-ROM driver. Adjust the commands to the new location for the driver at the root of C: (as opposed to C:\WINDOWS or C:\CDROM).
- Reboot the system.
- Insert the Novell NetWare 5.0 Install CD-ROM into the drive.
- Change to that drive and type INSTALL
- Accept the default path C:\NWSERVER for the startup files.
- Accept the language and keyboard type or modify it for your language. (The default is U.S. English.)
- Accept or modify display and mouse type as required for your particular server.
- Select the storage device type.
- Select the network board driver.
- After selecting your drive's free space for the NetWare partition you will receive a **Create a NetWare partition and SYS volume** screen. Be sure to limit the SYS volume size to leave space for your DATA volume if you are using only one hard drive. The SYS volume should have a minimum of 500 MB. The size of your DATA volume will depend upon the number of students. Multiply the number of students by 5 MB to give your minimum. After specifying the SYS volume size, press F10 to continue.

- The installation program will now copy initial files to the C:\NWSERVER directory and SYS volume.
- After the File Copy is complete, the GUI installation screen will display.
- Enter the server name: **CONSTELLATION**.
- When the NetWare disk space windows displays, click on **Free space** and click **Create**.
- Enter **DATA** for the new volume name and click **OK**.
- Click **Next** when both SYS and DATA volumes display.
- Click **Next** when presented with the option to mount all volumes when the server re-boots.
- Click on your network card.
- Click on **IP** and enter a valid IP address and subnet mask for your network

NOTE ON IP ADDRESSES

The determination and selection of IP addresses is beyond the scope of this book. Typically, you will be assigned these numbers by your MIS department or system administrator. This is in order to coordinate with the rest of your network's IP addresses as well as connecting to the Internet. If you are assigning these numbers, and are on an isolated system which won't be connected to another IP network, you can use some defaults:

IP Address	128.0.0.1 *or* 123.45.67.89
Subnet Mask	255.255.255.0
Gateway	(leave blank)

- Click on **IPX** (this will allow students to test IPX-only tools.).
- Click **Next** after selecting the IP and IPX protocols.
- Select your time zone and click **Next**.

NetWare 5.0 defaults to using Ethernet 802.2. If you need to change this to 802.3, or want to include this additional protocol, you can edit the IPX protocol in the Customization screen at the end of the Install process.

2). Create the NDS Structure

After you have completed the above steps you will next need to create the CBELABS structure by performing the following:

- Click on the option to **Create a new tree** and click **Next**. (Do NOT choose to add this server to an existing tree if you have one.)
- Enter the following data:
  Tree Name: CBELABS (or the name of the tree you selected earlier)
  Context for Server: O=CBE_Labs
  Admin Name: Admin
  Admin context: O=CBE_Labs
  Password: (Enter any password, but be sure you can remember it)
- Click **Next** to display a verification window.

- Click **Next** to continue.

3). Complete the Installation

You only need to select NDPS and SMS for installation from the list of optional components of NetWare 5.0 for this course. (Doing it now is much easier than running NWCONFIG later on to add these components.) The GUI installation program will now copy all necessary files to your system. This process will take 30-45 minutes depending upon your CD-ROM and disk speed. After all files are copied you will need to re-boot the server.

4). Verify the Server JVM

You'll need to verify that the server Java Virtual Machine (JVM) loaded. Once the server reboots and loads, check to see if the ConsoleOne GUI desktop is present. If you don't see it displayed, press <Ctrl><Esc> to see if this is listed as one of the loaded screens.

If it isn't present, you can manually load it. The server-based Java GUI desktop automatically loads if these two commands are in your AUTOEXEC.NCF file:

```
LOAD SYS:JAVA\BIN\JAVA.NLM
STARTX
```

This runs the Java Virtual Machine and the Servertop desktop. (You can check for these commands in the file using the NWCONFIG utility.)

You should be patient as it can take several minutes for the JVM to become properly configured (this is based on the amount of RAM you have. It takes several minutes with 64MB, under a minute with 128MB.) If you switch over to watch the server console, you can see the server progressing through a number of NLMs, config files, and other support programs for the JVM before it finishes.

Once it loads, you can go to the servertop desktop and choose the lower-left-hand-corner menu labeled NOVELL (in the same way you would choose the Win95/98 START menu). Then choose ConsoleOne. ConsoleOne then loads on the server desktop.

STARTX itself is an .NCF file, so if you want to view its contents:

1. Load EDIT at the console.
2. Press <INS> and choose SYS, JAVA, and the NWGFX directories.
3. Choose the file STARTX.NCF to view the contents of this file.
4. You can test each of these commands at the server console by pressing <CTRL><ESC> simultaneously to view the Select Screen menu. Select 1--Server Console.
5. Type in a command from the STARTX.NCF file. If necessary, you can press <CTRL><ESC> then select the EDIT screen to review the commands.

Once the JVM loads (which is shown by the fact that you have a grey-colored desktop with an arrow cursor in the middle of it onscreen,) you can then choose the NOVELL\CONSOLEONE option to load the tool.

5). Create the NetWare File System

Use this volume form to create the NetWare file structure on CONSTELLATION:

Volume Design Form

Created By:	*Dave Johnson*		**Date:**	*9/15/99*	
Volume:	*CONSTELLATION_SYS:*		**Capacity:**	*4 GByte*	
NetWare Version:	*5.0*	**Note: Functions below are not applicable to 3.x**			
		Block Suballocation:	X	**Enable**	
Block Size:				**Disable**	
				Not applicable	
		File Compression:	X	**Enable**	
				Disable	
	X			**Not applicable**	
		Data Migration:		**Enable**	
			X	**Disable**	
				Not applicable	

Directory Structure Diagram

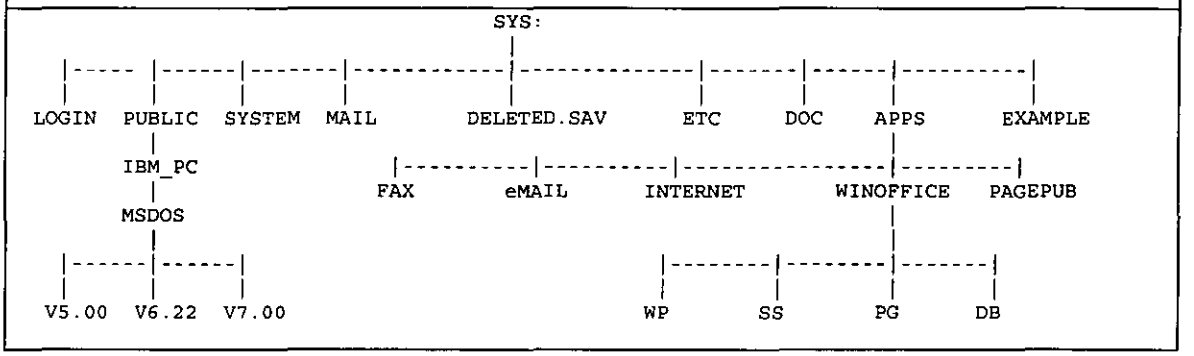


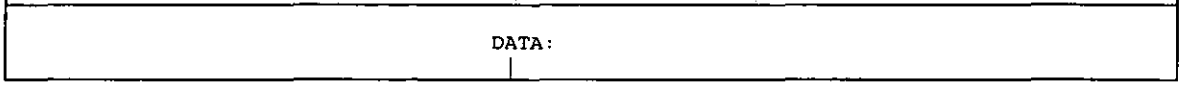
Figure IM-2 - The volume CONSTELLATION/SYS: directory structure

and this form for the CONSTELLATION_DATA volume:

Volume Design Form

Created By:	*Dave Johnson*		**Date:**	*9/15/99*	
Volume:	*CONSTELLATION_DATA:*		**Capacity:**	*6 GByte*	
NetWare Version:	*5.0*	**Note: Functions below are not applicable to 3.x**			
		Block Suballocation:	X	**Enable**	
Block Size:				**Disable**	
				Not applicable	
		File Compression:	X	**Enable**	
				Disable	
	X			**Not applicable**	
		Data Migration:		**Enable**	
			X	**Disable**	
				Not applicable	

Directory Structure Diagram



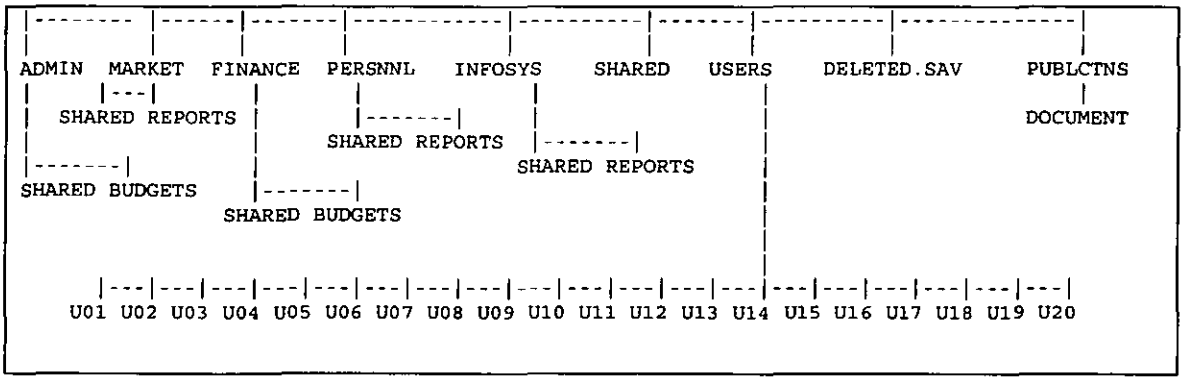


Figure IM-3 - The volume CONSTELLATION_DATA: directory structure

In the CONSTELLATION_DATA/USERS directory, the U01, U02, etc. user home directories will be created by NetWare Administrator as you add each user to the tree. (These directory names will then be 10ADMIN, 11ADMIN, etc.)

At this point, you are ready to run the class up to Chapter 6 of the text. This server and NDS tree allows students to practice using NetWare utilities including Login, Logout, and NetWare Administrator. It is not necessary to install the optional SARATOGA or RANGER servers at this time.

The files needed to set up the NetWare file system in your class are in the NWSERVER directory of the Instructor's Resource Kit CD-ROM. The files are used to set up a network for the CBE Labs project, which is the primary on-going project in this book. There are also files for the optional NWTC project as well.

Simplified Server Setup

Use these instructions if you want to do a full install and configuration of NetWare 5.0 on a single server in Chapters 6 and 7. These steps allow your students to do the projects in Chapters 1-5.

1. Follow the steps outlined earlier in sections 1 through 4 to install NetWare 5.
2. Do not create the CONSTELLATION_DATA volume.
3. Create an OU in the CBE_Labs organization called CLASS.
4. Create inside USERS an appropriate number of User objects named ##Admin where the ### indicates a random student number for each class attendee.
5. Choose to create a Home directory for each student on the CONSTELLATION_SYS:EXAMPLE directory.
6. Make the USERS container a trustee of CONSTELLATION_SYS:PUBLIC and CONSTELLATION_SYS:PUBLIC\WIN32 The default of Read rights and File Scan rights is sufficient.
7. Click OK to save the configuration.

This configuration should allow the students to perform all the work in chapters 1 to 5.

Configuring Network Workstations

NetWare 5.0: Network Administrator is written for use with workstations running Windows 95/98 and the Novell Client network client. (Microsoft's Client will not work for the NetWare utilities.) All screen shots are from Windows 95/98 and steps in the text are based on Windows 95/98 with the Novell Client extensions. If you are using Windows 3.1, Windows 3.11 or Windows for Workgroups 3.11, you will need to make allowances since the NetWare utilities for those platforms may not support all the functions used in the exercises.

If you are using Windows 95/98 and the Novell Client, be sure to download and use the latest version of the Novell Client for Windows 95/98 on all your workstations. (NetWare 5.0 shipped with v3.0 of the client. Novell now has a newer version, v3.1, on their web site for downloading.)

If you are using Windows 3.1x or Windows for Workgroups 3.11, you should use the Novell Client for DOS/Windows v2.71

Step 1: Initial Administrator Client Setup

1. If necessary, install Windows 95/98 on all your student workstations. During this installation you may want to install the Microsoft NetWare client as well. This will allow students to install the Novell Client from the server rather than from the CD-ROM.

2. Make a subdirectory in Windows named CAB and copy all the Windows Installation files with the extension .CAB into the CAB subdirectory.

3. Install a local printer. Use the same printer type as your network printer. Students will then be able to re-direct the output from this printer to the network printer.

4. Use the NetWare 5 Client CD-ROM to install the Novell Client on your instructor Windows 95/98 computer as described:

    - Run the WinSetup program from the Novell Client installation CD-ROM. This program will usually auto-start when you insert the CD-ROM into the drive. If it doesn't, you can run it by selecting it from My Computer.
    - Select Windows 95/98 Client installation.
    - Click **Install Novell Client**.
    - Click **Yes** to agree to the license agreement.
    - Follow the remaining prompts to install the client.

Note: after installing the client on one computer, you may wish to copy the client software to the network as described in the next step and then install the client on your remaining computers from the network rather than from the single CD-ROM.

5. In order to perform the client installation from the network, you will need to copy client software to the network.

- From the Client CD-ROM run the WinSetup program. Again, this program will usually auto-start when you insert the CD-ROM. If not, double-click it from My Computer.
- Click on **English**
- Click the **Install Z.E.N.works** option.
- Click **Next** and agree to the license agreement.
- Click the **Custom** option and click **Next.**
- Select only the **Copy Clients to Network** box. You should de-select the other options at this time.
- Click **Next.**
- Select only the **Files** option. You should de-select the Schema and Application Objects.
- Click **Next.**
- Select your **CONSTELLATION** server and click **Next.**
- Select the **English** language and click **Next.**
- Check your current settings and click **Next** to continue.
- The client files will now be copied to your server. After the copy is complete you can remove the check marks from the Readme and Log options and click **Finish**. You will then be given an option to view the Client Update documentation or click the exit button to return to your desktop.

6. Verify Installation.
   a) Boot your master computer and start Windows.
   b) Use the NetWare Login window to log in as Admin.
   c) Create a shortcut on the desktop for the 32-bit version of NetWare Administrator found in the PUBLIC\WIN32 directory.
   d) Launch NetWare Administrator (NWADMN32.EXE) and open a browse window. Your tree should contain a Class organization with the following objects:

      SMS SMDR Group (if this doesn't appear, you need to install the SMS optional component)
      CONSTELLATION server
      CONSTELLATION Backup Queue (again, this is part of SMS.)
      Admin user account
      CONSTELLATION_SYS volume object
      CONSTELLATION_DATA volume object
      Novell+NetWare 5 Conn SLC+500 license object
      Novell+NetWare 5 Server+500
      NLS_LSP_CONSTELLATION
      CONSTELLATION_BROKER (Part of NDPS. If it isn't listed, use NWCONFIG to install
      NDPS.)

Installing Novell Client 3.1

If you choose to install the Novell Client across the network, you can do so in two ways: have users run the SETUP.EXE program themselves or to set it up to perform automatically.

Run Setup

Students can log into CONSTELLATION using the Microsoft Client for Novell Networks. They can then use the Start/Run menu to browse through the Network Neighborhood to locate the:

CONSTELLATION_SYS:PUBLIC\CLIENT\WIN95

folder to find the SETUP.EXE program. Users should change the command to read:

SETUP /NCF

and not simply accept the default. Using the /NCF parameter tells the Setup program to look for the .CAB files on the local, rather than the network drive. This saves considerable time, especially if all your users are logging in during class time pretty much simultaneously.

Without the /NCF parameter, the Setup program will ask the user to insert the Windows 95 Install CD-ROM into their local drive. Again, this will slow things down in the class.

Automated Installation

You can also have NetWare do the Client install using the following procedure rather than visit every workstation with the Client CD-ROM. This automated process of upgrading each workstation is a good suggestion since most administrators will need to do such upgrades.

During Step 5 above, NetWare created a folder on the server for the Client software and copied those files to this folder. Typically this is CONSTELLATION_SYS:PUBLIC\CLIENT\WIN95 for our CBELABS tree. These files came from the PRODUCTS\WIN95\IBM_ENGLISH folder on the Client CD-ROM. (If you are using another language, then it would be IBM_*language* where *language* is the name of the language you run on the workstation.)

[Look ahead to the next section on configuring NDS objects before continuing here if you do not know how to add a group container to the tree or wait until you complete that section to continue.]

1. Create a group called ACU in your CLASS container.
2. Place into that group all the users whose workstations need to be upgraded, in this case, all the ##ADMIN users.
3. Grant the group ACU Read and File Scan rights to the new folder.

Modify the Container Login Script

You need to modify the CLASS container login script so all your students automatically install the client on their workstations. Add the line:

@\\constellation\sys\public\win95\setup.exe /ncf

Again, the parameter /NCF allows the Setup program to look for the .CAB files on the local, rather than the network drive.

What Users See

As users log into CBELABS, ACU upgrades the client software and then restarts the workstation. Users will also see system messages as ACU upgrades their workstations.

Installing the Java Virtual Machine

You have the option of having the students run the Java-based remote console tool Console1. To do this, each student workstation needs the Java Virtual Machine software loaded. This is included on the Novell Client CD-ROM. You insert the disc, then in the Install utility:

1. Choose English
2. Choose Windows 95/98 Client
3. Choose Install Java

This places the JVM software on your workstation.

ISDN Line Simulator

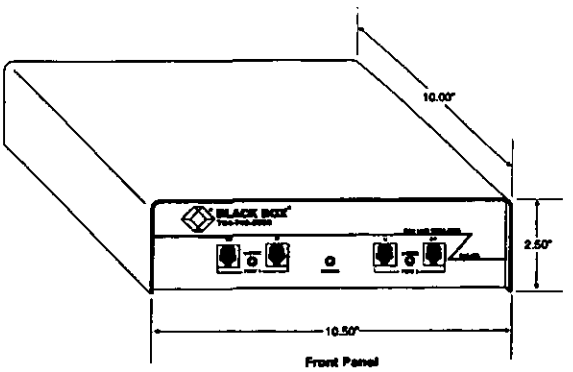
SETUP AND CONFIGURATION INSTRUCTIONS

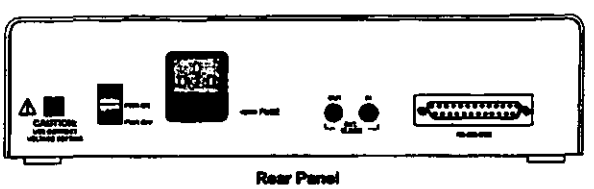
Materials needed: Black Box® TS225A ISDN Line Simulator
115-volt AC power cord
3 1/2" floppy diskette containing TS225A Configuration Software
RS-232 cable with 25-pin male connector/9-pin female connector ends

The TS-225A ISDN Line Simulator is configured at the factory for National ISDN-1 protocol. Most communications devices work properly with this switch setting. In the event that this switch type, or the default values that the TS225A is configured for, do not match the equipment that is being attached to the simulator, then the simulator may be reconfigured. The Configuration Software for the TS225A must be installed on the PC that will be used during the reconfiguration.

INSTALLING THE CONFIGURATION SOFTWARE

1. Insert the 3 1/2" floppy disk containing the Configuration Software into the floppy disk drive (A:)
2. From the Windows startup screen, select Start, then select Run
3. When the Run dialog box opens, type A:\Setup.exe in the Open box (or select Browse, select 3 1/2 floppy (A:), select Setup, and click OK)
4. The DLS Configuration Screen should appear. Select the appropriate drive or directory to install the software to. The default setting is C:\DLS.
5. Click Continue.
6. The DLS Configuration Setup message should appear telling you that the DLS Configuration Software installation is complete. Click OK.





PREPARING THE TS225A SIMULATOR FOR CONFIGURATION

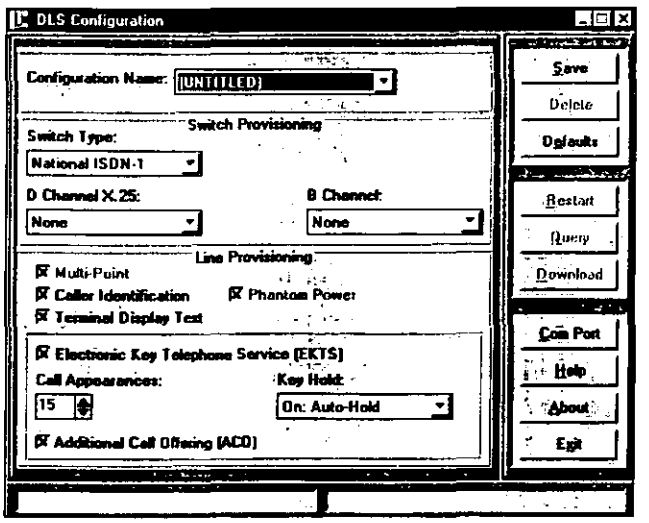
1. Place the simulator on the workbench next to the computer containing the Configuration Software.
2. Check the voltage setting on the back of the simulator to ensure that the switch is set to 115 VAC.
3. Check the power switch to ensure that the switch is set to the PWR OFF position.
4. Install the RS-232 cable to the 25-pin connector on the back of the simulator.
5. Connect the 9-pin connector of the RS-232 cable to the COM1 port of the computer (during the independent study session, it was noticed that some of the computers had the COM ports labeled in reverse order).
6. Insert the 115-volt AC power cord into the three-pronged outlet on the rear of the simulator.
7. Plug the other end of the 115-volt power cord into a 115-volt power outlet.
8. Place the simulator's power switch in the PWR ON position.
9. The simulator will begin an internal self-test. Allow the simulator to sit idle for 60 seconds to allow the self-test to be completed.

The simulator is now ready for configuration.

RUNNING THE CONFIGURATION SOFTWARE

In order to run the Configuration Software, you must be on the Windows startup screen. Select Start, select Programs, and then select DLS Configuration. The configuration settings that are stored in the simulator's non-volatile memory will be uploaded to the DLS Configuration program. The screen that appears should be similar to the screen shown below.

Figure 1 TS225A Configuration Software Opening Screen



The TS225A Configuration Software will attempt to query the simulator via COM1, the default communications port. If a serial cable is connected to COM1 and the simulator, the loaded configuration will appear on the screen. If an error message appears, follow the instructions as required, i.e., if the communications port is other than COM1, select another port as necessary. When a valid query has been completed, the Configuration Name will appear as QUERY, with Switch and Line Provisioning settings shown. No attempt to compare against a stored value is done. Two messages at the bottom of the screen will aid the user in provisioning of the TS225A. The lower left hand message box will display status messages at different times, such as QUERY, DOWNLOAD, National ISDN-1 defaults, and other messages. The lower right hand message box provides short messages about the feature under the cursor, such as Save User Configuration, when the cursor is over the Save button. It also displays a time bar when downloading or querying.

Provisioning of features using the TS225A Configuration Software allows the user to select from several stored configurations, as well as allow the user to store other configurations as needed. If a stored configuration is selected, and any feature is changed, the Configuration Name changes to (Untitled). If you attempt to exit the program without saving the configuration, you will be prompted to do so. The DOWNLOAD button downloads the new configuration shown on the configuration screen to the NVRAM of the simulator.

BASIC FEATURES OF THE TS225A SIMULATOR AND SUPPORTING DEFINITIONS

STATUS indicator: the LED display for STATUS will light up as soon as the internal self-test is completed.

U-SYNCH indicator: the LED display for U-SYNCH will light up for each PORT when that PORT's U Interface has synchronized the connection with the device attached to that respective PORT. The synchronization process may take from five to thirty seconds. The U-SYNCH indicator does not apply to the S/T interfaces, which synchronize in less than a second. There is no status indicator for the S/T interface.

PORT 1 and PORT 2: each PORT represents an ISDN Basic Rate Interface (BRI) telephone connection.

Another, each carrying different calls, or, depending on the configuration settings, protocols used, and bandwidth demand, may both be used for one call. An idle B channel may be allocated to assist an ongoing call on the other channel, and then reassigned to an incoming call if the situation arises.

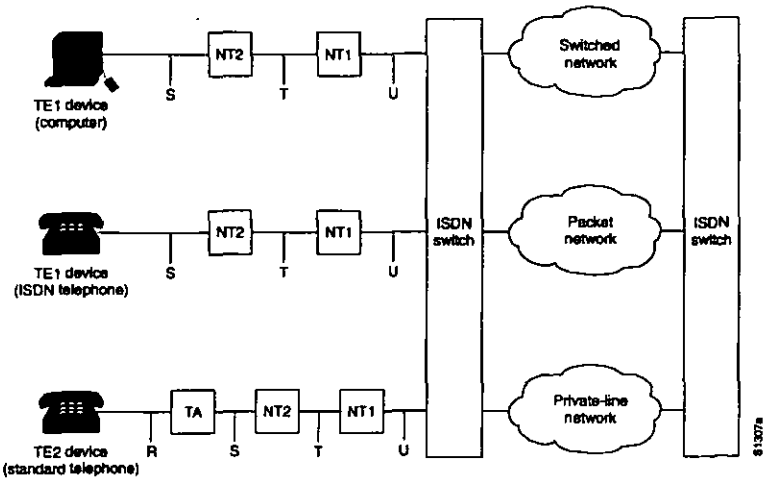
U Interface: the U Interface is a two-wire interface to the local or long-distance telephone central office. It can also connect terminal equipment to Private Branch Exchanges (PBXs) to support distances up to 3000 meters. The U Interface is not currently supported outside North America. The U Interface must be connected to an NT1 device or a device that contains an NT1.

S/T Interface: the S/T interface is a four-wire interface that connects customer site NT2 switching equipment, such as PBXs or switching hubs, to NT1 equipment that physically connects the customer site to the telephone company's local loop. The NT1 provides a four-wire connection to the customer site and a two-wire connection to the network. In Europe, the telecommunications carrier owns the NT1 equipment. In North America, the customer, as part of the Customer Premises Equipment (CPE), must supply NT1 equipment.

Terminal equipment: TE1 terminal equipment consists of devices that have a built-in ISDN interface. TE2 terminal equipment does not have native ISDN support. TE2s must be attached to an ISDN line through terminal adapters. Terminal equipment consists of devices that use ISDN to transfer information, such as computers, telephones, FAX machines, or videoconferencing equipment.

Terminal adapters: terminal adapters (TAs) translate signaling from non-ISDN TE2 devices to ISDN format. TAs are usually stand-alone devices.

Figure 12-1 Sample ISDN configuration illustrates relationships between devices and reference points.



Service Access Point Identifier (SAPI): the SAPI is one of two numbers involved with packet addressing in ISDN transmissions. The SAPI addresses one of three logical links, or destinations, within a device.

Terminal Endpoint Identifier (TEI): the TEI is the second number that is used to address a packet in an ISDN transmission. The TEI serves as a unique identifier for each piece of terminating equipment on a particular ISDN line.

ATTACHING DEVICES TO THE SIMULATOR

The TS225A simulator is designed to have a device attached to either the U Interface or the S/T Interface of a given Port, but will not accommodate the simultaneous use of both interfaces of a Port. If devices are attached to both interfaces of one port, the simulator will provide service from only the S/T Interface. It is permissible to use the U Interface of one Port and the S/T Interface of the other Port, provided that an NT1 device is attached to the U Interface as part of the installation. An NT1 device should not be attached to an S/T Interface.

Figure 2 U interface operation

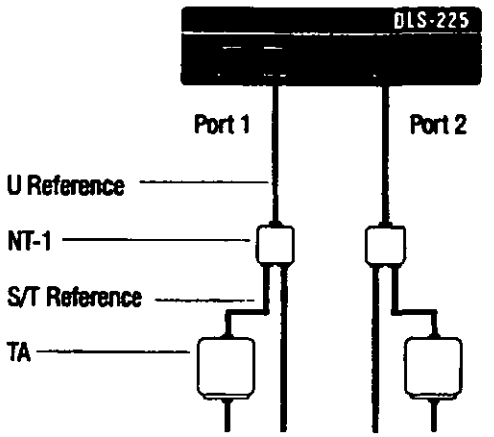
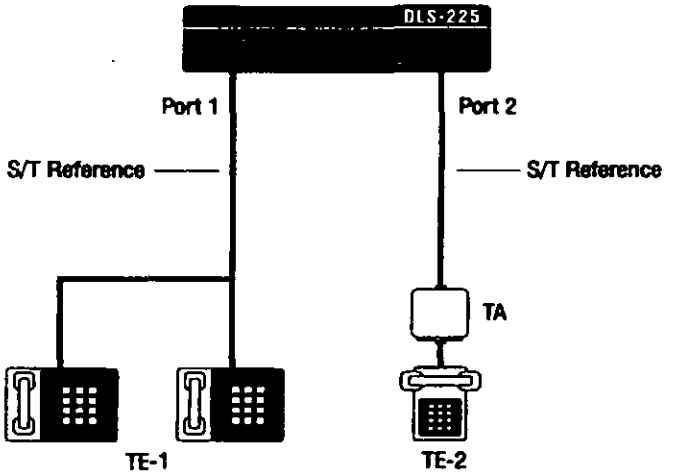


Figure 3 S/T interface operation



ISDN DIRECTORY NUMBERS AND SERVICE PROFILE IDENTIFIERS

The TS225A simulator emulates two ISDN Basic Rate Interface service connections, each of which supplies the user with two 64 Kbps bearer channels (B channels) for transmitting data and one 16 Kbps D channel for establishing, maintaining, and terminating the communications link. Each of the B channels is assigned a Directory Number and a Service Profile Identifier. The Directory Number (DN) is the telephone number which is used to access a particular B channel. The Service Profile Identifier (SPID) is a number specified by the ISDN service provider that identifies a specific ISDN terminal (the device attached to the B channel) to the network. The SPID contains the B channel's DN and coding to identify the switch type being used by the ISDN service provider, for example, AT&T 5ESS or National ISDN-1. The simulator, like an ISDN switch, expects specific SPIDs and DNs to be assigned to a particular port. The TS225A simulator uses the following DNs and SPIDs:

Simulator Port Number	Directory Number	Service Profile Identifier
Port 1 - first device attached	1-800-835-6661	0835866101
Port 1 - second device attached	1-800-835-8663	0835866301
Port 2 - first device attached	1-800-835-8662	0835866201
Port 2 - second device attached	1-800-835-8664	0835866401

There may be instances in which the entire directory number may not be used. For example, when programming the Cisco 2503 routers for ISDN, there are certain IOS commands which do not require the "1-800" part of the DN to be entered. One should pay special attention to the documentation for devices attached to ISDN lines to ensure that the correct DN and SPID are chosen, as well as the correct form of the DN for the particular application.

Appendix A :

Internet History

1969
Conceived in the early 1960s, ARPANET is born, the result of Bolt, Beranek and Newman (BBN) Inc.'s successful installation of four hosts at the University of California at Los Angeles, Stanford Research Institute, the University of California at Santa Barbara, and the University of Utah.

1970
Advanced Research Projects Agency (ARPA) funds an experiment to create a network, Alohanet, that transmits data into a computer via radio waves.

1971
The ARPANET grows to 23 hosts connecting universities and government research centers around the country.

1972
The Inter-Networking Group is created to develop standards for the ARPANET. Vint Cerf is elected the first chairman. Ray Tomlinson of BBN creates the first software allowing e-mail to be sent between computers.

1973
ARPANET traffic grows to more than 3 million packets per day. Robert Metcalfe writes a 13-page description of what will become Ethernet as part of his Harvard Ph.D. thesis.

1974
Vint Cerf and Robert Kahn publish *A Protocol for Packet Network Internetworking.* It's the first time the term 'Internet' is used. BBN opens Telenet, the first commercial version of the ARPANET.

1976
Queen Elizabeth goes on line with the first royal e-mail message.

1978
Vint Cerf, Danny Cohen, and Steve Crocker create a plan to separate TCP's routing functions into a separate protocol called the Internet Protocol (IP).

1979
Tom Truscott and Jim Ellis, graduate students at Duke University, and Steve Bellovin at the University of North Carolina establish the first USENET newsgroups. Users from all over the world join these discussion groups to talk about the 'Net, politics, religion, and thousands of other topics.

1982
The first PC LAN is demonstrated at the National Computer Conference by Drew Major, Kyle Powell, and Dale Neibaur. Their software would eventually become Novell's NetWare.

1983
The ARPANET is split into military and civilian sections. The entire ARPANET switches from Network Computer Protocol (NCP) to TCP/IP.

Internet Milestones

1984
The Domain Name System (DNS) is introduced. Moderated newsgroups are introduced on USENET.

1985
The first ".com" and ".edu" domains are assigned.

1986
The Network News Transfer Protocol (NNTP) is designed to enhance USENET news performance over TCP/IP.

1987
The industry gains momentum -- and credibility -- with the establishment of the first TCP/IP Interoperability conference in March 1987, held in Monterey, California, establishing an official forum for vendors to test the compatibility of their products. The name of the conference changes to INTEROP the following year.

1988
Bernard Daines creates the first Ethernet switch to add Ethernet support to Northern Telecom central-office telephone switches.

1989
The first gateways between private e-mail carriers and the Internet are established. CompuServe is connected through Ohio State University, MCI through the Corporation for National Research Initiatives.

1990
The ARPANET is decommissioned, leaving behind a vast network of networks called the Internet. The World (world.std.com) launches online services, becoming the first commercial service provider of Internet dial-up access.

Headlines are made at the INTEROP trade show when John Romkey connects a kitchen appliance to the Internet, allowing it to be operated remotely. Dubbed the

"Internet Toaster," this remarkable appliance clearly demonstrates the value of the Internet to the masses. Through the years, INTEROP has evolved into the popular and well-attended NetWorld+Interop trade show.

1991
The National Science Foundation (NSF) lifts restrictions on the commercial use of the NSFNET backbone, clearing the way for electronic commerce.

1993
The White House and the United Nations launch Web sites. Mosaic, the first graphics-based Web browser, becomes available. Traffic on the Internet expands at a 341,634 percent growth rate.

1994
The NSFNET backbone is upgraded to 155 Mbps as traffic passes 10 trillion bytes per month. Pizza Hut begins taking orders over the Internet. The first cyberbank opens for business on line.

1995
The Telecommunications Act of 1996 is passed, opening US local and long distance markets to competition.

1998
Electronic postal stamps become a reality, enabling US postal stamps to be purchased and downloaded for printing via the Web.

Appendix B:

Communications and Networking Glossary of Terms

1000Base-CX -- A gigabit Ethernet Standard for Short-haul copper "twinax."

1000Base-SX -- A gigabit Ethernet standard for HDX and FDX fiber @ 850nm wavelength.

1000Base-LX -- A gigabit Ethernet standard for HDX and FDX fiber @ 1300nm wavelength.

100Base VG AnyLan -- The IEEE specification for 100 Mbps Token Ring and Ethernet implementations over four pair UTP. The Media Access Control (MAC) layer is not compatible with the 802.3 MAC layer.

100Base-T Fast Ethernet -- A 100 Mbps technology based on the Ethernet/CD network access method.

10BaseT -- The IEEE 802.3 specification for Ethernet over unshielded twisted pair (UTP).

Asynchronous Transfer Mode (ATM) -- (1) The CCITT standard for cell relay wherein information for multiple types of services (voice, video, data) is conveyed in small, fixed-size cells. ATM is a connection-oriented technology used in both LAN and WAN environments. (2) A fast-packet switching technology allowing free allocation of capacity to each channel. The SONET synchronous payload envelope is a variation of ATM. (3) ATM is an international ISDN high speed, high-volume, packet switching transmission protocol standard. ATM currently accommodates transmission speeds from 64 Kbps to 622 Mbps.

B Channel -- In ISDN, a full-duplex, 64 Kbps channel for sending data.

Backward Explicit Congestion Notification (BECN) -- A bit in the frame relay header. The bit is set by a congested network node in any frame which is traveling in the reverse direction of the congestion. (In frame relay, a node can be congested in one direction of frame flow but not in the other.)

Bandwidth -- (1) Measure of the information capacity of a transmission channel. (2) The difference between the highest and lowest frequencies of a band that can be passed by a transmission medium without undue distortion, such as the AM band 535 to 1705 kilohertz.

Basic Rate Interface (BRI) -- ISDN standards and specifications for provision of low-speed ISDN services. Supports two "B" channels of 64 Kbps each and one "D" channel of 16 Kbps on a single wire pair.

Baud (Bite at Unit Density) -- A measure of the speed of transmission of data; number of elements transmitted per second.
Bridge/Router -- A device that can provide the functions of a bridge, router, or both concurrently. Bridge/router can route one or more protocols, such as TCP/IP and/or XNS, and bridge all other traffic.

Broadband -- A data-transmission scheme in which multiple signals share the bandwidth of a medium. This allows the transmission of voice, data, and video signals over a single medium. Cable television uses broadband techniques to deliver dozens of channels over one cable.

Broadband Inter -- Switching System Interface (B-ISSI). Between ATM nodes.

Broadcast Address -- A special address that is reserved for simultaneous broadcast to all stations.

Broadcast Domain -- Defines the set of all devices which will receive broadcast frames originating from any device within the set. Broadcast domains are normally bounded by routers.

Brouter -- Concatenation of "bridge" and "router." Used to refer to devices which perform both bridging and routing functions.

Buffer -- A storage area used for handling data in transit. Buffers are often used to compensate for differences in processing speed between network devices.

Byte -- The fundamental unit that a computer uses in its operation. It is a group of adjacent binary digits, usually 8, often used to represent a single character.

Caching -- (1) Speeds information processing by storing information from a transaction to use for later transactions. (2) Storing or buffering data in a temporary location, so that the information can be retrieved quickly by an application program.

Category 3 Unshielded Twisted Pair (CAT-3) -- Industry standard for unshielded twisted wire pair capable of supporting voice and low-grade data traffic.

Category 5 Unshielded Twisted Pair (CAT-5) -- The highest grade of unshielded twisted-pair cable available, as defined by EIA/TIA 568. Category 5 UTP is required to run standard compliant CDDI to 100 meters.

Central Office (CO) -- (1) A local telephone company office which connects to all local loops in a given area and where circuit switching of customer lines occurs. (2) A local Telephone Company switching system, where Telephone Exchange Service customer

station loops are terminated for purposes of interconnection to each other and to trunks. In the case of a Remote Switching Module (RSM), the term Central Office designates the combination of the Remote Switching Unit and its Host.

Central Office Local Area Network (CO-LAN) -- A data switching service based on a data PBX in a carrier's CO.

CGI (Common Gateway Interface) -- A standard that allows Web servers to run external applications such as search engines.

Circuit Switching -- Switching system in which a dedicated physical circuit path must exist between sender and receiver for the duration of the "call". Used heavily in the phone company network, circuit switching often is contrasted with contention and token passing as a channel-access method, and with message switching and packet switching as a switching technique.

Competitive Local Exchange Carrier (CLEC) -- A company that builds and operates communication networks in metropolitan areas and provides its customers with an alternative to the local telephone company.

Computer Telephony Integration (CTI) -- The name given to the merger of traditional telecommunications (PBX) equipment with computers and computer applications. The use of Caller ID to automatically retrieve customer information from a database is an example of a CTI application.

Convergence -- The industry trend towards sharing network resources among disparate applications and traffic types.

Customer Premises Equipment (CPE) -- (1) Telephone terminal devices, such as handsets and private branch exchanges (PBXs), located on the customer's premises. (2) Terminating equipment, such as terminals, phones, routers and modems, supplied by the phone company, installed at customer sites, and connected to the phone company network.

Data Communicating Equipment (DCE) -- In RS232 communications, a device implementing the interface and handshaking of a data communications device (such as a modem).

Data Link Connection Identifier (DLCI) -- A value in frame relay that identifies a logical connection.

Data Link Control (DLC) -- The SNA layer responsible for transmission of data between two nodes over a physical link.

Data Terminal Equipment (DTE) -- The part of a data station that serves as a data source, destination, or both, and that provides for the data communications control

function according to protocol. DTE includes computers, protocol translators, and multiplexers.

Demodulation -- Opposite of modulation; the process of retrieving data from a modulated carrier wave.

Destination MAC Address (DA) -- A six octet value uniquely identifying an endpoint which is sent in IEEE LAN frame headers to indicate frame destination.
Destination Service Access Point (DSAP) -- Address field in header of LLC frame to identify a user within a station address (Layer 2).

Digital Certificates -- A virtual security document which ensures the association between the user's public key and the user's identity and security privileges.

Domain Name System (DNS) -- The distributed name/address mechanism used in the Internet.

Domestic Satellite -- A satellite that provides transmission of information between points within the United States by an authorized common carrier.

Dynamic Bandwidth Allocation (DBA) -- A process that optimizes overall network efficiency by automatically increasing or decreasing the bandwidth of a channel to accommodate changes in data flow from end-user equipment.

Dynamic Password -- An automatically generated single-use password.

Electronic Funds Transfer (EFT) -- An electronic system that transfers money and records financial transactions, replacing the use of paper.

Electronic Industries Association (EIA) -- A group that specifies electrical transmission standards.

Emulated Local Area (ELAN) -- A logical network initiated by using the mechanisms defined by LAN Emulation. This could include ATM and legacy attached end stations.

Encapsulation -- The wrapping of data in a particular protocol header. For example, Ethernet data is wrapped in a specific Ethernet header before network transit.

Encryption -- Applying a specific algorithm to data
in order to alter the data's appearance and prevent other devices from reading information. Decryption applies the algorithm in reverse to restore the data to its original form.

Ethernet -- A baseband LAN specification invented by Xerox Corporation and developed jointly by Xerox, Intel, and Digital Equipment Corporation. Ethernet networks operate at 10 Mbps using CSMA/CD to run over coaxial cable. Ethernet is similar to a series of standards produced by IEEE referred to as IEEE 802.3.

Extended Superframe (EF) -- An Extended Superframe consists of 24 frames of 193 bits each (4632 bits total). In each frame, one "F bit" is followed by 24 8-bit bytes. The 8 Kbps of F-bit overhead is divided into 2 Kbps for framing, 2 Kbps of CRC-6 code for logic error checking, and a 4 Kbps Data Link for maintenance communications. As in the Superframe (D4) format, 1.536 Mbps is the available bandwidth for user information.

Exterior Gateway Protocol (EGP) -- The service by which gateways exchange information about what systems they can reach; generally, an exterior gateway protocol is any internetworking protocol for passing routing information between autonomous systems.

Extranet -- A collaborative network that uses Internet technology to link businesses with their suppliers, customers, or other businesses that share common goals.

FDDI II -- The proposed ANSI standard to enhance FDDI. FDDI II will provide isochronous transmission for connectionless data circuits and connection-oriented voice and video circuits.

Fiber Channel -- FC Fiber Channel is a high performance serial link supporting its own, as well as higher level protocols such as the FDDI, SCSI, HIPPI, and IPI. The fast (up to 1 Gbps) technology can be converted for Local Area Network technology by adding a switch specified in the Fiber Channel standard, that handles multipoint addressing. Fiber Distributed Data Interface (FDDI) -- An ANSI-defined standard specifying a 100 Mbps token-passing network using fiber-optic cable. Uses a dual-ring architecture to provide redundancy.

Fiber In the Loop (FITL) -- Optical technology from CO to customer premises.

Fiber Optic Cable -- A transmission medium that uses glass or plastic fibers, rather than copper wire, to transport data or voice signals. The signal is imposed on the fiber via pulses (modulation) of light from a laser or a light-emitting diode (LED). Because of its high bandwidth and lack of susceptibility to interference, fiber-optic cable is used in long-haul or noisy applications.

Fiber Optics -- A method for the transmission of information (sound, pictures, data). Light is modulated and transmitted over high purity, hair-thin fibers of glass. The bandwidth capacity of fiber optic cable is much greater than that of conventional cable or copper wire.

File Transfer Protocol (FTP) -- (1) An IP application protocol for transferring files between network nodes. (2) An Internet protocol that allows a user on one host to transfer files to and from another host over a network.

File Transfer, Access, and Management (FTAM) -- The OSI remote file service ad protocol.

Firewall -- (1) Isolation of LAN segments from each other to protect data resources and help manage traffic. (2) Hardware or software that restricts traffic to a private network from an unsecured network.

Flash EPROM -- PROM (Programmable Read-Only Memory) technology providing nonvolatile storage that can be electrically erased in the circuit and reprogrammed; developed by Intel and licensed to other semi-conductor companies.

Fractional E3/T3 -- Fractional E3/T3 refers to the leasing of portions of E3/T3 bandwidth (a specific number of time slots) by carriers. FE3 or FT3 allows for more economical networking in some applications.

Fractional T-1 -- A WAN communications service that provides the user with some portion of a T1 circuit which has been divided into 24 separate 64 Kb channels..

Frame Relay -- High-performance interface for packet-switching networks. Considered more efficient than X.25 which it is expected to replace. Frame relay technology can handle "bursty" communications that have rapidly changing bandwidth requirements.

Frame Relay Service -- A connection oriented service that is capable of carrying up to 4096 bytes per frame.

Frequency Modulation (FM) -- Radio transmission covering 88-108 megahertz on the broadcast band. It is less susceptible to interference than AM broadcasting. Also used in other frequency bands for two way communications in land mobile and marine services.

Gateway -- A set of functions intended to facilitate electronic access by users to remote services and vice versa. Gateways are intended to provide a single source through which users can locate and gain access to a wide variety of service. Gateways typically offer a directory of services available through them, and provide billing for these services.

Gigabit -- One billion bits.

Gigabit Ethernet -- A 1 Gbps standard for Ethernet.

Gigabit Ethernet Alliance -- An association of Gigabit Ethernet manufacturers and suppliers formed for the purpose of promoting Gigabit Ethernet Technology.

Group Address -- A single address that refers to multiple network devices. Synonymous with multicast address.

Groupware -- A network-based application that lets users collaborate.

High Performance Routing (HPR) -- A form of dynamic call routing in the PSTN.

High Speed Serial Interface (HSSI) -- Standard for a serial interface at high speeds (64 Kbps and higher up to 52 Mbps) between DTE and DCE equipment over very short distances. Used for the physical connection between a router and a DSU.

Home Page -- The first page of a Web site or of a logical group of HTML documents.

HP Open View Windows -- A graphical user interface that integrates and presents network management applications and system management applications. It allows you to perform both system management and network management from a single terminal in a multi-vendor, distributed computing environment.

Hyper Text Transfer Protocol (HTTP) -- (1) The protocol most commonly used in the World Wide Web to transfer information from Web servers to Web browsers. (2) The protocol that negotiates document delivery to a Web browser from a Web server.

Hyper Text Markup Language (HTML) -- (1) The language used in the World Wide Web to create web pages with links to other documents, rich text enhancements (bold, italic, etc.) and so on. The "source" file for what you see on a web page is written in HTML. (2) The language with which World Wide Web documents are formatted. It defines fonts, graphics, hypertext links, and other details. HTML is an implementation of SGML.

Initial Cell Rate (ICR) -- An ABR service parameter, in cells/sec, that is the rate at which a source should send initially and after an idle period.

Integrated Services Digital Network (ISDN) -- (1) The recommendation published by CCITT for private or public digital telephone networks where binary data, such as graphics, digitized voice, and data transmission, pass over the same digital network that carries most telephone transmissions. (2) An overall application of the technology to provide for both newer digital and more traditional telephone services in an integrated network that incorporates the new network and interfacing standards which are being adopted worldwide.

Interactive Voice Response (IVR) -- Term used to describe systems that provide information in the form of recorded messages over telephone lines in response to user input in the form of spoken words or more commonly DTMF sugnalling. Examples include banks that allow you to check your balance from any telephone and automated stock quote systems.

Interexchange Carrier (IXC) or Interexchange Common Carrier -- Any individual, partnership, association, joint-stock company, trust, governmental entity, or corporation engaged for hire in interstate or foreign communication by wire or radio, between two or more exchanges.

International Organization for Standardization (ISO) -- Best know for the 7 layer OSI Reference Model.

International Record Carrier (IRC) -- A common carrier engaged in providing overseas telecommunications service. Services furnished traditionally include telex, private line service, and alternate voice data service.

Internet Assigned Numbers Authority (IANA) -- The entity responsible for assigning numbers in the Internet Suite of Protocols.

Internet Gateway Protocol (IGRP) -- A proprietary IGP used by Cisco System's routers.

Internet Protocol (IP) -- A Layer 3 (network layer) protocol that contains addressing information and some control information that allows packets to be routed. Documented in RFC 791.

Internet Protocol Version 6 (IPng, IPv6) -- IPv6 is a new version of the Internet Protocol which is designed to be an evolutionary step from its predecessor, version 4. There are many RFCs defining various portions of the protocol, its auxiliary protocols, and the transition plan from IPv4. The core RFCs are 1883 through 1886.

Internet Service Provider (ISP) -- (1) Any of a number of companies that sell Internet access to individuals or organizations at speeds ranging from 300 Bps to OC-3. (2) A business that enables individuals and companies to connect to the Internet by providing the interface to the Internet backbone.

Internet Telephony -- Generic term used to describe various approaches to running voice telephony over IP.

Internetwork -- A collection of networks interconnected by routers that function (generally) as a single network. Sometimes called an internet, which is not to be confused with the Internet.

Internetwork Packet Exchange, Network Protocol (IPX) -- LAN protocol developed by Novell for NetWare.

Internetworking -- General term used to refer to the industry that has arisen around the problem of connecting networks together. The term can refer to products, procedures, and technologies.

Interoperability (IOP) -- The ability of equipment from different manufacturers (or different implementations) to operate together.

Inverse Multiplexing -- A method of combining individually dialed low-speed circuits into a single high-speed data stream.

IP Address -- The 32-bit address defined by the Internet Protocol in RFC 791. It is usually represented in dotted decimal notation

IP Datagram -- The fundamental unit of information passed across the Internet. Contains source and destination addresses along with data and a number of fields which define such things as the length of the datagram, the header checksum, and flags to say whether the datagram can be (or has been) fragmented.

IP Next Generation (IPng) -- Collective term used to describe the efforts of the Internet Engineering Task Force to define a new version of the Internet Protocol (IP) which can handle larger IP addresses to cope with the explosive growth of the Internet. Also known as Ipv6.

IP Spoofing -- An attack whereby a system attempts to illicitly impersonate another system by using its IP network address.

ISDN BRI -- A digital access line that is divided into three channels. Two of the channels, called B channels, operate at 64 Kbps and are always used for data or voice. The third D channel is used for signaling at 16 Kbps.

ISDN Centrex -- A service provided by local telephone companies to customer premises, in which a central office digital switch performs in lieu of a customer PBX in an ISDN system. ISDN Centrex uses one B channel and one D channel to provide an array of digital voice and data capabilities.

ISDN PRI -- Based physically and electrically on an E1 circuit, but channelized so that two channels are used for signaling and 30 channels are allocated for user traffic. ISDN PRI is available in E1 and T1 frame formats, depending on country.

Java -- A object-oriented programming language developed by Sun Microsystems. Applets written in Java include their own software players, so you can download and run them on any computer.

Kerberos -- A component of MIT's Project Athena. Kerberos is the security system, based on symmetric key cryptography.

Layer 3 Switching -- The emerging Layer 3 switching technology integrates routing with switching to yield very high routing throughput rates in the millions-of-packets-per-second range. The movement to Layer 3 switching is designed to address the downsides of the current generation of layer 2 switches, which are functionally equivalent to bridges. These downsides for a large, flat network include being subject to broadcast storms, spanning tree loops, and address limitations that drove the injection of routers into bridged networks in the late 1980s. Currently, Layer 3 switching is represented by a number of approaches in the industry.

Lightweight Directory Access Protocol (LDAP) -- This protocol provides access for management and browser applications that provide read/write interactive access to the X.500 Directory.

Line-Side Connection -- A connection of a transmission path to the line side of a local exchange switching system.

Link -- Physical connection between two nodes in a network. It can consist of a data communication circuit or a direct channel (cable) connection.

Local Exchange Company (LEC) -- A telephone company that provides customer access to the worldwide public switched network through one of its central offices.

Local Loop -- The line from a telephone customer's premises to the telephone company Central Office.

Logical IP Subnetwork (LIS) -- An IP subnetwork is a single network on which all devices have a direct communications path to all other devices.

Logical Link Control (LLC) -- IEEE-defined sub layer of the OSI link layer. LLC handles error control, flow control, and framing. The most prevalent LLC protocol is IEEE 802.2, which includes both connectionless and connection-oriented variants.

Mail Gateway -- A machine that connects two or more electronic mail systems (especially dissimilar mail systems on two different networks) and transfers messages between them. Sometimes the mapping and translation can be quite complex, and generally it requires a store-and-forward scheme whereby the message is received from one system completely before it is transmitted to the next system after suitable translations.

Motion Picture Experts Group (MPEG) -- (1) Industry organization developing standards and specifications for the encoding and transmission of video information over various media and network technologies.

Multimode -- Used to describe optical fiber that allows more than one mode of light signal transmission.

Multiplexer (MUX) -- A technique that enables several data streams to be sent over a single physical line. It is also (ISO), a function by which one connection from a layer is used to support more than one connection to the next higher layer.

Multipoint -- The connection of more than two locations to affect a teleconference, as opposed to only point-to-point connections.
Narrowband -- Mobile or portable radio services which can be used to provide services to both individuals and businesses such as paging and data services.

Narrowband Integrated Services Digital Network (N-ISDN) -- Services include basic rate interface (2B+D or BRI) and primary rate interface (30B+D-Europe and 23B+D-North America or PRI). Supports narrowband speeds at/or below 1.5 Mbps.

Network Interface Card (NIC) -- The circuit board or other hardware that provides the interface between a communicating DTE and the network.

Network Operations Center (NOC) -- Any center tasked with the operational aspects of a production network. These tasks include monitoring and control, trouble-shooting, user assistance, and so on.

Network Services Access Point (NSAP) -- OSI generic standard for a network address consisting of 20 octets. ATM has specified E.164 for public network addressing and the NSAP address structure for private network addresses.

Network-Level Firewall -- A firewall in which traffic is examined at the network protocol packet level.

Non-return To Zero (NRZ) -- A signal that does
not return to the zero level between successive transmitted ones.

Novell Internetwork Packet Exchange (IPX) -- A built-in networking protocol for Novell Netware. It was derived from the Xerox Network System protocol and operates at the network layer of the OSI protocol model.

Open Network Architecture (ONA) -- The structure of a communications network that permits all types of terminals and users to have access to any network capability without compatibility restrictions.

Open Shortest Path First (OSPF) -- Routing protocol for TCP/IP networks.

OSI Reference Model -- Seven-layer network architecture model of data communication protocols developed by ISO and CCITT. Each layer specifies particular network functions such as addressing, flow
control, error control, encapsulation, and reliable message transfer.

Physical Layer (PHY) -- The bottom layer of the OSI and ATM protocol stack, which defines the interface between ATM traffic and the physical media.
The PHY consists of two sublayers: the transmission convergence (TC) sublayer and the physical medium-dependent (PMD) sublayer.

Ping (Packet Internet Grouper) -- Refers to the ICMP echo message and its reply. Often used to test the reachability of a network device.

Point to Point Tunneling Protocol (PPTP) -- Manages the separation of traffic streams via tunneling over PPP.

Point-to-Point Protocol (PPP) -- (1) Successor to SLIP. Provides router-to-router and host-to-network connections over both synchronous and asynchronous circuits. (2) A protocol which allows a computer to use a modem and a regular telephone line to make a

TCP/IP connection directly to the Internet. PPP is gradually replacing SLIP for this purpose.

Private Network-to-Network Interface (P-NNI) -- A routing protocol that allows multiple vendors' ATM switches to be integrated. It automatically and dynamically distributes routing information, enabling any switch to determine a path within the network.

Proxy -- The mechanism whereby one system "fronts for" another system in responding to protocol requests. Proxy systems are used in network management to avoid having to implement full protocol stacks in simple devices, such as modems.

Public Key Cryptography -- A security scheme in which a different key is used for encryption and decryption. Key-1 is the public key; that is, everyone knows it. Key-2 is private so that only the recipient knows it. In this scheme, it is computationally impossible to derive the identity of key-2 from key-1.

Public Switched Network -- The combined transmission facilities of the world's telephone companies and administrations, including all those circuits available to subscribers on an unrestricted basis.

Quality of Service (QoS) -- Term for the set of parameters and their values which determine the performance of a given virtual circuit.

Regional Bell Operating Company (RBOC) -- The acronym for the local telephone companies created in 1984 as part of the break-up of AT&T. The seven RBOCs are Ameritech, Bell Atlantic, Bell South, NYNEX, Pacific Telesis Group, Southwestern Bell, and U.S. West.

Remote Access Server -- Access equipment at a central site that connects remote users with corporate LAN resources.

Remote Authentication Dial-In User Service (RADIUS) -- A security administration standard that functions as an information clearinghouse, storing authentication information about users and administering multiple security systems across complex networks.

Reverse Address Resolution Protocol (RARP) -- A part of the TCP/IP protocol suit used to determine a destination host's IP address using its hardware MAC address. Commonly used by diskless workstations.

RJ-11-Standard 4 -- Wire connectors for phone lines.

RJ-45-Standard 8 -- Wire connectors for IEEE 802.3 1BaseT networks.

Route -- A path through an internetwork.

Route caching -- Storage of forwarding information (based on network topology and routing policy) associated with a destination. It starts when the first packet to the destination is processed, to speed the forwarding of all subsequent packets to the same destination.

Router -- An OSI Layer 3 device that can decide which of several paths network traffic will follow based on some optimality metric. Also called a gateway (although this definition of gateway is becoming increasingly outdated), routers forward packets from one network to another based on network-layer information.
Router Cluster -- Private, high-speed switched links to each building in a campus. They are used to expand interbuilding bandwidth.

Routing Domain -- A set of routers exchanging routing information within an administrative domain.

Routing Information Protocol (RIP) -- An IGP supplied with Berkeley UNIX systems. It is the most common IGP in the Internet. RIP uses hop count as a routing metric. The largest allowable hop count for RIP is 16.

Routing Metric -- The method by which a routing algorithm determines that one route is better than another. This information is stored in routing tables. Metrics include reliability, delay, bandwidth, load, MTUs, communication costs, and hop count.

Routing Protocol -- A protocol that accomplishes routing through the implementation of a specific routing algorithm. Examples of routing protocols include IGRP, RIP, and OSPF.

Routing Table -- A table stored in a router or some other internetworking device that keeps track of routes (and, in some cases, metrics associated with those routes) to particular network destinations.

Secure HTTP (S-HTTP) -- An extension of HTTP for authentication and data encryption between a Web server and a Web browser.

Secure Sockets Layer (SSL) -- A transport-level technology for authentication and data encryption between a Web server and a Web browser.

Serial Line Internet Protocol (SLIP) -- A standard for use of a regular (serial) telephone line and a modem to connect a computer as a true Internet site. This protocol is gradually being replaced by PPP.

Service Access Point (SAP) -- The point at which the services of an OSI layer are made available to the next higher layer. The SAP is named according to the layer providing the services: e.g., transport services are provided at a Transport SAP (TSAP) at the top of the Transport Layer.

Service Advertising Protocol (SAP) -- Periodic broadcast by LAN device (Netware); filtered by FRADs to reduce overhead on access links.

Session Layer -- OSI layer that provides a means for dialogue between end systems.

Shared Ethernet -- Conventional CSMA/CD Ethernet configuration to which all stations are attached by a hub and share 10 or 100 Mbps of bandwidth. Only one session can transmit at a time. This is the most popular network type today.

Shielded Twisted Pair (STP) -- Two-pair wire medium used in the transmission of several different protocols. It is capable of supporting CDDI for link distances of up to 100 meters. These wires have a layer of shielded insulation to reduce EMI.

Signaling Systems 7 -- The out of band signaling protocol developed by the Consultative Committee for International Telephone and Telegraph (CCITT) and the American National Standards Institute (ANSI).

Simple Gateway Management Protocol (SGMP) -- The predecessor to SNMP.

Simple Internet Protocol Plus (SIPP) -- One of 3 IPng candidates.
Simple Mail Transfer Protocol (SMTP) -- Protocol governing mail transmissions. It is defined in RFC 821, with associated message format descriptions in RFC 822.

Simple Management Protocol (SMP) -- Newer and more robust than SNMP.
Simple Network Management Protocol (SNMP) -- The Internet network management protocol. SNMP provides a means to monitor and set network configuration and runtime parameters.

Socket -- A paring of an IP address and a port number.

Source Routing Transparent (SRT) Bridge -- Proposed IEEE 802.1 bridge to combine source routing (in which the source end system provides routing information) with transparent bridging.

Spoofing -- A method of fooling access equipment into thinking a network connection is active even when it's not.

SubNetwork Access Protocol (SNAP) -- Internet protocol that operates between a network entity in the subnetwork and a network entity in the end system and specifies a standard method of encapsulating IP datagrams and ARP messages on IEEE networks. The SNAP entity in the end system makes use of the services of the subnetwork and performs three key functions: data transfer, connection management, and quality of service selection.

SubNetwork Protocol (SNP) -- Protocol residing in the subnetwork layer below IP that provides data transfer through the local subnet. In some systems, an adapter module must be inserted between IP and the Subnetwork Protocol to reconcile dissimilar interfaces.

Switched Ethernet -- Configuration supporting an Ethernet hub with integrated MAC layer bridging or switching capability to provide each port with 10 or 100 Mbps of bandwidth. Separate transmissions can occur simultaneously on each port of the switching hub, and the switch filters traffic based on the destination MAC address.
Switched Multimegabit Data Service (SMDS) -- High-speed, packet switched, connectionless LAN service.

T1 -- Digital transmission facility operating with a nominal bandwidth of 1.544 Mbps. Also known as Digital Signal Level 1.

T3 -- Digital transmission facility operating at 45 Mbps bandwidth. Composed of 28 DS-1 channels in many cases. Also known as DS-3.

Thin Client -- A 'thin storage' client in a network application environment. The client downloads the program (java applets, for example) from the server and performs processing just like a PC, but does not store applications or data locally. All programs and data are on the server, minimizing management costs on the client side.
Time Division Multiplexing (TDM) -- Technique where information from multiple channels may be allocated bandwidth on a single wire based on time slot assignment.

Transmission Control Protocol/Internet Protocol (TCP/IP) -- The common name for the suite of protocols developed by the U.S. Department of Defense in the 1970s to support the construction of world-wide internetworks. TCP and IP are the two best-known protocols in the suite. TCP corresponds to Layer 4 (the transport layer) of the OSI reference model. It provides reliable transmission of data. IP corresponds to layer 3 (the network layer) of the OSI reference model and provides connectionless datagram service.

Tunneling -- Tunneling refers to encapsulation of protocol A within protocol B, such that A treats B as though it were a datalink layer. Tunneling is used to get data between administrative domains which use a protocol that is not supported by the internet connecting those domains.

Twisted Pair (TP) -- Cable consisting of two 18 to 24 AWG (American Wire Gauge) solid copper strands twisted around each other. The twisting provides a measure of protection from electromagnetic and radio-frequency interference.

Unshielded Twisted Pair (UTP) -- Four-pair wire medium used in the transmission of many different protocols such as Ethernet, 10BaseT, and CDDI.

User Datagram Protocol (UDP) -- A connectionless transport-layer protocol belonging to the Internet protocol family.

Value Added Network (VAN) -- A national (or international) enhanced network that is designed expressly to carry data communications. VANs also provide billing and other special services to their customers.

Very Small Aperture Terminal (VSAT) -- Satellite dish under 1m.

Virtual Channel -- A defined route between two end nodes that may access multiple virtual paths.

Virtual IP -- A function provided on the Catalyst with the Virtual Network Services software which enables the creation of logically separated switched IP workgroups across Catalyst switch ports.

Virtual LAN -- Membership to a Virtual LAN is defined administratively independent of the physical network topology. A virtual LAN segment is a unique broadcast domain.

Virtual Private Network (VPN) -- A network service offered by public carriers in which the customer is provided a network that in many ways appears as if it is a private network (customer-unique addressing, network management capabilities, dynamic reconfiguration, etc.) but which, in fact, is provided over the carrier's public network facilities.

VoiceLAN -- The synergy amid a group of technologies which together allow for the convergence of voice, computing, and other types of communications to coexist on a Local Area Network.

Wide Area Network (WAN) -- A network that encompasses interconnectivity between devices over a wide geographic area. Such networks require public rights-of-way and operate over long distances.

Workgroup -- A group of workstations and servers that commonly exchange data. This term is also used to describe a group of people who work together.

X.400 -- International standard for a store-and-forward message handling system in a multivendor environment.

X.500 -- The CCITT and ISO standard for electronic directory services.

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