Chapter 1

SOHO Network Uses/ Applications

Chapter Syllabus

- Basic Network Applications
- Internet Access
- Web Serving
- Voice over Internet Protocol (VoIP) Telephony
- Telecommuting
- General Networking Approaches
- Summary
- Key Technical Terms
- Review Questions

This chapter examines in more detail the basic SOHO applications. These applications as identified in the introduction are disk/file sharing and printer sharing. Sharing high-speed connections to the Internet are a new application that is driving installation of many home office LANs.

Small office/home office network applications include the traditional disk, file, and printer sharing. These form the base for other small-office LAN applications. Intranet Web serving and e-mail applications rely on accessing key files on a server computer.

Sharing high-speed Internet access is quite different from sharing disk and printer resources. This relies on connection-sharing software or a router to merge Web page and other network information requests into a composite data stream to the Internet and in turn separate the replies and forward them to the requesting SOHO host PCs. Voice over Internet Protocol (VoIP) telephony is a demanding SOHO application. It requires a low-latency (minimum transmission delay) network and specialized telephony servers connected to the Internet and/or the Public Switched Telephone Network (PSTN).

Telecommuting applications require secure access to centralized organization LANs and data. Each application presents special challenges. This chapter examines how these applications benefit organizations and generally how they may be implemented. Finally, the basic networking approaches identified in the Introduction are expanded upon to provide greater insight into SOHO networking technologies.

Basic Networking Applications

The primary SOHO network applications are disk, file, and printer sharing. PC fixed disk drives hold files that are either data or software. The disk drive and its files may be shared across a SOHO LAN. Similarly, data may be printed on any printer attached to a SOHO LAN. Let's examine this in more detail.

Disk Sharing

PC disk drives under Windows store both data and programs in a file hierarchy. There is a root directory for each drive and under that subdirectories or folders containing either more subdirectories or files. In both home office peer-to-peer and small office client/server networks, all attached PC hosts can share their disk drives. This disk drive sharing is a two-step process. The first step is installing the disk and file sharing networking software provided with Windows and the second step is actually sharing the disk drives. When the drives are shared, access to them is specified for all users using passwords, or for specific users as determined by the central network security provider. To make this clear we look at disk sharing in our two-PC host, peer-to-peer home office LAN first, and then we look at disk sharing in a centrally administered small-office client/server LAN.

Disk sharing between two PC hosts on a simple SOHO LAN is shown in Figure 1.1. Each disk drive has its own file structure that can be viewed using

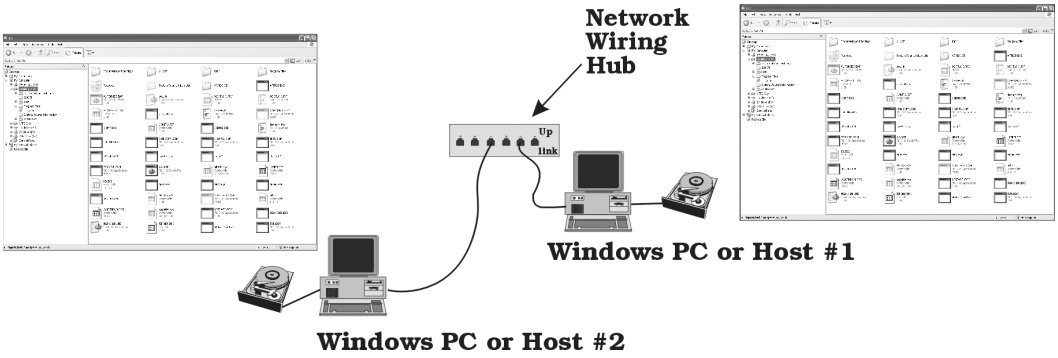


Figure 1.1 Two-PC host disk sharing.

the Windows Explorer. This structure is somewhat standardized by Windows on drive C: Documents and other files are contained in the folder My Documents under Windows 9x and in the folder Documents and Settings under Windows XP/2000. Programs are installed in the Program Files folder and Windows itself resides in the Windows or WinNT folder. In each folder there are either files or more folders. When a PC host shares its disk drive in a simple peer-to-peer network, there are two steps. Windows file and print sharing software must be installed, and then the disk drive or folder itself must be shared. Without performing both steps, the host PC is like a car with an engine (Windows file and print sharing software) but no transmission (sharing the disk drives with a designated security assignment).

We can tell that the disk drives are shared in the figure because the disk drive has a sharing icon associated with it. See Figure 1.2.

Figure 1.2
Windows XP Disk Sharing icon.

Figure 1.3
SYSTRAY Network icon.

The general procedure to check out disk drive sharing on any PC host attached to a LAN is similar for Windows 9x and Windows XP/2000/NT except that some of the labels vary. Windows XP provides network access through a network icon appearing in the SYSTRAY. The SYSTRAY is a Windows feature that displays icons for some programs and services running in the background under Windows. It provides a convenient mechanism for opening those programs and services like opening the network service running when the PC host is connected to a SOHO LAN. See Figure 1.3.

In Windows 9X we most commonly use Network Neighborhood to examine disk sharing setup. In Windows ME and Windows 2000 the same icon is labeled My Network Places. To look at disk drives we use the My Computer icon. In this case let me illustrate disk sharing using a Windows XP PC. The examples show screen captures from Windows XP. All versions of Windows follow similar disk sharing set up screens, but some Windows ME and Windows XP/2000/NT screens have different labels.

Brain Teaser: SOHO LAN Disk Sharing

Open the My Computer icon on your Windows desktop and see if any of the disk drives are shared. Shared drives have the Sharing icon, a hand supporting the disk drive. If there are no hands supporting your disk drives, they are not shared.

The easiest way to determine whether disk drives are shared on a SOHO LAN is to use the Windows Explorer and open My Network Places, as shown in Figure 1.4.

When the Entire Network icon is expanded, the Microsoft Windows network is expanded, and the domain "TMChqtrs" is expanded, we see the PC hosts in the domain listed. Clicking on one of these PC hosts, in this case NTServer, lists the shared resources, including the disk drives. When disks are not shared, we see no shared drives listed.

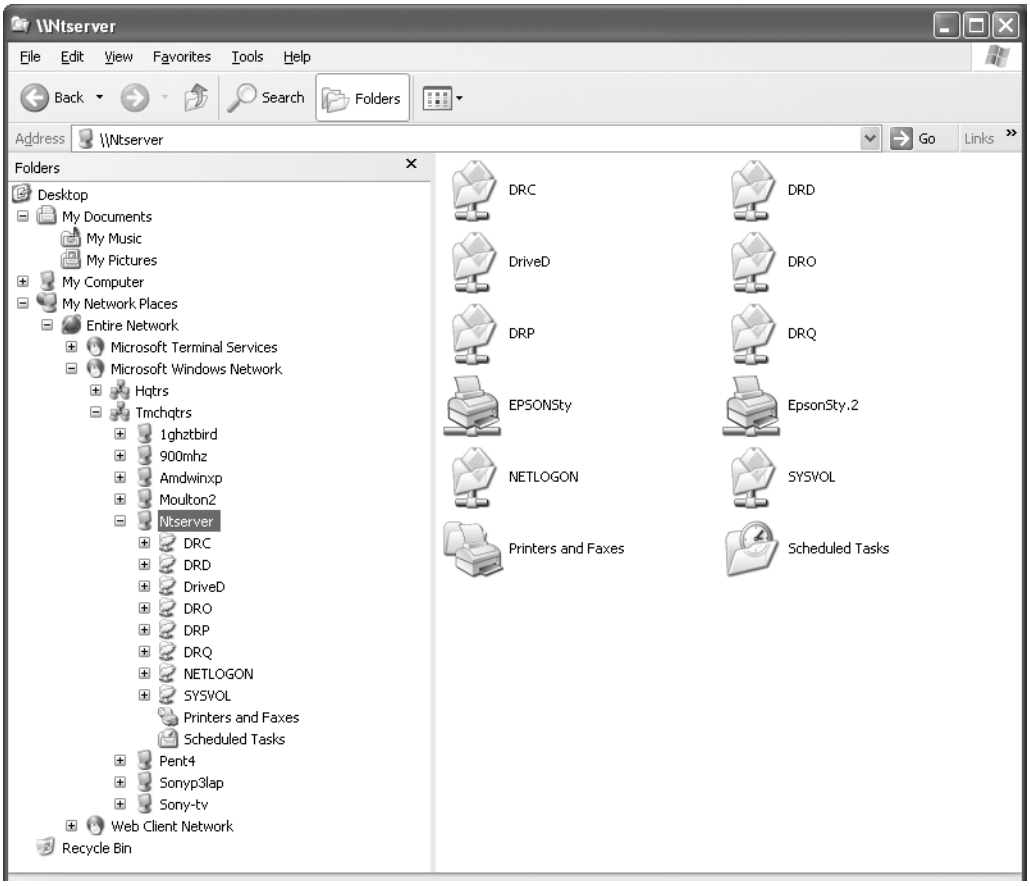


Figure 1.4 NTServer shared network drives.

File Level Access Control or File Sharing

Sharing individual files by a Windows PC host or server on a SOHO LAN is not performed with the older File Allocation Table (FAT) disk file system. Sharing folders is supported by both the FAT and Windows XP's NTFS (NT File System) on Windows PC hosts. File level access control or file sharing is supported on Windows XP Professional and Windows servers using NTFS. File-level access control or file sharing is performed using the inherited rights and the added security tab for files provided by NTFS. To determine if a file, folder, or disk is shared on a FAT or an NTFS partition, click on the file, folder, or disk icon to highlight the file, folder, or disk, and then right click to select Properties. The Windows XP File Properties screen pops up. See Figure 1.5.

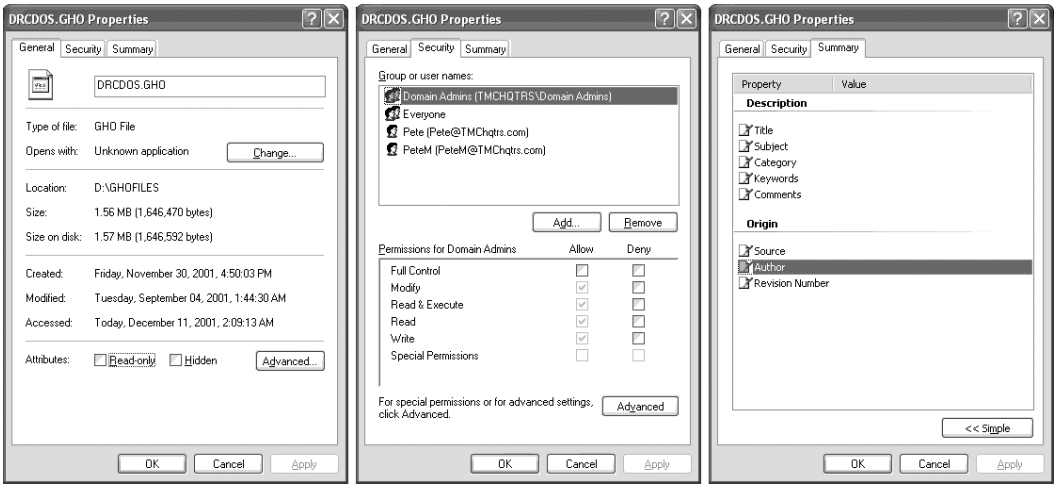


Figure 1.5 Windows XP File Properties.

The three tabs describe the shared file. The General tab provides overall information on the file. The Security tab regulates file-level access control or file sharing. The file-level access control or file-sharing rights are inherited under NTFS when the disk drive is shared. However, the file-level access control or file-sharing security tab permits us to further restrict access to the shared file for network users and groups based upon inherited security rights. The Summary tab provides added information on the file.

File-level access control or file sharing is an additional inherited security parameter for folder sharing and disk sharing. Sharing files is typically set up using inherited rights from a shared disk drive or a shared folder. See Figure 1.6.

Disk sharing rights lay the foundation for Folder sharing. Folder sharing generally places more restrictions on drive contents than does disk sharing. Finally,

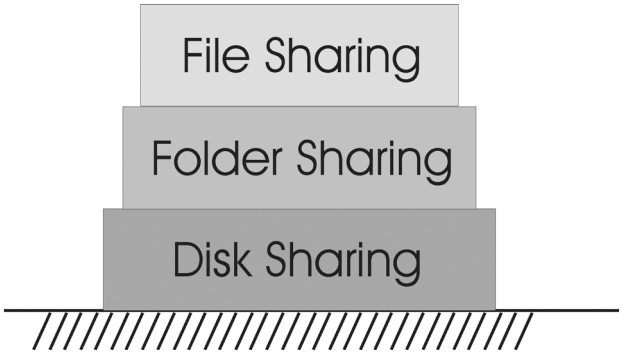


Figure 1.6
Windows disk, folder, and file-level access control or file sharing.

file sharing protects individual files more than disk or folder sharing. A strategy is to give open access to the disk drive and then protect critical areas on the drive from access by using increased folder and file level access control or file sharing restrictions. Windows supports other strategies as well.

For home office LANs, the typical installation strategy is to install the LAN with relaxed security restrictions, then tighten the restrictions when the LAN operates as they expect. For larger small-office LANs only specific folders and files are shared as needed. This protects critical PC host configuration information from being accessible to ordinary users. Administrative personnel generally set up a network so that they can get at critical configuration information to facilitate centralized network administration.

Printer Sharing

Printers attached directly to a PC host or other network printers may be shared. When sharing a network printer, the PC host connects to it using a TCP/IP port that acts like a local parallel or serial port. Once shared, the printer, similar to a disk drive, has an associated Sharing icon.

To determine in Windows XP if a printer is shared, use the Control Panel to open the printer's icon and view the printers. Network printers have an associated Network icon and local shared printers have the associated Sharing icon. See Figure 1.7.

In the figure the Tektronix printer is shared and the HP LaserJet printers are all network printers attached to other network PC hosts. This concludes the traditional SOHO LAN applications. These applications have been supported by SOHO LANs since the mid-1980s. Newer applications are based upon enhanced LAN technologies and high-speed communications.

Brain Teaser: SOHO LAN Printer Sharing

Using the Start button in Windows, go to Settings, and open the Printers icon to see if a printer attached to your PC is shared. Shared printers, similar to shared drives, have the Sharing icon—a hand supporting the printer. If there are no hands supporting your locally attached printer, it is not shared.

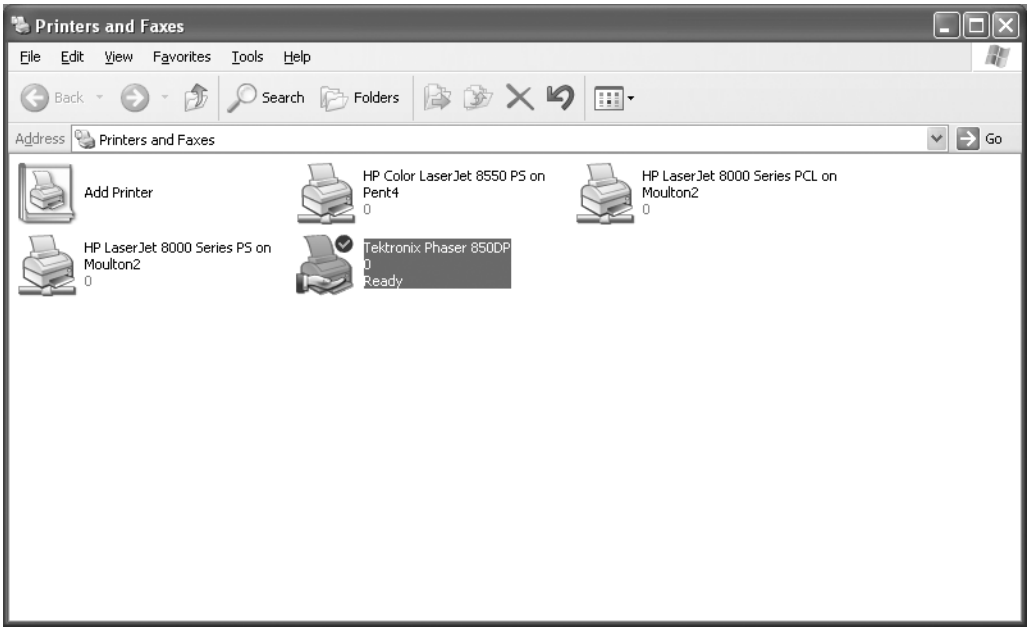


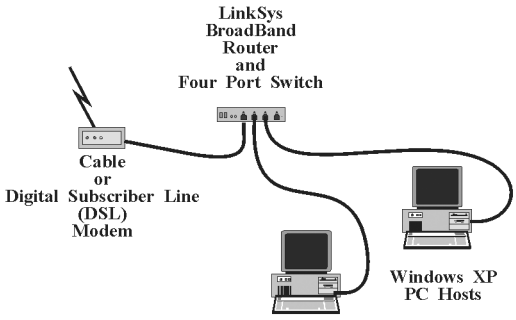
Figure 1.7 Windows XP network and shared printers.

Internet Access

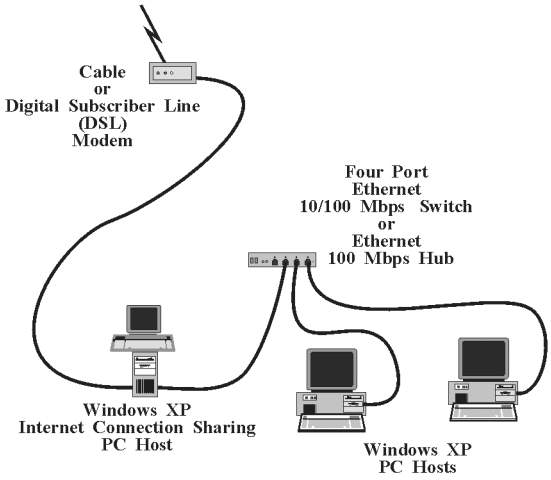
Sharing high-speed connections to the Internet is a hot application area for SOHO LANs. In homes and offices today, cable modems or Digital Subscriber Line (DSL) modems provide 10-Mbps Ethernet connections into the SOHO LAN. These cable modems and DSL connections do not operate at the full Ethernet 10-Mbps speed, but rather they typically provide an uplink from the SOHO LAN to the Internet at a speed of 128 to 384 Kbps and a downlink from the Internet to the SOHO LAN of 400 Kbps to 1.544 Mbps for a $49 to $99 monthly fee. The cable modem or DSL modem provides the buffering needed to match the 10-Mbps Ethernet speed to the slower speeds of the uplink and downlink to the Internet.

Internet connection sharing is accomplished in two ways (see Figure 1.8):

1. The cable modem link is attached to a SOHO network component called a router.
2. A Windows XP PC host is configured to support Internet connection sharing with all Internet traffic then routed through a single Windows XP host PC.



Router Configuration



XP Internet Connection Sharing Configuration

Figure 1.8 Router and Internet connection sharing configurations.

At the top of the figure there are two Windows XP PC hosts connected via a switch/router to the cable or DSL modem. We examine the functions of these SOHO network components in greater detail in Chapter 5. In the bottom of the figure a Windows XP PC host has been configured to share the high-speed cable or DSL modem Internet connection. This is a configuration of the software components built into Windows XP that we shall also examine later in the book.

Cable Modems

Cable modems use the CATV coaxial cable to connect to central facilities at the CATV provider's head end facility. There the data stream from the cable modem is routed to a LAN that in turn is connected to the Internet. The LAN has local server computers, Internet caching servers, mail servers, and more. Typically the CATV provider also acts as an Internet service provider. It provides caching of frequently accessed Web pages on the local Internet caching servers, e-mail services, news group services, Web page storage, and sometimes more.

The cable modems are just a high-speed modem capable of 40-Mbps transmission speed, but centrally configured by the CATV provider to operate at 128 Kbps on the uplink and 400 to 800 Kbps on the downlink. The uplink and downlink speeds can vary depending upon network traffic. During high traffic periods the speeds are often lower. Unfortunately, the uplink speed of 128 Kbps never gets higher during low traffic periods. The downlink speed may exceed 800 Kbps.

Cable modems conform to a Data Over Cable Service Interface Specification (DOCSIS). These cable modems can be controlled from a central CATV head-end network facility. A central controller can vary the speed at which they send and receive data. Most CATV providers sell multiple addresses that can be assigned to each cable modem. My cable modem provider sells up to four addresses that can be assigned to a single cable modem.

The basic cable modem cost is about $40 per month, with added addresses costing about $10 per month. However, added addresses do not translate into added cable modem transmission capacity. All addresses for the cable modem share the cable modem's assigned transmission capacity. Such capacity sharing is also required for the router and Internet connection-sharing configurations. For small networks of two to 20 PC hosts, sharing is typically not a problem. There is no apparent performance degradation owing to multiple users. For larger networks multiple cable modems or higher-speed DSL modems could

be deployed. Groups of PC hosts can be assigned to a specific cable modem, spreading a heavy load over multiple $40 per month cable modem connections.

For larger networks a T-1 connection may be needed to provide the requisite performance. A T-1 connection is a channel leased from the telephone company; it operates at 1.544 Mbps. Costs for such a leased channel vary from $600 to $1,000 per month plus a significant installation fee.

Cable modems can be purchased at retail computer outlets (what I refer to as computer grocery stores) like Best Buy and CompUSA. They come in a kit that SOHO LAN operators can readily install. Comcast runs a funny advertisement showing that a klutz who cannot fix anything at home can easily install a cable modem. Installation is not quite as easy as they imply in the advertisement, but most SOHO LAN operators can accomplish it.

Digital Subscriber Line (DSL)

A Digital subscriber line is a pair of modems that convert an ordinary telephone line into a high-speed Internet connection. DSL modems provide equivalent uplink and downlink speeds to a cable modem. The connection to the SOHO LAN is a 10-Mbps Ethernet connection. We discuss Ethernet in more detail in Chapter 2. For a SOHO LAN both DSL and cable modems provide basically equivalent high-speed Internet access.

Similar to cable modems, there is central control of DSL modems. SOHO LAN operators in some cases can install DSL modems. If not, telephone company service personnel can assist with the installation.

One limiting factor for DSL modems is that they must meet specific criteria to be able to function on the existing telephone wire. There are distance limitations from the telephone company central office that when exceeded prohibit the use of DSL modems. When the distance exceeds 18,000 feet the DSL modem typically does not operate. In my case, my facility is 27,000 feet from a telephone company central office, so I cannot get a DSL modem.

Cable modems do not have distance limitations like DSL modems. If you have CATV service and the CATV service supports cable modems, then you can get a cable modem.

Some DSL modems require that you logon to the DSL provider's network to use the DSL. When a PC host does not logon, the high-speed DSL Internet link is not available. This can be irksome. However, routers provide the capability to automatically logon to a DSL provider network whenever there is SOHO LAN activity requesting high-speed Internet access.

Web Serving

Web serving brings Internet-style Web site hosting capabilities into the SOHO LAN. Here we're interested in publishing Web sites over the company's internal network—its *intranet*. These sites are not available to anyone outside the network. In this case a PC host acts as a Web site server that is accessible using any Web browser. A special Internet Information Services (IIS) Windows XP software component is added to Windows PC hosts that permit them to act as a Web site server. While it is possible to set up an internal Web-style site by sharing a folder containing an index.HTM file, the IIS, and other Web server software make the reference to this intranet Web site more general and easier to use. Linux hosts with Apache and Samba Web serving software and other network components like the Sun Cobalt Cube and RaQ server appliances support Web site hosting and other functions. The Linux operating system can be obtained for free, but a PC host is required to run it. The Sun Cobalt Qube costs around $1,100 and the Sun RaQ can run as high as $2,200.

Windows computers can install personal Web server software to provide similar functions. Web pages are created using Web page creation software like FrontPage and then stored on the PC host running the IIS software. Web browser software like Internet Explorer can now display the Web pages stored internally on the intranet.

This application permits businesses to publish frequently changed information electronically. Because of its electronic form and universal availability to every PC host that is SOHO LAN attached, the information can be easily maintained and disseminated to SOHO LAN users. Take for instance an internal telephone directory. Such a document changes often and needs to be referred to by everyone. Publishing it as a Web page on an intranet saves significant time and money for any business.

There are a couple of cautions when publishing Web pages. First, links require continual testing to ensure that they always work. Second, Linux (and UNIX) servers use links that are case sensitive, while Windows does not.

When mixed case is used in a Web site name and a Web site link (a uniform resource locator—URL), Windows servers ignore the mixed case and Linux servers do not. This can cause problems unless the site is targeted at Linux servers by using only lowercase site names and URLs.

Web serving is an application that is used more by larger enterprises and much less frequently used by home office LANs. In a home office there is little need to publish internal Web documents. However, they can be published with pictures, so this may be the way to keep family photos in the future. Web publishing in a business can be much more useful. Instruction manuals, policy and procedure manuals, sales documents, memos to groups of employees, and other information that changes periodically and needs wide internal distribution are all candidates for intranet Web serving.

Internet Information Services

The IIS software is required to establish an internal Web server on a SOHO network. The IIS software is automatically installed with the Windows 2000 server software and can be manually installed in Windows XP or Windows 2000 Professional. Windows 9x versions use different software to perform the same Web page publishing functions.

When installed, the Windows XP Control Panel provides access to the administrative tools, which in turn has the shortcut to the IIS manager. See Figure 1.9.

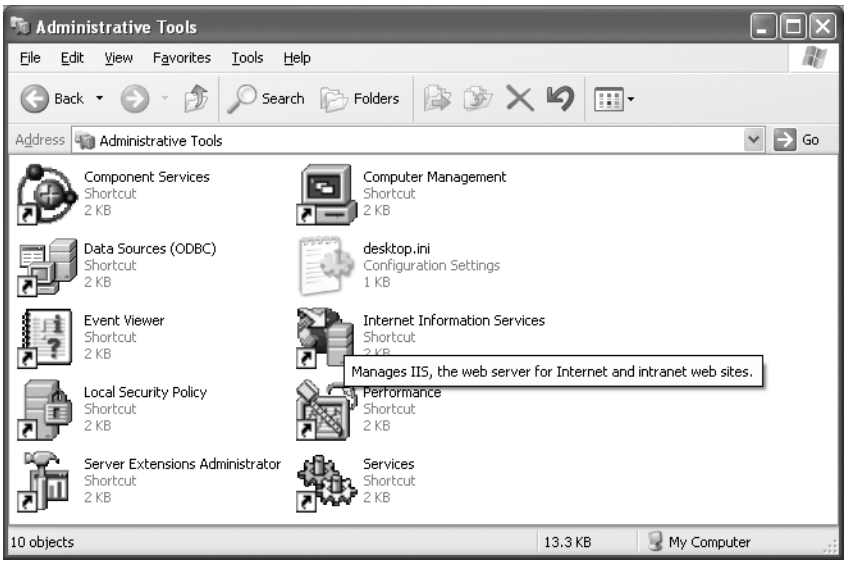


Figure 1.9 Administrative tools.

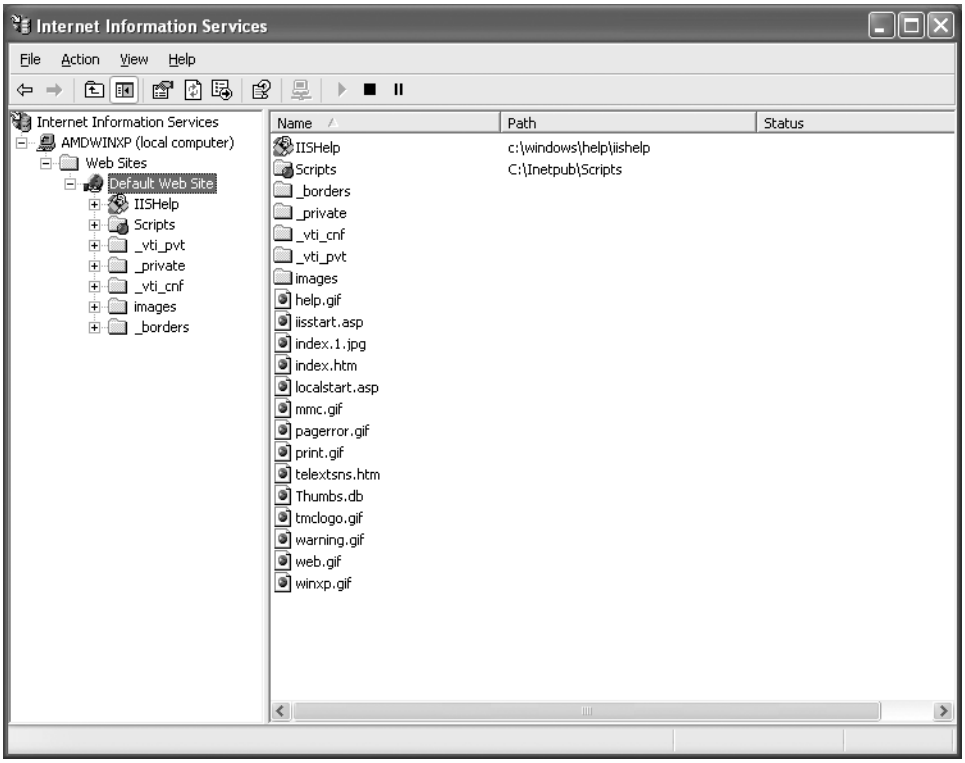


Figure 1.10 IIS default Web site display.

Once the administrative tools are opened, they show the contents of the default Web page. See Figure 1.10.

This figure shows the Windows XP intranet Web site server and the Web pages and files contained in the default Web site. For my intranet, two Web pages were created, INDEX.HTM and TELEXTSNS.HTM. These pages were created using FrontPage, and then published to the intranet default Web site.

FrontPage

Microsoft's FrontPage software creates Web pages. In our case we opened FrontPage to create a new Web page. Then we created the INDEX.HTM page and linked it to the TELEXTSNS.HTM page. On the index page, a graphic logo TMCLOGO.GIF was used. See Figure 1.11.

Figure 1.11 FrontPage creating index page.

FrontPage software comes with full versions of Microsoft Office software. FrontPage provides a variety of Web page publishing and formatting capabilities. Its major drawback is that the raw HTML code it creates is cumbersome and difficult to understand. However, for simple SOHO intranet publishing it functions adequately.

Intranet and Internet Publishing

Once FrontPage creates a Web site, the site is published to the intranet using the default Web site. The published Web page can be viewed by all SOHO LAN-attached PC hosts by using the URL http://*server_name*. See Figure 1.12.

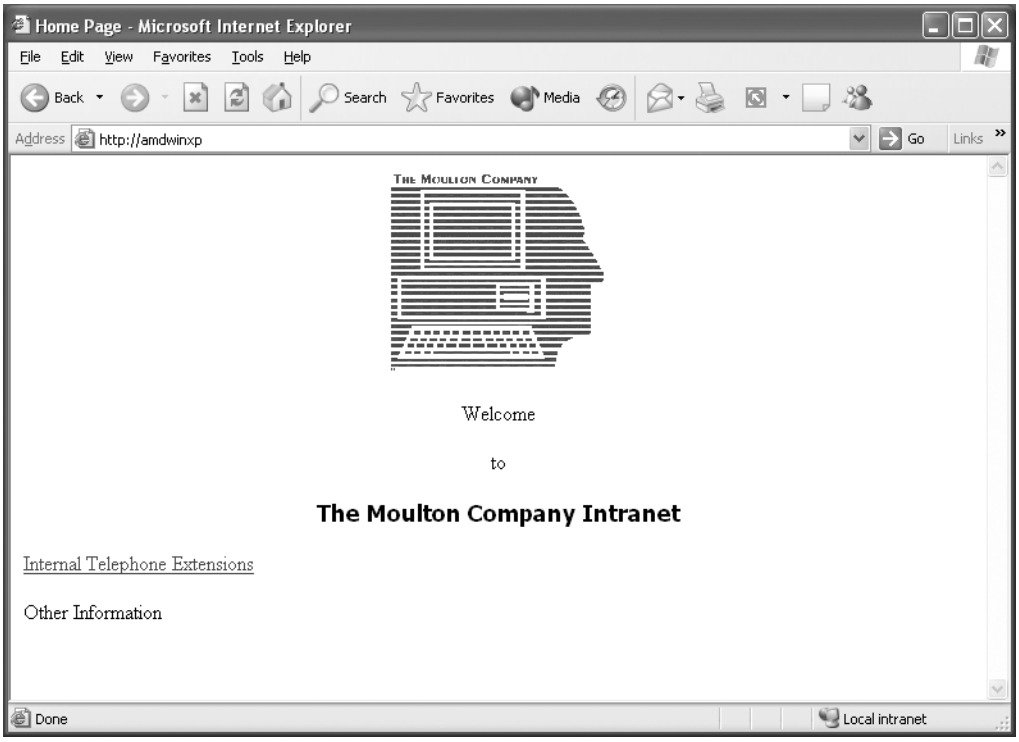


Figure 1.12 IE intranet Web page display.

An intranet Web site can be used for internal testing of Internet Web site content or just to provide information to enterprise employees. In the intranet site shown in Figure 1.13 there is a link to a Web page that lists all the telephone extensions throughout my home office. See Figure 1.13.

In my intranet the URL *http://amdwinxp* accesses the intranet Web page. The *"amdwinxp"* designates the Windows XP Professional PC host acting as an intranet Web server. When *http://amdwinxp* is entered into the IE browser, the intranet Web page pops up.

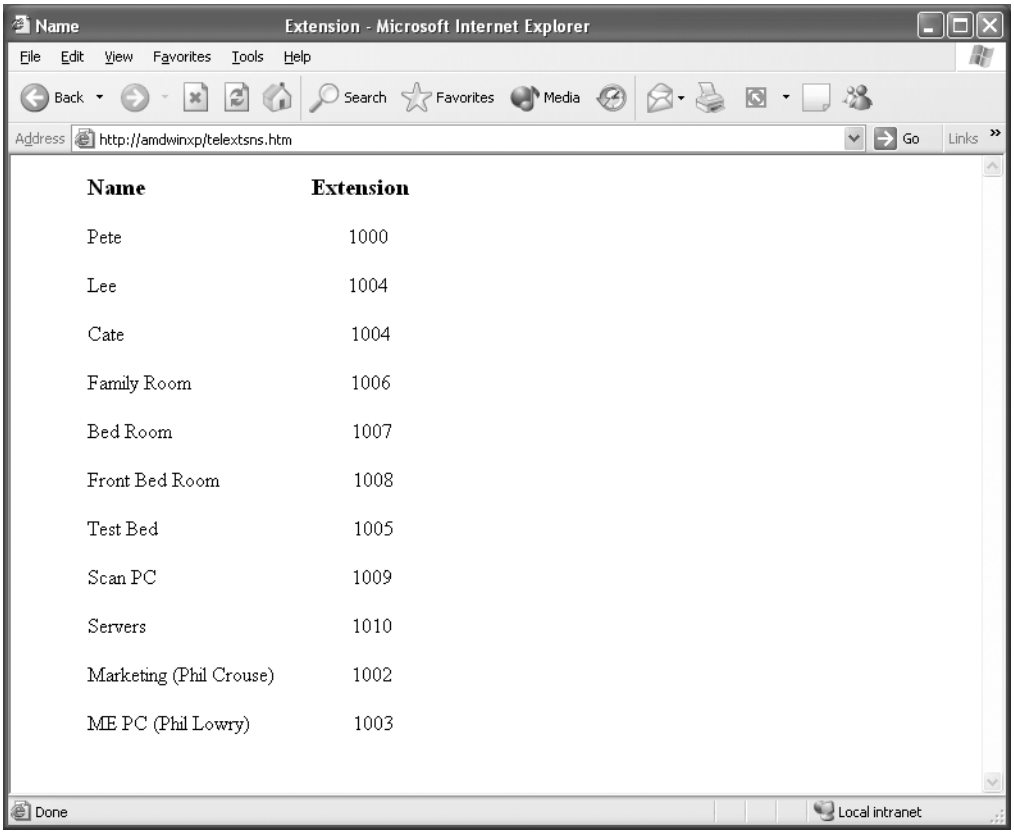


Figure 1.13 Telephone extensions intranet Web page.

Voice over Internet Protocol (VoIP) Telephony

Voice over Internet Protocol (VoIP) telephony marries an enterprise's telephone system to its SOHO LAN. Marrying a Private Branch Exchange (PBX) to a SOHO LAN is not really a home office application because how many homes besides mine have their own PBX? However, there are low-end VoIP components for the home-office LAN that can be used to reduce long distance costs by providing free PC-to-PC VoIP connections and home-office LAN to Public Switched Telephone Network (PSTN) connections. Typically, a special telephony server or gate keeper is needed to provide the translation

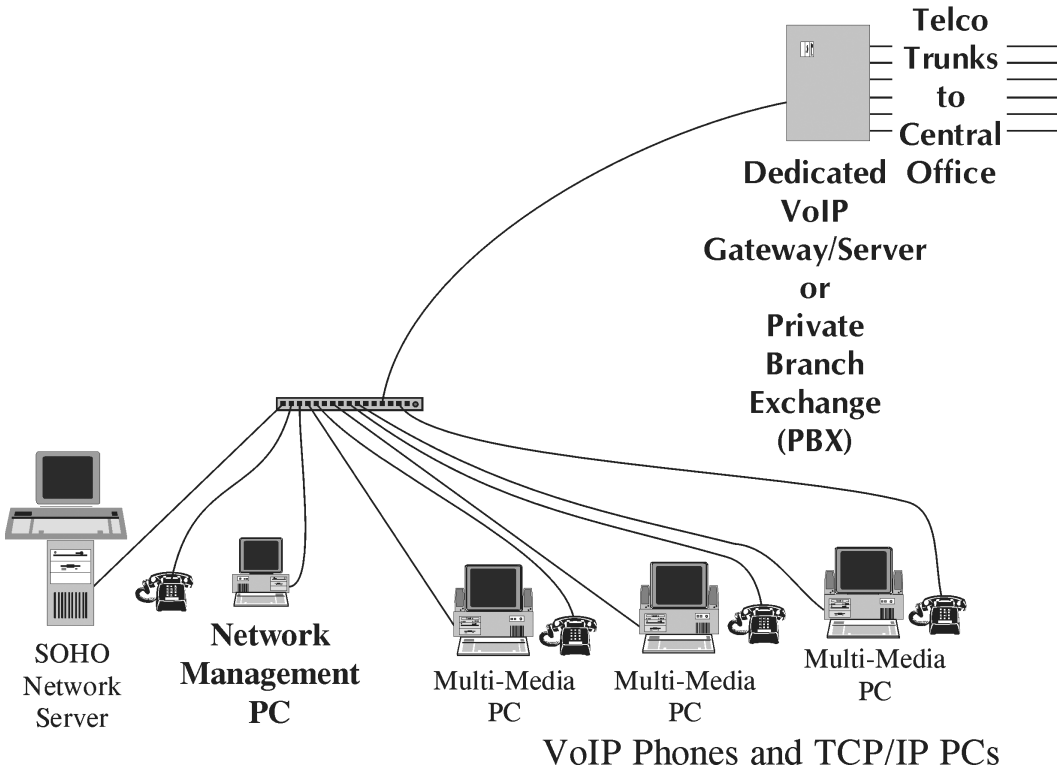


Figure 1.14 VoIP LAN configuration.

from the internal SOHO IP network to the dialup operation of the PSTN. See Figure 1.14.

In Figure 1.14 both PC hosts and telephones connect by the same wiring to the hub. The PC host traffic flows into the SOHO network server, while the VoIP traffic is routed to the dedicated VoIP gateway/server or PBX. Such VoIP applications depend upon the SOHO network using TCP/IP as its protocol.

TCP/IP

Transmission Control Protocol/Internet Protocol (TCP/IP) is the Internet protocol used by most LANs. Virtually all Windows operating systems support TCP/IP protocol, even Windows 3.1. TCP/IP performs routing and message delivery functionality. It operates efficiently.

TCP/IP is the basic communication language of the Internet. It is also frequently used as a communication protocol in SOHO networks. When a Win-

dows PC host has a direct connection to the Internet, that PC host generally uses Windows' TCP/IP software components to send and receive messages and other data from Internet-connected host computers. Those computers also run TCP/IP software components.

TCP/IP provides two functions that are layered upon one another. The two parts of TCP/IP identify these functions. The higher layer is TCP and the lower layer is IP.

The higher-layer function, TCP, breaks apart messages or files into smaller packets that are transmitted over the TCP/IP network. At the destination host computer the TCP layer in turn receives these smaller packets and reassembles the packets into the original message.

The lower-layer function, IP, provides packet addressing so that the packets get to their destination. In a SOHO network Windows computers typically use the Active Directory Domain Name Service (DNS) or Windows Internet Name Service (WINS) to track IP addresses for each PC host and server. WINS is used for internal address resolution and DNS is used for both internal and external (Internet) address resolution. Each PC host uses the DNS or WINS information to send data and messages to the correct destination PC host address. In the Internet routers and gateway computers check the IP address to see where to forward data and messages. Sometimes packets from the same message get routed differently through a network than others. Regardless of such diverse routing, all packets are reassembled at the destination host computer.

TCP/IP uses client/server communication operation in which a network host client requests and is provided a service such as transmitting a Web page by network host server. TCP/IP communication is point-to-point, with each communication traveling from one host computer in the network to another point or network host computer. The IP layer is a connectionless service because packets follow no fixed path through the TCP/IP network. The TCP layer is connection-oriented because each message's packets must be received and reassembled to complete the message.

Some higher-level applications that use TCP/IP may also be considered connectionless because each client request is considered a new request unrelated to any previous one. Data requests come in wads and chunks. The wads and chunks arrive irregularly with no guaranteed arrival rate or transmission speed. Because IP is connectionless—sending IP packets only when there is information to send—it frees network paths so that they can be used as needed. In an IP network there are no paths dedicated to a single connection. All communications links or paths are shared by the information being sent across the communications links or paths.

This is different from phone conversations that are circuit switched and require a dedicated 64-Kbps constant bit speed connection for the duration of

a call. In a telephone network, a 64-Kbps link is used for a single call whether there is voice traveling across that link or not.

This highlights the basic conflict between TCP/IP data applications that have no guaranteed connectivity and delivery and telephony applications that require a fixed connection with guaranteed data delivery. Consequently, TCP/IP networks provide delivery guarantees for specific data types so that telephony applications requiring delivery guarantees to provide acceptable voice quality can operate on a TCP/IP network. These delivery guarantees are referred to as quality of service (QoS).

On SOHO LANs a single server using Dynamic Host Configuration Protocol (DHCP) TCP/IP dispenses addresses automatically. This facilitates central management of the network and saves administrative personnel from running between PC hosts when IP addressing problems arise. DHCP IP address assignment is used for Internet connections for SOHO LANs and in SOHO client/server LANs. The DHCP capability is provided by Windows 2000/NT Server software. For SOHO Windows clients using DHCP, the TCP/IP setting is used to obtain an IP address automatically. See Figure 1.15. Clicking on the Windows Network icon in the SYSTRAY and selecting Properties enters this client setup.

SOHO peer-to-peer LANs can use fixed or dynamic IP addresses for the TCP/IP protocol. This is easy enough to manage for two to 10 PC hosts. To set

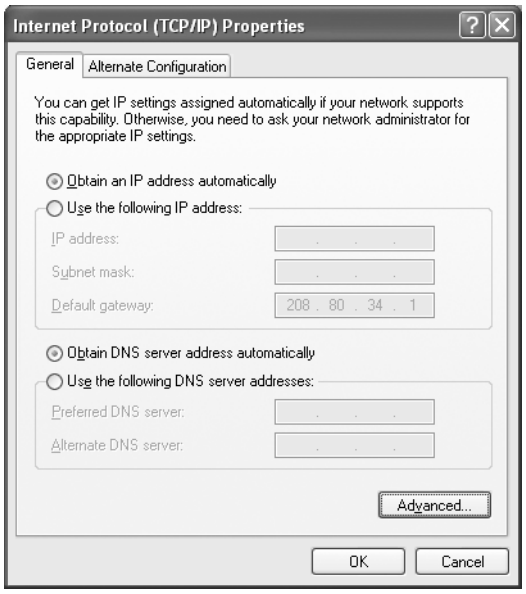


Figure 1.15
TCP/IP DHCP client setup.

a fixed IP address, select "Use the following IP address" and then enter an IP address. IP addresses consist of four numbers that range from 0 to 255.

Some IP addresses to use are 10.10.10.10 to 10.10.10.100 or 172.16.10.10 to 172.16.10.100. The Internet Assigned Numbers Authority (IANA) reserved three blocks of IP address space for private intranets:

10.0.0.0	to	10.255.255.255
172.16.0.0	to	172.31.255.255
192.168.0.0	to	192.168.255.255

Any enterprise using IP addresses in the address space above can do so without any coordination with IANA or an Internet registry.

Each fixed IP address should have the same numbers for the first three settings. The varying number is the last or right-most number, as in 10.10.10.nnn. Because many networks tend to use the addresses near nnn.nnn.nnn.255 and nnn.nnn.nnn.10 for SOHO LAN servers and routers, it is better to use a number greater than 10 or a number not near 255. Other IP addresses can potentially interfere with some TCP/IP network functions. Other TCP/IP network functions use specific IP addresses like the loopback address of 127.0.0.1, the 0.0.0.0 default route address, or the 224.nnn.nnn.nnn to 248.nnn.nnn.nnn addresses used by Internet routers or reserved for future use, so such numbers are good to avoid as well.

Brain Teaser: IP Address Assignment

Using your Windows Start button, go to Control Panel and open the Network and Dialup Connections icon, highlight the LAN connection icon, right click, and select Properties. This should reveal a panel with Internet Protocol (TCP/IP) as a selection. Highlight it and select the Properties button below to see if the PC uses a fixed IP address. Most likely you will find that "Obtain an IP address automatically" has been selected.

Higher-layer application protocols ride on top of TCP/IP to provide PC hosts with special Internet services like Web browsing and e-mail. Such higher-layer protocols include the World Wide Web's Hypertext Transfer Protocol (HTTP); the File Transfer Protocol (FTP); Telnet (TELNET) for logging on remote UNIX/Linux computers as a terminal; and the Simple Mail Transfer Protocol (SMTP), the Post Office Protocol 3 (POP3), and the Internet Message Access Protocol (IMAP) used in combination to manage and deliver e-mail. These protocols are packaged together with Windows TCP/IP

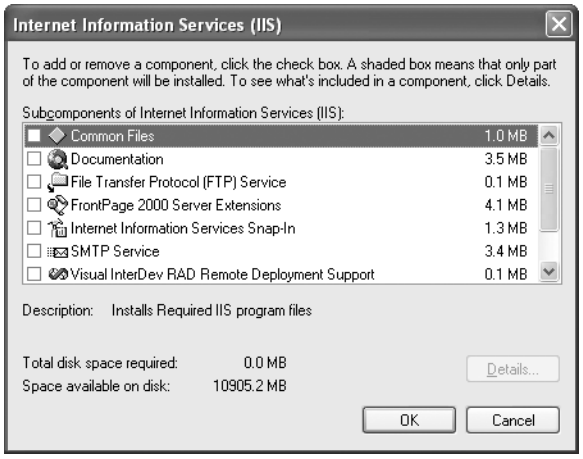


Figure 1.16
IIS-supported functions and protocols.

protocol. The IIS implements FTP, SMTP, and HTTP protocols to provide intranet services. Internet Explorer uses HTTP to retrieve Web pages from intranet and Internet Web sites. See Figure 1.16.

Dialup connections to the Internet use the Serial Line Internet Protocol (SLIP) or the Point-to-Point Protocol (PPP). These protocols operate at a lower level than the IP protocol. They encapsulate the IP packets and send them over dialup phone connections to an Internet service provider.

VoIP

Voice over Internet Protocol uses TCP/IP to transport voice as packetized data across a LAN. In the telephone network each phone line is translated into a continuous 64-Kbps digital stream. In the TCP/IP LAN world, the telephone network 64-Kbps data streams or analog telephone network channels must be translated by a gateway/server into the TCP/IP packets that travel across the TCP/IP LAN. They typically are encoded at a lower speed than in the PSTN. The concern here is that once telephone conversations are translated to TCP/IP packets, the connectionless nature of TCP/IP can cause the voice quality to degrade. If some voice conversation packets were to arrive late, this could cause the voice output to warble or sound unclear. With a VoIP TCP/IP network, performance and guarantees of timely packet delivery is very important.

VoIP benefits include all voice and LAN data traffic running across the same wiring. There is no need to maintain two separate sets of wiring. It is also becoming increasingly possible to route long-distance voice calls across the

Internet or other private IP networks. This can greatly reduce the cost of long distance and overseas voice telephone calls.

Telecommuting

A combined home office and enterprise application is telecommuting. In this case a home office LAN at the telecommuter's residence is linked to the enterprise network, permitting the home office worker to function electronically as though he or she were present in the enterprise's normal office facilities. This electronic link works for many types of office and professional jobs. When telephone calls are routed to a telecommuter's home, the caller can in no way tell that the telecommuter is working from home and not from some central office facility. The only time a telecommuter cannot report to work is when the electronic links between the home and the enterprise office facility are broken or out of service. When telecommuters are spread across a metropolitan area, it would be very difficult to have every telecommuter unable to connect to the central enterprise office facility.

Telecommuters can depend upon Windows Virtual Private Network (VPN) and Remote Access Server (RAS) software to link their home office LAN to the central enterprise network. Windows VPN capability is built into most Windows versions. It permits the remote Windows system to securely connect to a central office Windows system over a virtual connection that travels across a private TCP/IP network or the Internet. A central office Windows or other VPN server routes the data from the remote Windows PC host to the enterprise network servers. A Windows or other RAS server permits remote PC hosts to dial into the central facility network using the Public Switched Telephone Network (PSTN). In other cases remote PC hosts may connect directly as terminals to enterprise network mainframe computers to access and update specific databases. See Figure 1.17.

The Windows Server routing and Remote Access software has several configurations that support SOHO telecommuter configurations and other small office network configurations, as described in Figure 1.17.

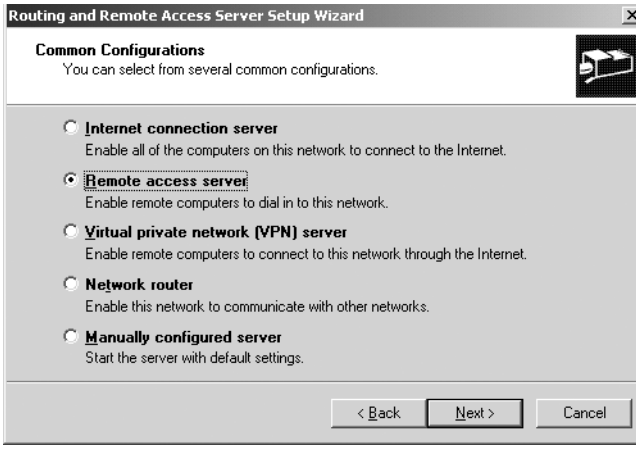


Figure 1.17
Windows 2000 Server Remote Access software.

Virtual Private Networks (VPN)

Virtual Private Networking has been used by enterprises for quite some time. It creates logical software-defined virtual circuit connections between host computers on a TCP/IP network. Both the remote PC host and the central PC server ensure that all communications between them remain private by encrypting data flowing between them. Further, the remote users are connected to the central office network as though they were sitting at a PC host in the office. This means that they must logon to the central office network with their user name (USERID) and password to authenticate them and assign them their requisite network security authorizations. See Figure 1.18.

Figure 1.18
Windows XP VPN network connections.

The Windows VPN software is easily configured to connect to a central office companion VPN server. The Windows VPN server permits connections via the Internet. VPN connections run across high-speed cable modems or DSL links into the Internet.

Remote Access Server (RAS)

A Remote Access Server is a server with the Routing and Remote Access Service specially configured to provide remote networking for telecommuters, mobile workers, and network administrators. The Windows routing and remote access service permits telecommuter PCs to dial into the RAS and access the central facility network. RAS permits remote access to file and printer sharing, e-mail, scheduling, and database access.

Windows remote access servers set up secure connections through the PSTN. In this case the telecommuters need to be in a local calling area to avoid expensive toll charges.

Host Network Access

Windows XP PC hosts can use the HyperTerminal program to directly access mainframe computers as though they were terminals attached to the host computer system. The HyperTerminal emulates a variety of dialup terminal types. See Figure 1.19.

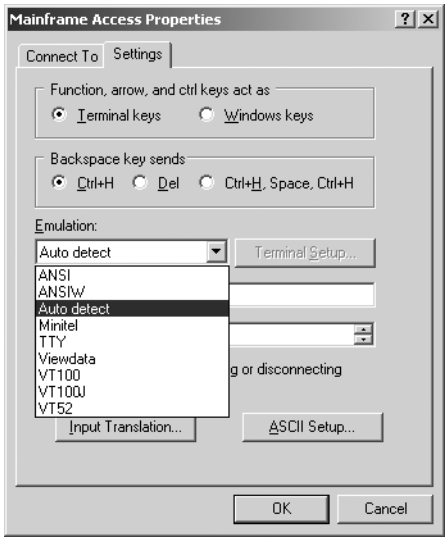


Figure 1.19
HyperTerminal dialup terminal emulation.

The HyperTerminal is configured to use a specific COM port, and its attached modem will call a mainframe computer supporting dialup connectivity. Windows XP dial-up networking configuration is not needed for HyperTerminal. HyperTerminal may be used to directly connect to computer and communications equipment that uses a command line interface such as telecommunications PBX switches, the Linksys 24-port gigabit switch (EF24G2), and Small Computer System Interface (SCSI) Redundant Array of Independent Disks (RAID) controllers. For telecommuters the ability to dialup mainframe computers is the key feature.

Brain Teaser: Finding HyperTerminal

Using the Windows Start button, go to Programs, select Accessories, Communications, and open HyperTerminal. If the Location Information Wizard pops up, enter your area code and any number needed to access an outside line (usually 8, 9, or no number). Click OK and click OK again to set the "My Location" dialing rules. HyperTerminal will then open. Enter any name like "Eat at Joe's" and select OK to connect using COM1. Note the port settings and select OK. Then exit by disconnecting and not saving the "Eat at Joe's" session.

General Networking Approaches

After examining the SOHO LAN applications, we turn our examination to the general approaches to SOHO networking. These approaches deal with the communications channel or wiring and the networking protocols used. An approach is embodied in the Network Interface Card (NIC).

Most often the wire and the networking protocol are married together for life because they are implemented in a NIC. However, it is possible to see a wider variety of networking approaches today. There is nothing that mandates that Ethernet run at 100 Mbps over unshielded twisted pair wire. With that said, I must stress that the more esoteric combinations of wiring and protocol are most often some manufacturer's response to a niche market, and are not anywhere near the market mainstream.

Home Wiring

All SOHO LAN operators would like to use the electrical wiring in the home to act as the communications medium for the SOHO LAN. Linksys at one time provided SOHO LAN products that worked with the electrical wiring in the home. These products seem to be falling victim to emerging 802.11 wireless networking products. Home electrical wiring communications technology does not deliver the transmission speeds (capacity or bandwidth) or the reliability that are realized by special SOHO home wiring tailored to Ethernet and video transmission or to that provided by wireless LAN products.

There are manufacturers that produce special wire tailored to home office networking. They include SEIMON, and OnQ. At one time both IBM and Lucent were developing and selling home wiring products, but they appear to have dropped those product lines.

Most home wiring systems have a central hub. All room outlets are star wired to the central hub. The central hub is used to cross connect the various cables to provide the video and SOHO network connections for a home. Home wiring systems are easy and cost effective to install in a new home, but they are somewhat more costly and difficult to install in an existing home.

Universal Serial Bus (USB) Networking

All PC hosts today have Universal Serial Bus (USB) ports. These ports can be interconnected to network PC hosts. USB operates at 1.5 Mbps or 12 Mbps, with the speed of an individual bus determined by the slowest device on the bus. For a very small network, USB networking would be OK. However, more than two or three devices on a USB network would not work as well as using 100 Mbps Ethernet. USB requires special cables that have special connectors. USB acts like any NIC in that it fulfills the wiring and communications protocol requirements for a network. It falls short when it comes to transmission speed as compared with Ethernet. Higher transmission speeds should be available soon in USB networking components. However, they will still lag behind Ethernet.

Another networking approach similar to USB networking is to use IEEE 1394 FireWire. Sony computers come with this interface. I have networked two Sony laptops using their FireWire ports and Windows built-in software networking protocols. They implemented a peer-to-peer network using FireWire in place of Ethernet NICs.

Both USB and FireWire lack the plethora of networking components found for Ethernet. Further, they both operate at speeds of 12 Mbps, or 480

Mbps for USB and 400 Mbps for FireWire. They will most certainly operate at higher speeds, but they may lack Ethernet's flexibility to run different links at 10 Mbps, 100 Mbps, 1 Gbps, and 10 Gbps in the same network. Consequently they are both good for SOHO networking with two or three PC hosts.

Brain Teaser: Finding USB Connections

Look at the rear of your computer for the connections and their symbols. Do you find any rectangular connections? What is the symbol next to them? Does the symbol look like a growing plant? If it does, then these are USB connections. Verify by going to a computer or electronics store and looking for USB cables. The same USB symbol should appear on the USB cable box.

Ethernet

Ethernet is the primary SOHO and LAN networking technology. It operates at speeds of 10 Mbps, 100 Mbps, 1 Gbps, and 10 Gbps. It is easy to migrate a slower SOHO Ethernet LAN from a slower operating speed to a faster operating speed because Ethernet networking hubs, switches, and routers provide built-in speed buffering. Ethernet NICs and other components are cheap. They interconnect directly with cable and DSL modems, and they support TCP/IP. Ethernet networking components can be centrally monitored and managed, and they provide the high speed and QoS network management needed for VoIP networking. This makes Ethernet the primary SOHO LAN technology candidate.

Wireless Networking

Wireless networking technology provides some competition for Ethernet. It too comes from the development and standardization work of the IEEE 802 committee. The major attractiveness of wireless LANs is the lack of fixed wiring. This means that in a home few physical wires need to be run. Some Ethernet wiring at the central network hub point is needed, but this can be confined to a single room. Then a Wireless Access Point (WAP) connects into the existing Ethernet and provides the wireless connections to the PC hosts. These RF links can connect through walls and floors. However, there are limits there. Regardless of these connectivity limits, the higher cost of wireless

networking components, and special security considerations, wireless SOHO LANs are becoming increasingly popular.

Our Networking Focus

In this book we will focus on market mainstream SOHO LAN networking approaches. This means largely Ethernet and wireless networking. These will be examined in more detail in subsequent chapters. We have also discussed USB and FireWire networking for small SOHO networks because they are inexpensive to implement (one only needs a cable for two PC hosts) and in some cases readily available.

Summary

This chapter has examined basic SOHO LAN applications. It illustrated how to determine if a PC LAN was set up for disk sharing, folder sharing, file sharing, and printer sharing. We then looked at the popular application of sharing high-speed Internet connections. These applications comprise the most common applications for home office LANs.

The chapter then moved to more common small-office LAN applications that included Web serving supporting enterprise intranets, Voice over IP (VoIP) telephony that combines both the small-office LAN and telephony so all communications run across a single wiring plant, and telecommuting applications where Virtual Private Networking (VPN) and Remote Access Service (RAS) software connect telecommuters seamlessly to enterprise networks.

The chapter concluded with a quick tour of the general approaches to SOHO networking. Ethernet and wireless networking (sometimes referred to as WiFi) command the market mainstream. USB and FireWire networking can be used to quickly network two computers. These networking approaches are embodied in the Network Interface Card (NIC). They are combinations of wiring and hardware protocols built into NICs. Our networking focus in this book will be to examine the market mainstream networking approaches.