Uyless Black

Fourth Edition

Sams Teach Yourself

Networking

in 24 Hours

SAMS

Sams Teach Yourself Networking in 24 Hours

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Introduction

This book provides a reference guide for anyone who wants to get up to speed on computer network concepts and networking technologies. Because each piece of networking hardware and software operates differently, it would require a book the size of the New York City white pages to cover all aspects of the subject. Thus, this book concentrates on fundamental concepts. Emphasis is placed on understanding how the major components of a computer network function and how to use proven practices to deploy, upgrade, and maintain the network.

What's New in This Edition

This book has been overhauled for this Fourth Edition, including scores of references to commercial products and websites. New coverage has been added related to Microsoft Windows Server software. Updated information on the Linux platform and wide area networks (WANs) is also included. The wireless material on Wi-Fi and Bluetooth has been updated and expanded. As well, the latest Internet security protocols have been added to Hour 20, "Security."

Organization of This Book

The book is divided into six parts. Each part provides a body of information that covers a specific area pertaining to computer networks.

- Part I, "What Is Networking?," introduces networking, including an overview of the primary components of computer networks. This part explains the broader issues of how hardware and software function to support the interworking of computers, servers, routers, and other devices.
- Part II, "The Basics," focuses on the concepts underlying data networks. We examine how packet-switching operates and look at the operations of local area networks (LANs) and WANs. This part discusses computer network protocols and explains a widely used conceptual model that depicts how a sending computer transfers data to a receiving computer. Because of the impact and importance of wireless networks, the hour on this topic has been moved from Part VI (of the previous edition) to this part of the book.
- Part III, "Building Networks," walks you through the process of planning and building a network from conception to implementation. Issues related to planning network

capacity, creating the network, and then connecting to the Internet are included as part of the discussion. For this latter discussion, the information of TCP/IP and related, supporting protocols has been expanded.

- Part IV, "Network Operating Systems," provides an overview of network operating systems, the major network servers, and Microsoft Windows Server 2003/2008, UNIX, and Linux.
- Part V, "Network Administration," examines the issues related to administering a network. This part includes discussions on both troubleshooting and management.
- Part VI, "The Future of Networking," examines future possible implementations of wireless technology, operating systems, and other aspects of networking. This part discusses the issues related to the future of Linux, the emerging network "cloud," nationwide wireless hotspots, and the extraordinary field of protein-based computers.

For these 24 hours, you will be the designer of a computer network, as well as its implementer. After you have successfully created a plan for the system, you will undo the shrink-wrap and assemble the components. Next, you will take over the role of the network administrator and make sure the users are happy with your creation. Don't worry—you've been blessed with a competent project team; you can delegate a lot of the work to them.

Conventions Used in This Book

Each hour starts with "What You'll Learn in This Hour," which is a brief list of bulleted points highlighting the hour's contents. A summary concluding each hour provides similar though more detailed insight reflecting what you should have gained from the hour.

This book has several unique elements to help you as you're learning networking. Throughout the book, you'll see the following elements:

Did you Know? This element offers advice or teaches an easier way to do something.

By the Way This element provides additional information that's directly related to the surrounding discussion.

Watch Out! This element advises you about potential problems and helps you steer clear of disaster.

I look forward to hearing your comments about this book and learning about your ideas. Please feel free to communicate with me at UylessBlack.com.

HOUR 1

An Overview of Networking

What You'll Learn in This Hour:

- Definition of a computer network
- Why we need computer networks
- Components of a network
- Different types of networks
- Importance of the Internet

Computer networks have become part of our everyday lives. We use them to take cash from the local ATM. Whenever we send email or browse the Web, we rely on the world's largest computer network, the Internet, to be our electronic mailman. Telemarketers, usually during dinner hour, use computer networks to sell us their wares. Our cable television stations rely on computer networks to transport programs onto our TV screens. What is a compelling example of their presence in our lives? Without computer networks, our cellular phone is little more than a battery powering-up a meaningless screen.

To provide these extraordinary services, computer networks transfer data to and from our TV sets, personal computers, cell phones, and other modern machines. This data is then translated by applications into video TV images, icons on PC screens, and text messages on cell phones. These network tasks take only a second or so (often less) to be completed—even if the network must fetch data from around the world. Why watch a science fiction movie? A computer network is equally impressive.

Although data networks, like computers, have become an integral part of our lives, most people consider computer networks too complex a subject to even consider setting one up. Usually, we resort to a nearby geek squad to help us, or we bring in specialists from our company's networking department.

But let's leak a secret—one these technical "whizzes" would like not to be known: Networking is not all that complicated. It doesn't require a membership in a secret society. Unless you choose to become a software programmer or a hardware designer, unless you choose to build a network from scratch, you have no need to devote years of study to be able to set up and manage your own network.

In the past, managing networks did indeed require in-depth experience and training. And make no mistake: This book will not give you sufficient information to manage the Internet! But now, with the proliferation of millions of networks and network users, the industry provides tools to allow you to not only understand computer networks but to set them up and manage them effectively.

Gaining the ability to create a computer network requires an understanding of a few fundamental concepts, the nuts and bolts of data communications. Coupled with the pliers of common sense—and reading this book—you can assemble your own network.

Did you Know?

Reading to Learn More

The more you read about networking concepts and issues related to computer networks, the easier it will be to implement and maintain your own network. The website www.informit.com is a good way to get started. After reading this book, go to that site. You might be surprised to learn how familiar the concepts are to you. Also, I recommend the Wikipedia entries on the subject at http://wikipedia.org. For the more advanced reader, I suggest studying the Internet specifications, available at http://www.isoc.org.

What Is a Network? What Is Networking?

In simplest terms, a computer network consists of two or more connected computers. This connection is twofold: (a) physical, through wires, cables, and wireless media (the atmosphere with, say, cell phones), and (b) logical, through the transport of data across the physical media. We discuss the components required to make the physical connection in several parts of this book; notably, Hours 4, 10, and 23. The logical connections are discussed throughout the book.

In the context of this book, what is networking? If I say to someone, "I'm networking!," what does this declaration mean? For starters, it doesn't mean I'm socializing with co-workers or mingling with parents at the local PTA. It means I'm sitting at a computer, communicating with someone or something via a computer network. Fine, but you don't need to do 24 hours of reading to teach you how to sit at a terminal and play online Scrabble.

Thus, *Sams Teach Yourself Networking in 24 Hours* is a shorthand title for teaching you how to *build* a network so that you can later *do* networking.

As suggested, there's more to networking computers than physical connectors, such as electrical plugs in the wall and ports on a PC. Several basic rules must be followed if the computers are to exchange data with each other.

- The machines in the network must use the same procedures for sending and receiving data. These procedures are called *communications protocols*. If these devices do not (or cannot) use the same protocols, conversions must take place, usually with services called *protocol converters*. The idea is akin to someone who translates between a person speaking Spanish and a person speaking English. For computer networks, I can send my son an email from my wire-based computer to his Internet cell phone.[1] For my son (Tommy) to read this message, conversions are performed at the physical level (wire-based images to wireless-based images) and at the logical level (email format to text format). Fortunately, you will not have to deal with protocol converters. They are provided for you automatically.
- The data must be delivered without corruption. That is, if I key-in "Hello, Tommy" in my email, it must (and will) be received at his cell phone as, "Hello, Tommy," and not, say, "Hello, Mommy."
- A method must be in place whereby the receiving computer (By the way, a modern cell phone contains at least one computer) can acknowledge the receipt of uncorrupted data and inform the sending computer if the data was indeed received in error. Thus, if Tommy's machine receives "Hello, Mommy," Tommy will never see this error appear on his screen. Unbeknownst to Tommy, a piece of software will check the data and return a message to my computer asking for a retransmission. I also will not know about this wonderful service. What is more, because *all* these dialogues are taking place so quickly (in a few fractions of a second), Tommy and I are unaware of the short delay in our ongoing dialogue.
- Computers on a network must be capable of determining the origin and destination of a piece of information, such as an email or a text message. After all, if Tommy wants to send a response to me, the network must be able to route it to my computer, and Tommy's device must provide the address to the network. Once again, you usually don't need to be concerned with these tasks. Addresses are often assigned to you automatically. As we shall see, it is yet another service provided to network users.
- Obviously, standardized addresses are required for the correct exchange of data between computers. Because millions of computers around the world can be

[1] *As of this writing, not all cell phones support Internet sessions, but the trend is in this direction.*

networked, these addresses must be "scalable" to accommodate a large computer population.

- For security and management, there must be a method for identifying and verifying the devices connected to a network. Hackers must be prevented from damaging computers and files.

This list is not an exhaustive set of network requirements and, as stated, to obtain most of these services, you need not lift a finger to your keyboard or keypad. We've listed them to give you an idea of some of the issues faced when computer networking gurus tackle the task of exchanging and sharing data between computers. As seen earlier, for data transfer among computers to take place, rules must be followed. Otherwise, the process is akin to people attempting to speak to each other in different languages.

Networks can be as simple as a point-to-point connection between two computers transferring files to each other. Networks can also be quite complex. One example that comes to mind is the Federal Reserve's system, which allows us to electronically transfer funds between accounts. Another is the cellular network. It tracks us as we move across a terrain and hands off our connection to the next wireless tower in a "cell" where we have recently moved.

Despite the fact the point-to-point example is much simpler than the bank and cellular examples, each has to follow the same basic rules to permit users to communicate with each other. We will explore both simple and complex networks in this book.

However, before we delve into the details of a computer network and how to set one up, we should pause and answer this question: Why would we want to build a network in the first place? I suspect you have your own answer; otherwise, you would not be reading this book. Permit me to offer some thoughts on the matter; perhaps they are the same as yours.

Why Build a Network?

If we're happy with receiving or sending information by hand, we can resort to the postal service. But hard copy correspondence is called "snail-mail" for good reason. It's far too slow in today's accelerated world. By the time a letter arrives, its contents are often old news.

- In contrast, a computer network enables faster communications between parties. In so doing, it leads to more efficient use of time.

- By sharing electronic data among perhaps thousands of people, a computer network encourages (requires!) the use of standard policies and procedures. After all, our personal computer and our text-proficient cell phone have no inferential power as we humans do. We can just respond with, "Say again please," if we don't understand a transmission. But a computer network must be laboriously programmed to perform this one simple task. However, and once again, these standardized procedures lead to more efficient communications.
- Networks provide backup and recovery support for our data. If the postal service's mail truck breaks down, our letter might be delayed for a day—at least. Not so for a computer network. It's designed to provide near-instantaneous recovery from a failure—all *without a loss* of a single character or number in our (electronic) mail.
- "I've lost that file!" "I've lost the letter!" These lamentations are no longer true with computer networks. If networks are properly designed, it's easy to store copies of our data. Be it mail, photographs, files, or video, we can keep copies safe and sound on another computer in another part of the country—if we take the time to instruct the network to do so.
- Shared resources lead to less expensive communications. Take the Internet, for example. It's an expensive public network (in reality, millions of interconnected networks), but we use it for a few dollars a month, and its performance is such that we might consider it our own private network. That is, we think we have this network for ourselves, but we don't. A term to describe this fine service is *virtual private network*.

As many reasons exist for using computer networks as there are people sharing them and organizations building them. One person might have a bunch of computers at home—one for her, one for him, several for the kids. She may want to hook all the computers together so the family can have a common calendar and email, which, as we know, the kids will more readily read than the note on the fridge. Another person may want to connect his small office or home network to the Internet to use the Web. Yet another person in Texas may to play Texas Holdem with his friends living in New Jersey.

Computer networks have transformed the way we work and play. For better or worse, they've changed our lives. I trust that you think the change is for the better. I do. But we've said enough about why we use computer networks. Let's now see how they're used, and more to the point, how we can use them to improve our personal and professional lives.

How Networks Are Put Together

To repeat an important point, if we were to break down a network into its simplest components, these components would be identified as one of two categories. One is the physical network. It consists of the wiring or wireless medium; the network cards inside the computer that interface with the "plugs" on the computer; and, of course, the computers themselves (which might take the form of mail servers, file servers, and other machines discussed later). The other category is the logical part of the network. Usually implemented in software, it provides the means to build those parts of the network with which we "interface." Examples are email, text messaging, web pages, videos, and the images on our computer screen. We introduce these components during this hour, and they are covered in more detail in coming hours.

The Network Architecture: Combining the Physical and Logical Components

When computers are connected, we must choose a network architecture, which is the combination of all the physical and logical components. The components are arranged (we hope) in such a way that they provide us with an efficient transport and storage system for our data. The network architecture we choose dictates the physical topology and the logical arrangements of the system. For example, if I say, "I'm building a Switched Ethernet network," this statement implies the overall architecture of my future network. Let's now examine these physical and logical components.

The Physical Network

The physical network is easy to understand because it's usually visible. Mainly, it consists of hardware: the wiring, plugs such as computer ports, printers, mail servers, and other devices that process and store our data. The physical network also includes the important (read: vital) signals that represent the user data. Examples are voltage levels and light pulses to represent binary images of 1s and 0s—strung together in many combinations to describe our data.

I say "usually visible" because we can't see wireless connections. Although more ethereal than copper wire connections, wireless connections are nonetheless physical, taking the form of electromagnetic radio waves.

Quite rare only a few years ago, wireless networks such as Wi-Fi are now common. If you have a broadband connection in your home, chances are good your computer is

connected to your broadband hardware device with a wireless arrangement. How we explain the layout (also called a *topology*) of a wireless network is no different from that of a wire-based network.

Physical Layout—Network Topologies

As mentioned, the physical aspect of the network consists of the components that support the physical connection between computers. In today's networks, four topologies are employed: (a) star, (b) ring, (c) bus, and (d) cell. They are depicted in Figure 1.1.

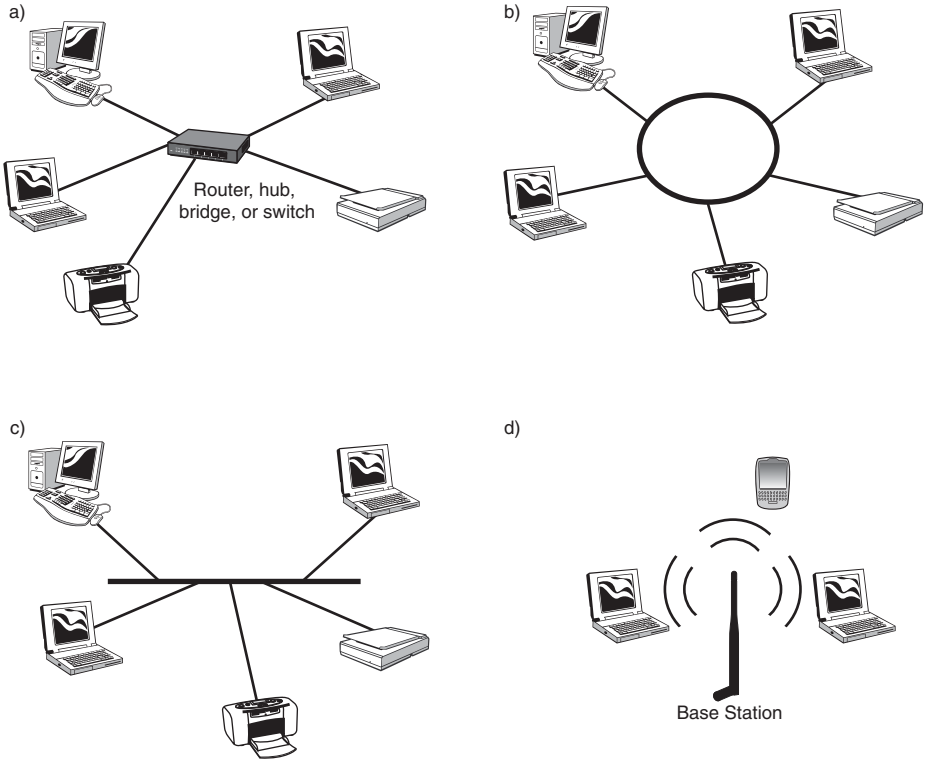

FIGURE 1.1
Network topologies: (a) Star topology, (b) Ring topology, (c) Bus topology, (d) Cellular topology

- **Star**—The *star* topology employs a central connection point, called a *router, hub, bridge*, or *switch*. The computers on the network radiate out from this point, as seen in Figure 1.1(a). The job of the central point is to switch (relay) the

users' data between user machines and perhaps other central connection points. The terms router, hub, bridge, or switch are used interchangeably by some people. Generally, the terms hub and bridge are associated with devices of a somewhat limited capacity. The term switch has historically been associated with telephone networks (with the exception of the 1970's computer network message switches and 1980's packet switches). The term router found its way into the industry in the 1980s and is now used more frequently than the other terms. Whatever we call these machines, they manage *traffic* on the network and relay this traffic back and forth between our computers.

- **Ring**—The *ring* topology, shown in Figure 1.1(b), connects the computers through a wire or cable. As the data (usually called a *packet*) travels around the ring, each computer examines a destination address in the packet header (similar in concept to a postal envelope's "to" address) and copies the data if the computer's address matches its address. Otherwise, the computer simply passes the packet back onto the ring to the next computer (often called the next *node*). When the packet arrives at the originating node, it removes the packet from the ring by not passing it on.

  The ring topology is the first example of a *broadcast* network: Nodes in the network receive all traffic in the network. Whether a node chooses to accept the packet depends on the destination address in the packet header.

- **Bus**—The *bus* topology is shown in Figure 1.1(c). It consists of a wire with taps along its length to which computers connect. It is also a broadcast network because all nodes receive the traffic. The sending node transmits the packet in both directions on the bus. The receiving nodes copy an image of the packet if the destination address matches the address of the node. The packet rapidly propagates through the bus, where it is then "terminated" at the two ends of the bus. As you may have surmised, packets traveling along this bus may interfere with each other if the nodes relay the packets onto the bus at about the same time. The bus topology handles this situation with a collision detection procedure. A node keeps sending until it detects its transmission has occurred without interference (by checking its own transmission).

- **Cellular**—The *cellular* topology is employed in wireless networks, an arrangement shown in Figure 1.1(d). Cellular networks use broadcast protocols; all nodes (cellular phones) are capable of receiving transmissions on a control channel from a central site. A wireless control node (called the base station) uses this common channel to direct a node to lock onto a specific (user) channel for its connection. During the ongoing connection, the cell phone is simultaneously communicating with the base station with the control link and the user link.

The Logical Network

The previous section explained the physical layout of networks, such as the star topology. In explaining how packets of user traffic are moved across these topologies, we have also explained the logical aspects of a network. Again, the logical parts of computer networks entail the invocation of software to "propel" the packets across the physical media and to receive them at the other end.

Unlike the physical network, the logical network is not visible. It uses the physical network for transport of data. We defer describing the details of the logical network here, as it is described extensively in almost every subsequent hour.

Two Varieties of Networks: Local and Wide Area

The topology of a computer network is an important feature of its composition. Another is the geographical composition: the network's coverage. That is to say, how far does it extend? The span of a network—its physical girth—often dictates how it goes about sending, receiving, and otherwise managing data.

By the Way

The Word "Link" Is Used in Two Ways

Often, the word "link" is used to describe a computer network communications channel, such as a satellite link or a cellular telephone link. Other words for link are line and channel. Be aware that the Web use of "link" is different. For the Web, "link" means a connection to something else, such as another web page or another web site.

LANs

A local area network (LAN) is so-named because the nodes are in close proximity to each other, usually within a building or inside a home. In the past, the procedures (protocols) employed to manage a LAN depended on the nodes being close to each other—within a kilometer or so. The older Ethernet bus topology is an example of this distance-limited idea. Another way to describe a LAN is that it is usually a private network. It is owned, operated, and used by a company or an individual, to the exclusion of other companies and individuals.

Also, in the old days (a couple decades ago), a LAN was noted for its "high-speed" capacity. The original Ethernet LAN sent and received data at 10 million bits per second (bps)—a phenomenal transfer rate in those days. Today, this capacity and beyond is enjoyed by both LANs and wide area networks (WANs), discussed next.

Did you Know?

"High-Speed" Networks Are No Faster Than "Low-Speed" Networks

All computer networks operate at the same speed. They send and receive data at roughly 186,000 miles per second. So, what makes those wonderful "broadband" Internet connections seem so "fast"? After all, the transmission speed is limited by the laws of physics. The answer is that computer networks use various methods to represent data on the communications link. For example, the character "U" in my name could possibly be represented by a code of eight bits (binary 0s and 1s). However, for "high-speed" links, data is coded and compressed in such a way that large data streams are represented by far fewer bits. Therefore, a broadband link, operating at millions of bits per second, is using clever coding and compression techniques to put more bits per second onto a communications channel.

The term "speed" to describe (1) a high-capacity system (2) offering fast response times is just fine. Speed in this context describes the rate at which data is transmitted or the measurement of how long it takes for a function to be performed.

WANs

As their name implies, wide area networks (WANs) are geographically scattered. They are usually connected to local networks with a router. This machine relays the packets between computers, which often reside on LANs, as seen in Figure 1.2. Access to a WAN is obtained with a dial-up telephone line or with a broadband link, such as a Digital Subscriber Line (DSL), a cable TV link, or a satellite link. The dial-up option, although widely used, is quite limited in its capacity, perhaps operating at only 56,000bps. In contrast, broadband links transport data in the megabit per second (Mbps) range. Once you've used broadband, you likely won't be happy with dial-up. Downloading a web page on a dial-up line might take several minutes, in contrast to a broadband link, which takes a few seconds.

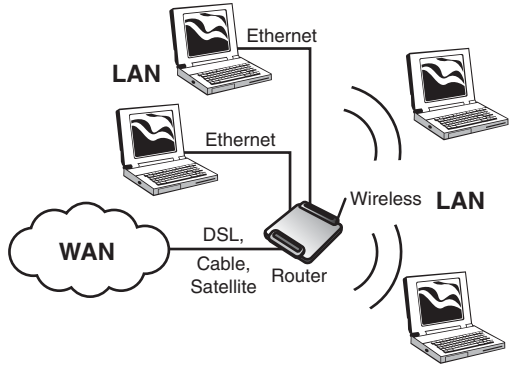

FIGURE 1.2
LANs and WANs

The term "broadband" can be confusing. Strictly speaking, it refers to the frequency spectrum with a broad band of frequencies, but it also describes a network or communications link that sends and receives data at a high bit rate, such as 4,000,000bps. If eight bits are used to comprise a character, such as the letter A, this broadband link can accommodate 1/2 million alphabetic characters per second (4,000,000/8 = 500,000). It's easy to understand why broadband is so popular.

WANs are often public networks. That is, they're available to anyone who wants to use them and pay for their use. The telephone system is a WAN public network facility. So is the Internet. Some WANs are private networks, owned and operated by companies or other enterprises. An example of a private WAN is a bank's ATM network. Typically, the bank leases communications links from a communications carrier, such as AT&T, and then installs its own ATM machines and routers, configuring them for its own unique requirements. As a bank customer, we can use the ATM network, but we can't connect our computers to it. In this regard, it's a private network.

Examples of Network Topologies, LANs, and WANs

Insofar as possible, we've avoided using buzz words to describe network topologies. It might be helpful to associate specific names with these topologies, but you can skip this section if you prefer. Here's a list of common computer networks and their associated topologies; all will be examined in subsequent hours:

- **Star networks**—Switched Ethernet (LAN); Asynchronous Transfer Mode (ATM) (LAN or WAN); Frame Relay (WAN); the Internet (WAN); Synchronous Optical Network (SONET) (WAN)
- **Ring networks**—Token Ring (LAN); IBM Token Ring (LAN); Fiber Distributed Data Interface (FDDI) (LAN); Synchronous Optical Network (SONET) (WAN)
- **Bus networks**—Ethernet Bus (LAN); Token Bus (LAN)
- **Cellular networks**—The cell phone networks (WAN); Bluetooth (LAN); Wi-Fi (LAN)

How the Internet Relates to Your Network

The most widely used data network in the world is the Internet, which is a public WAN. We gain access to it by paying a monthly fee to an Internet service provider (ISP) such as AOL or Verizon. Our interface with the ISP is with a dial-up link or a broadband connection. The ISPs have contractual arrangements with each other for the purpose of exchanging traffic with their respective customers.

The Internet owes its origin to the pioneering endeavors of the U.S. Department of Defense. During the 1960s, the Advanced Research Projects Agency (ARPA) was tasked with creating a government network to facilitate the exchange of information between various agencies and universities. Eventually, the ARPANET evolved to the Internet of today. This extraordinary network consists of millions of connected networks, such as the LAN in your home or office. According to www.internetworldstats.com/stats.htm, 1.5 billion people are now using the Internet (sometimes called the Net for short).

The ISPs manage their respective part of the Internet with routers, servers, and firewalls and play the vital role of informing other networks and providers about their customers. This procedure is elegantly simple. An ISP advertises its customers to the Internet by sending out information. For example, a packet, sent to practically any ISP in the world, states, "Uyless Black can be reached through me." In so doing, the ISP advertises my name (such as UylessBlack.com) and an address to reach me (such as a network ID and an end user ID).

Did you Know?

An Email Address Is Not an Address

When we say, "Send me your email address," we don't mean what we say. Our so-called email address is an email name. One of mine is UylessBlack.com. It is the job of the ISP to correlate this name into a routable address. Chances are you've come across an Internet address. It might appear as 192.99.3.4, for example. Internet addresses are similar in concept to postal addresses (street, city, state, and ZIP code) and are explained in Hour 3, "Getting Data from Here to There: How Networking Works."

Connecting to the Internet

Until a few years ago, the prevalent method for connecting to the Internet was through POTS (plain old telephone services). These dial-up connections are still popular, but they are of limited capacity. Increasingly, Internet users are migrating to broadband services provided by the telephone and cable TV companies, as well as satellite and cellular companies.

Figure 1.3 shows an example of a machine that can connect users' computers to the Internet. It is called by various names because it provides a multitude of services. First, it is a modem. A modem (from modulator/demodulator) provides the physical transmissions for the connection, such as voltages and frequencies. Second, it acts as a firewall; that is, it attempts to block unwelcome visitors from intruding into users' computers and files. Third, it performs the functions of a router. For example, this machine can support several computers' Internet sessions with both remote and local computers. It

"routes" traffic back and forth by examining addresses in each packet. Fourth, it is a wireless (cellular) machine. The antenna and associated components in the machine send and receive traffic within a LAN—in this situation, our home or office.

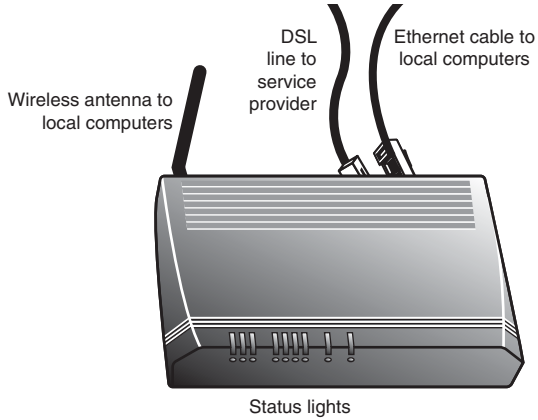

FIGURE 1.3
A router and attached links

Why the Internet Matters

At the risk of stating the obvious, the Internet has transformed the way we do business. Prior to its inception, it was quite difficult to transfer data from one computer to another—unless that computer toed the line and used the same proprietary procedures as the sending machine. For example, IBM marketed its own suite of protocols, as did other vendors. None of them could communicate with each other. The data communications industry was operating in a Tower of Babel. It was suffering from serious compatibility problems, with the resultant loss of productivity.

To their credit, many international organizations had standards used by hardware and software vendors. The modem and fax standards, published by the International Telecommunications Union (ITU), were adapted by all modem and fax manufacturers. But this is not the situation for data communications protocols. For example, the ITU's Open Systems Interconnection (OSI) protocols never caught on. The OSI protocols suffered from unnecessary complexity and from the fact that the standards (the documents) were "owned" by the ITU. But, as discussed in Hour 3, the OSI model itself is still widely used and cited by the industry.

In contrast, the Internet's protocols are designed for simplicity. What's more, they're "open." Anyone can use the Internet specifications without paying a red cent for them. These standards are codified in the Request for Comments (RFCs). They are the Bible of the Internet and the bedrock of data communications networks.

Later we will examine several of the Internet data communications protocols. I suspect you've already come across many of them. Does TCP/IP ring a bell? You may not know, but these communications protocols run in your computer each time you log on to the Internet. We won't get ahead of ourselves but will return to the Internet several times in this book.

Intranets, Extranets, and internets

The Internet (uppercase *I*) is the public network we use to send email and browse the Web. If we use the Internet protocols (such as TCP/IP) in a private network, we have created an internet (notice the lowercase *i*). Some vendors and associated literature use the term intranet to describe a private network that uses the Internet protocols. (Another term is extranet.)

Today, many businesses use the Internet to connect their internets with their customers, suppliers, and business partners. When implemented with proper security measures, Internet-internet associations provide a tremendous value to an organization. They dramatically reduce the costs of "doing" networking. The open, noncopyrighted standards of the Internet have been an extraordinary technical and financial blessing to the data communications industry and to our wired world. The virtual private network, introduced earlier, owes its existence to the Internet.

Summary

In this hour, we've learned about what computer networks are and how they operate. We've also come to know a bit about bits, bandwidth, and bits per second (bps). We've explored network topologies, local and wide area networks, and the Internet and internets.

Q&A

Q. ***What is a computer network?***

A. A computer network is an organized collection of computers linked together for the purpose of exchanging data with each other.

Q. ***What are the different topologies used on computer networks?***

A. The topologies are star, ring, bus, and cellular.

Q. ***Given the information gleaned from the previous question and answer, what is another variety of a computer network?***

A. The composition of a computer network is further distinguished by its geographical situation: local or wide area; and its "openness": private or public.

Q. ***What is the relationship of the Internet to an internet?***

A. The Internet is a public network. An internet is a private network that uses the same procedures (protocols) as the Internet. By using common protocols, internets can readily communicate with each other through the Internet.

Index

Numbers

8mm tape, 346
10BASE-T, 88-89
100BASE-T, 183-184
110 blocks, 207
568B standards (EIA), 89
802.11a standard, 122
802.11b standard, 122
802.11g standard, 123
802.11n standard, 123
1000BASE-T, 184

A

A resource record, 253
AAA resource record, 253
access control, 322-323
access rules, 164
Active Directory, 273-274
adapter cards, installing, 202-206
addresses
destination addresses, 24
email addresses, 14
Ethernet addresses, 40
I/O addresses, 202
IP addresses
configuring network devices with, 259-260
obtaining, 258
overview, 255
subnet masks, 257-258
subnetting, 255-256
network addresses
CIDR, 38-39
IP addresses, 37-38
IPv6 (version 6) addresses, 39
NAT (Network Address Protocol), 39
prefixes, 38
overview, 304
relationship within network, 305

relaying traffic with, 40-42
source addresses, 24
administrators
budgeting, 313-314
education and certification, 311-313
help desk analysts, 310
IT directors, 311
network administrators, 310
daily tasks, 376-378
establishing network policies, 379-380
responsibilities of, 373-376
strategies for supporting users, 378-379
overview, 309
project management, 315-317
responsibilities, 313
support specialists, 310
user support advisors, 310
ADSL (Asymmetric DSL), 102
Advanced Research Projects Agency (ARPA), 14, 232
Advanced Technology Attachment (ATA) disks, 56
advantages of networking, 6-7
centralized configuration management, 26-27
file management, 25
overview, 25
printer sharing, 26
software sharing, 25-26
speed and economy, 27
aero domain name, 250
Allman, Eric, 213
Amazon Web Services (AWS), 385
American National Standards Institute (ANSI), 150
American Registry for Internet Numbers (ARIN), 258
American Standard Code for Information Interchange (ASCII), 20
ANSI (American National Standards Institute), 150
antispam software, 219
antistatic mats, 200
antistatic wrist straps, 200
APIs (application programming interfaces), 30, 62
Apple, 67
AppleTalk, 67
application layer (OSI model), 31
application programming interfaces (APIs), 30, 62
application servers, 163, 297
application-specific integrated circuits (ASICs), 75
applications
CloudMark, 219
contact management, 221-223
email
configuring, 215-217
IMAP4, 214
MIME, 217
open-standards email, 215
overview, 213
POP3, 214
proprietary mail systems, 214-215
SMTP, 214
spam, 218-219
troubleshooting, 217-218
file transfer and FTP, 227-228
groupware, 212-213
Lotus Notes, 224-225
Microsoft Exchange Outlook, 225-227
Novell GroupWise, 223-224
OSs, 211
overview, 211
scheduling and calendars, 219-221
SonicWALL, 219
SpamAssassin, 219
archives, 353
ARIN (American Registry for Internet Numbers), 258
ARM (Asynchronous Transfer Mode), 78
ARPA (Advanced Research Projects Agency), 14, 232
ARPANET, 14, 20, 232
ASCII (American Standard Code for Information Interchange), 20
ASICs (application-specific integrated circuits), 75
assembling networks
adapter cards, 202-206
electrical damage, preventing, 199-200
overview, 176-177, 199
precautions, 200-202
wireless networks, 210
wiring closets, 207-209

assigning permissions, 287
Asymmetric DSL (ADSL), 102
Asynchronous Transfer Mode. *See* ATM
ATA (Advanced Technology Attachment) disks, 56
ATM (Asynchronous Transfer Mode)
cells, 110-111
overview, 44-45, 108-109, 236
permanent virtual circuits, 109-110
QoS (quality of service), 110
attacks, 330
audits, 326-327
authentication, 322
authentication servers, 164, 298
AWS (Amazon Web Services), 385

B

backups
backup media, 346
differential backup, 347
full backup, 347
Grandfather-Father-Son scheme, 347-349
incremental backup, 347
overview, 345
on server-based networks, 165
base 10 numbering system, 50
batch processing, 20
baud, 132
Bayesian filters, 219
BBN (Bolt, Beranek, and Newman), 21
benefits of networking, 6-7
centralized configuration management, 26-27
file management, 25
overview, 25
printer sharing, 26
software sharing, 25-26
speed and economy, 27
best practices
applying, 147-149
benefits of, 144-145
definition of, 143-144
design, 146
implementation, 146
planning, 146
security
monitoring, 152-153
overview, 150-151
secure behaviors, defining, 151-152
usage policies and procedures, 151
standards, 149-150
tuning, 147
BGP (Border Gateway Protocol), 235
bioengineering, 385-387
bits, 50
.biz domain name, 250
Bluetooth, 91, 123-125
Bolt, Beranek, and Newman (BBN), 21
bombs, 322
boot sector viruses, 328
Border Gateway Protocol (BGP), 235
bottlenecks, 196-197
bridges, 9, 182
broadband, 12-13
cable modem, 102-103, 132
definition of, 101
DSL, 101-102
satellite services, 103
broadcast networks, 10
budgeting, 313-314
building networks. *See* assembling networks
bus topology, 10
business impact, assessing, 350-351
bytes, 49

C

CA (certificate authority), 321
cable modem, 102-103
cabling
100BASE-T, 183-184
1000BASE-T, 184
calendars, 219-221
cards
expansion cards, 57-58
NICs (network interface cards), 58-59
PCI (peripheral component interconnect) cards, 58
video adapter cards, 59-60

cases, opening, 201
Category 1 twisted-pair wires, 89
Category 2 twisted-pair wires, 89
Category 3 twisted-pair wires, 89
Category 4 twisted-pair wires, 89
Category 5 twisted-pair wires, 89
Category 5e twisted-pair wires, 89
Category 6 twisted-pair wires, 89
cells, 45, 110-111, 120-121
cellular modems, 132
cellular topology, 10
centralized configuration management, 26-27
certificate authority (CA), 321
certificates, 321
certification, 311-313
channels, 11
CHAP (Challenge Handshake Authentication Protocol), 332
choosing
bridges, 182
hubs, 181
ISPs (Internet service providers), 237
network architecture
client/server networking, 185-187
peer-to-peer networking, 187-188
NOSs (network operating systems)
Linux, 195-196
Microsoft Windows Server, 194-195
Novell NetWare, 192-194
UNIX, 195-196
protocols, 197
routers, 182
server hardware, 180-181
switches, 182
WAPs (wireless access points), 182
CIDR (Classless Inter-Domain Routing), 37-39
ciphertext, 320
circuit switching, 21
Cisco Career Certifications, 312
Class A addresses, 37
Class B addresses, 37
Class C addresses, 37
Class D addresses, 38
Classless Inter-Domain Routing (CIDR), 37-39
cleartext, 320
Clearwire, 384
client/server model
clients
adding to domains, 279-280
configuring for Microsoft Windows Server, 279
licensing, 343-345
overview, 79, 185-187
servers
fault tolerance, 81-82
high availability, 81-82
overview, 80
RAID (redundant arrays of inexpensive disks), 80-81
SOSs (server operating systems), 83-87
CloudMark, 219
clouds, 385-386
CNAME resource record, 254
coaxial cable, 90
color depth, 60
.com domain name, 249
commands
nslookup, 371
ping, 367-368
traceroute, 370-371
communication servers, 163, 297
communications protocols
ATM (Asynchronous Transfer Mode), 44-45, 78
BGP (Border Gateway Protocol), 235
CHAP (Challenge Handshake Authentication Protocol), 332
choosing, 197
CIDR (Classless Inter-Domain Routing), 38-39
definition of, 5
DHCP (Dynamic Host Configuration Protocol)
client configuration, 262-263
deploying, 263-264
overview, 261-262
DNS (Domain Name System)
deploying, 254-255
how it works, 251-252
namespaces, 248-250
obtaining domain names, 252-253
overview, 247-248

root name servers, 250
RRs (resource records), 253-254
DNSSEC (DNS Security Protocol), 334
Ethernet, 42-43
FTP (File Transfer Protocol), 227-228, 369-370
HTTP (Hypertext Transfer Protocol), 266-267
IMAP4 (Internet Message Access Protocol), 214
IP (Internet Protocol)
addresses, 37-38, 43-44, 242-243
configuring network devices with, 259-260
obtaining, 258
overview, 255
subnet masks, 257-258
subnetting, 255-256
IPSec (Internet Security Protocol), 334
IPv6, 39
IPX (Internetwork Packet Exchange), 45-46
L2TP (Layer 2 Tunneling Protocol), 135-136
LMP (Link Manager Protocol), 124
MPLS (Multiprotocol Label Switching), 111-112
NAT (Network Address Protocol), 39
NetBEUI (Network BIOS Extended User Interface), 46
NetBIOS (Network Basic Input/Output System), 46
OSI model
development of, 30
illustration, 31
Layer 1 (physical), 35
Layer 2 (data link), 33-34
Layer 3 (network), 33
Layer 4 (transport), 32
Layer 5 (session), 32
Layer 6 (presentation), 32
Layer 7 (application), 31
overview, 30-31
relationship between layers, 34-35
overview, 29-30, 42
PAP (Password Authentication Protocol), 332
POP3 (Post Office Protocol 3), 214
PPP (Point-to-Point Protocol), 133-135
PPTP (Point-to-Point Tunneling Protocol), 333
protocol converters, 5
RADIUS (Remote Authentication Dial In User Service), 332-333
SMTP (Simple Mail Transfer Protocol), 214
SNMP (Simple Network Management Protocol), 356
SSH (Secure Shell), 333
SSL (Secure Sockets Layer), 333
SSTP (Secure Socket Tunneling Protocol), 333
TCP (Transmission Control Protocol), 243-244
TCP/IP, 238-240
UDP (User Datagram Protocol), 244
VoIP (Voice over IP), 102
WEP (Wired Equivalent Privacy), 336
WINS (Windows Internet Naming Service), 260
WPA (Wi-Fi Protected Access), 336
computer hardware, 50
computing environment vulnerabilities, assessing, 351
computing infrastructure, defining, 350
concentrators, 208
configuring
configuration management, 26-27, 166
DHCP (Dynamic Host Configuration Protocol), 262-263
email, 215-217
IP addresses, 259-260
Microsoft Windows Server 2003
domain client configuration, 279-280
protocol configuration, 280-282
server configuration, 276-278
Window client configuration, 279
network services on Linux server, 293-294

connecting to Internet, 14-15
BGP, 235
DHCP (Dynamic Host Configuration Protocol), 261-264
DNS. See DNS (Domain Name System), 247
IP (Internet Protocol), 242-243
IP addresses. See IP addresses
overview, 255
ISPs (Internet service providers), 233-234, 237
IXPs (Internet Exchange Points), 234-235
peering, 236-237
ports, 240-241
sockets, 241-242
TCP (Transmission Control Protocol), 243-244
TCP/IP, 238-240
UDP (User Datagram Protocol), 244
contact management, 221-223
cooperative multitasking, 63
copper wire, 88-89
CPUs, 52-53

D

DAT (digital audio tape), 346
data communications equipment (DCE), 60
data link layer (OSI model), 33-34
data terminal equipment (DTE), 60
datagrams, 44
DCE (data communications equipment), 60
decryption, 320
deployment
DHCP (Dynamic Host Configuration Protocol), 263-264
DNS (Domain Name System), 254-255
design
definition of, 146
logical network diagrams, 167-171
network needs, determining, 156-159
overview, 155-156
peer-to-peer networks, 161-162
physical network diagrams, 171-174
server-based networks, 163-164
application servers, 163
authentication servers, 164
backups, 165
communication servers, 163
configuration management, 166
file servers, 163-165
mail servers, 164
print servers, 163
web servers, 164
specification documents
reviewing with users, 176
writing, 174-175
topologies, 166-167
user needs, determining, 159-161
destination addresses, 24
device drivers, 68
DHCP (Dynamic Host Configuration Protocol)
client configuration, 262-263
deploying, 263-264
overview, 261-262
servers, 297
diagrams
logical network diagrams, 167-171
physical network diagrams, 171-174
Diamond, David, 87
differential backup, 347
digital audio tape (DAT), 346
digital signatures, 321
digital subscriber line (DSL), 101-102
DIMMs (Dual Inline Memory Modules), 54
direct sequence spread spectrum (DSSS), 122
disaster recovery planning
assessing business impact, 350-351
assessing computing environment vulnerabilities, 351
defining computing infrastructure, 350

developing plan, 351-353
overview, 349-350
disks, 55-56, 181
DLTtape, 346
DNS (Domain Name System)
deploying, 254-255
DNSSEC (DNS Security Protocol), 334
how it works, 251-252
namespaces, 248-250
obtaining domain names, 252-253
overview, 247-248
root name servers, 250
RRs (resource records), 253-254
servers, 297
DNSSEC (DNS Security Protocol), 334
Domain Name System. *See* DNS
domains, 272. *See also* DNS (Domain Name System)
adding clients to, 279-280
DNS (Domain Name System)
deploying, 254-255
how it works, 251-252
namespaces, 248-250
obtaining domain names, 252-253
overview, 247-248
root name servers, 250
RRs (resource records), 253-254
names
list of, 249-250
obtaining, 252-253
DOS, 66
DSL (digital subscriber line), 101-102
DSSS (direct sequence spread spectrum), 122
DTE (data terminal equipment), 60
Dual Inline Memory Modules (DIMMs), 54
Dynamic Host Configuration Protocol. *See* DHCP
dynamic ports, 240

E

economy of networking, 27
edu domain name, 249
education and certification, 311-313
EIA (Electronic Industries Association), 56, 60, 89, 150
electrical damage, preventing, 199-200
Electronic Industries Association (EIA), 56, 60, 89, 150
email
addresses, 14
configuring, 215-217
IMAP4, 214
MIME, 217
open-standards email, 215
overview, 213
POP3, 214
proprietary mail systems, 214-215
SMTP, 214
spam, 218-219
troubleshooting, 217-218
EMTA (Embedded Multimedia Terminal Adapter), 102
encryption
private key, 320
public key, 320-321
error checks, 24
Ethernet, 42-43
addresses, 40
headers, 36
network hardware selection, 182-183
100BASE-T, 183-184
1000BASE-T, 184
Gigabit Ethernet, 184
Megabit Ethernet, 184
EtherType, 36
evaluating
bridges, 182
hubs, 181
ISPs (Internet service providers), 237
network architecture
client/server networking, 185-187
peer-to-peer networking, 187-188
NOSs (network operating systems)
Linux, 195-196
Microsoft Windows Server, 194-195
Novell NetWare, 192-194
UNIX, 195-196
routers, 182

server hardware, 180-181
switches, 182
WAPs (wireless access points), 182
event logs, 364-366
expansion cards, 57-58
external attacks, 330
extranets, 16

F

fault tolerance, 81-82
FDDI (Fiber Distributed Data Interface), 43
FHSS (frequency hopping spread spectrum), 122
Fiber Distributed Data Interface (FDDI), 43
file servers, 163-165, 297
File Transfer Protocol (FTP), 227-228, 369-370
files
file management, 25
file viruses, 329
sharing on Linux networks, 295-296
in UNIX, 291
filtering packets, 331
firewalls, 14
overview, 330-331
packet filtering, 331
Windows Firewall settings, 331-332
FireWire, 62
firmware, 50
FLOPS (floating point operations per second), 73
folders, sharing on Microsoft Windows Server 2003, 282-285
forwarding, 77-78
fragmentation, 44
frame relay, 111
frames, 34-35
frequency hopping spread spectrum (FHSS), 122
frequency interference between W-Fi and Bluetooth, 125
FTP (File Transfer Protocol), 227-228, 369-370
full backup, 347
function calls, 30
future of Microsoft Windows Server, 286-287
future of networking
bioengineering, 385-387
clouds, 385-386
growth of Linux, 383-384
WiMax, 384

G

Gigabit Ethernet, 184
.gov domain name, 249
Grandfather-Father-Son scheme, 347-349
groupware, 25, 212-213
GroupWise (Novell), 223-224

H

Habraken, Joe, 287
hard drives, 361-362
hardware
adapter cards, 202-206
ASICs (application-specific integrated circuits), 75
bridges, 182
CPUs, 52-53, 358-361
definition of, 50
disks, 55-56, 181
for Ethernet networks, 182-183
100BASE-T, 183-184
1000BASE-T, 184
Gigabit Ethernet, 184
Megabit Ethernet, 184
expansion cards, 57-58
FireWire, 62
hard drives, 361-362
hubs, 181
memory, 53-55
motherboards, 52-53
NICs (network interface cards), 58-59
overview, 51, 179
PCI (peripheral component interconnect) cards, 58
remote access hardware, 138-140
routers
capabilities of, 78
choosing, 182
definition of, 74-75
forwarding, 77-78

routing, 75-76
troubleshooting, 356-357
server hardware, 180, 357-358
speed, 73
SSDs (solid state drives), 56-57
switches, 182
upgrades, 340-341
USB (universal serial bus), 60-62
video adapter cards, 59-60
WAPs (wireless access points), 182
Hayes Communication Smartmodem, 131
help desk analysts, 310
hierarchical file system in UNIX, 292
high availability, 81-82
history
of Internet, 231-233
of networking
ARPAnet, 20
circuit switching, 21
mobile wireless networking, 119-120
overview, 19-21
packet switching, 21-24
Telnet, 129-130
of UNIX, 289-290
HTML (Hypertext Markup Language), 265-266
HTTP (Hypertext Transfer Protocol), 266-267
hubs, 9, 181, 208
HughesNet, 103
hybrid networks, 118
Hypertext Markup Language (HTML), 265-266
Hypertext Transfer Protocol (HTTP), 266-267

I

I/O addresses, 202
IANA (Internet Assigned Numbers Authority), 240, 258
IDE (Integrated Drive Electronics) disks, 56
IEEE (Institute of Electronic and Electrical Engineers), 150
IETF (Internet Engineering Task Force), 36, 149, 215
IMAP4, 214
implementation
definition of, 146
mobile wireless networks, 126-127
IMPs (Interface Message Processors), 21, 232
incremental backup, 347
.info domain name, 250
information technology (IT) jobs, 310-311
education and certification, 311-313
help desk analysts, 310
IT directors, 311
network administrators, 310
daily tasks, 376-378
establishing network policies, 379-380
responsibilities of, 373-376
strategies for supporting users, 378-379
support specialists, 310
user support advisors, 310
inheritance, 164
INI (inner-network interface), 99
installing
adapter cards, 202-206
Microsoft Windows Server 2003, 274-276
Institute of Electronic and Electrical Engineers (IEEE), 150
Integrated Drive Electronics (IDE) disks, 56
integrity, 322
Intel-compatible IRQ settings, 203
Interface Message Processors (IMPs), 21, 232
interfaces, 99-101, 306
International Organization for Standardization (ISO), 30, 150
International Telecommunications Union (ITU), 15, 24, 30, 150
Internet
compared to intranets, 16
connections, 14-15
BGP (Border Gateway Protocol), 235
choosing, 237
DHCP (Dynamic Host Configuration Protocol), 261-264
DNS. *See* DNS (Domain Name System)

IP (Internet Protocol), 242-243
ISPs (Internet service providers), 233-234, 237
IXPs (Internet Exchange Points), 234-235
peering, 236-237
ports, 240-241
sockets, 241-242
TCP (Transmission Control Protocol), 243-244
TCP/IP, 238-240
UDP (User Datagram Protocol), 244
history of, 231-233
importance of, 15-16
IP addresses
configuring network devices with, 259-260
obtaining, 258
overview, 255
subnet masks, 257-258
subnetting, 255-256
names
overview, 304
relationship within network, 305
network components' position in layers, 302-304
overview, 13-14, 36, 301-302

Internet Assigned Numbers Authority (IANA), 240, 258

Internet Engineering Task Force (IETF), 36, 149, 215

Internet Exchange Points (IXPs), 234-235

Internet Message Access Protocol 4 (IMAP4), 214

Internet Protocol. *See* IP addresses

Internet Security Protocol (IPSec), 334

Internet service providers (ISPs), 13, 233-234, 237

internets, 16

interoperability of UNIX, 292

intranets, 16

IP (Internet Protocol) addresses, 37-38, 43-44, 242-243
configuring network devices with, 259-260
obtaining, 258
overview, 255
subnet masks, 257-258
subnetting, 255-256

IPSec (Internet Security Protocol), 334

IPv6 addresses, 39

IPX (Internetwork Packet Exchange), 45-46

IRQ settings, 203

ISO (International Organization for Standardization), 30, 150

ISPs (Internet service providers), 13, 233-234, 237

IT (information technology) jobs
education and certification, 311-313
help desk analysts, 310
IT directors, 311
network administrators, 310
daily tasks, 376-378
establishing network policies, 379-380
responsibilities of, 373-376
strategies for supporting users, 378-379
support specialists, 310
user support advisors, 310

ITU (International Telecommunications Union), 15, 24, 30, 150

IXPs (Internet Exchange Points), 234-235

J-K-L

Jobs, Steve, 67

jump blocks, 205

***Just for Fun: The Story of an Accidental Revolutionary* (Torvalds and Diamond), 87**

kernels (UNIX), 86

killer apps, 26

L

L2TP (Layer 2 Tunneling Protocol), 135-136
LAC (L2TP Access Concentrator), 135
LNS (L2TP Network Server), 136

labels (ATM), 108

LAC (L2TP Access Concentrator), 135

LANs (local area networks)
examples, 13
overview, 11-12
WLANs (wireless LANs), 118
Layer 2 (Ethernet) addresses, 40
Layer 2 Tunneling Protocol (L2TP), 135-136
Layer 3 addresses, 37
layers
of Internet model
network components' position in layers, 302-304
overview, 301-302
of OSI model
Layer 1 (physical), 35
Layer 2 (data link), 33-34
Layer 3 (network), 33
Layer 4 (transport), 32
Layer 5 (session), 32
Layer 6 (presentation), 32
Layer 7 (application), 31
relationship between layers, 34-35
leased lines, 106
levels (RAID)
RAID 0, 80
RAID 1, 80
RAID 5, 81
RAID 6, 81
library calls, 30
licensing, 343
Microsoft Windows Server 2003 licensing, 344
Microsoft Windows Server 2008 licensing, 344-345
Licklider, J. C. R., 232
Link Manager Protocol (LMP), 124
links, 11
LINUX, 67-68, 86-87, 188, 195-196
Linux
file sharing, 295-296
growth of, 383-384
as network platform, 292-293
network service configuration, 293-294
upgrading, 296
LMP (Link Manager Protocol), 124
LNS (L2TP Network Server), 136
local area networks. *See* LANs
LocalTalk, 67
logical network, 8, 11, 29, 167-171
diagrams, 167-171
structure, 272-274
logons, auditing, 326-327
logs, event, 364-366
Lotus Notes, 224-225

M

MAC (Media Access Control) addresses, 40
Macintosh OS X, 66-67, 189
macro viruses, 329
MacTCP, 67
MAE-East, 236
magnetism, disks and, 55
mail servers, 164
Management Information Bases (MIBs), 355-356
MCP (Microsoft Certified Professional), 312
media
Bluetooth, 91
coaxial cable, 90
copper wire, 88-89
optical fiber, 90
overview, 88
Wi-Fi, 91
Media Access Control (MAC) addresses, 40
Megabit Ethernet, 184
memory, 54
DIMMs (Dual Inline Memory Modules), 54
RAM (random access memory), 53-55
SIMMs (Single Inline Memory Modules), 54
troubleshooting, 363-364
MIBs (Management Information Bases), 355-356
microprocessors, 52-53
Microsoft Certified Professional (MCP), 312
Microsoft Exchange Outlook, 225-227
Microsoft Windows, 188-190, 192
Microsoft Windows NT Server 4.0, 272

Microsoft Windows Server 2003, 84-85, 194-195
domain client configuration, 279-280
folder sharing, 282-285
future of, 286
installing, 274-276
licensing, 344
logical network structure, 272-274
managing, 285-286
overview, 271
printers sharing, 282-285
protocol configuration, 280-282
server configuration, 276-278
Window client configuration, 279
Microsoft Windows Server 2008, 85, 287, 344-345
MIME (Multipurpose Internet Mail Extensions), 217
Minix, 86
mobile wireless networking
Bluetooth, 123-125
cell concept, 120-121
history of, 119-120
hybrid networks, 118
implementing, 126-127
overview, 117-119
security, 125-126
signal interference, 118
Wi-Fi
802.11a standard, 122
802.11b standard, 122
802.11g standard, 123
802.11n standard, 123
DSSS (direct sequence spread spectrum), 122
FHSS (frequency hopping spread spectrum), 122
frequency interference between W-Fi and Bluetooth, 125
WLANs (wireless LANs), 118
modems, 14
broadband modems, 132
cable modem, 102-103
cellular modems, 132
modulation/demodulation process, 131
proprietary modems, 131
V-Series modems, 131
modulation/demodulation process, 131
monitoring, 152-153, 357-358
motherboards, 52-53
MPLS, 111-112
MS-DOS, 66
multicasting, 38
multipartite viruses, 329
multiple-user computers, 160-161
multiplexing, 24
multiprocessing systems, 63
multitasking, 63
multiuser systems, 63
MX resource record, 254

N

name servers, 267
names
domain names
list of, 249-250
obtaining, 252-253
overview, 304
relationship within network, 305
usernames, 323
WINS (Windows Internet Naming Service), 260
namespaces, 248-250
NAT (Network Address Protocol), 39
needs, determining
of network, 156-159
of users, 159-161
.net domain name, 249
NetBEUI (Network BIOS Extended User Interface), 46
NetBIOS (Network Basic Input/Output System), 46
NetWare (Novell), 83-84, 192-194
Network Address Protocol (NAT), 39
network addresses
CIDR, 38-39
IP addresses, 37-38
IPv6 (version 6) addresses, 39
NAT (Network Address Protocol), 39
prefixes, 38

network administrators
budgeting, 313-314
daily tasks, 376-378
education and certification, 311-313
establishing network policies, 379-380
help desk analysts, 310
IT directors, 311
network administrators, 310
daily tasks, 376-378
establishing network policies, 379-380
responsibilities of, 373-376
strategies for supporting users, 378-379
overview, 309-310
project management, 315-317
responsibilities, 313, 373-376
strategies for supporting users, 378-379
support specialists, 310
user support advisors, 310
network architecture
client/server. *See* client/server model
Internet model
network components' position in layers, 302-304
overview, 301-302
logical network, 8, 11
media
Bluetooth, 91
coaxial cable, 90
copper wire, 88-89
optical fiber, 90
overview, 88
Wi-Fi, 91
overview, 71
peer-to-peer networks
Linux, 188
Macintosh OS X, 189
Microsoft Windows OS, 188-192
when to use, 187-188
physical network, 8-9
bus topology, 10
cellular topology, 10
ring topology, 10
star topology, 9
position of components in layers, 302-304
protocols, 78
routers
capabilities of, 78
definition of, 74-75
forwarding, 77-78
routing, 75-76
speed
definition of, 72
factors contributing to, 72-73
hardware considerations, 73
software considerations, 73-74
network assembly, 199
Network Basic Input/Output System (NetBIOS), 46
Network BIOS Extended User Interface (NetBEUI), 46
network design, 155
network interface cards (NICs), 58-59, 202-206
network layer (OSI model), 33
network management
archives, 353
backups
backup media, 346
differential backup, 347
full backup, 347
Grandfather-Father-Son scheme, 347-349
incremental backup, 347
overview, 345
client licensing, 343
Microsoft Windows Server 2003 licensing, 344
Microsoft Windows Server 2008 licensing, 344-345
disaster recovery planning
assessing business impact, 350-351
assessing computing environment vulnerabilities, 351
defining computing infrastructure, 350
developing plan, 351-353
overview, 349-350
hardware upgrades, 340-341
network upgrades, 339-340
overview, 339
software upgrades, 341-343

network needs, determining, 156-159
network-network interface (NNI), 99
network operating systems. *See* NOSs
network policies, establishing, 379-380
network requirements, 5-6
network services, configuring on Linux server, 293-294
network upgrades, 339-340
networking definition, 4
NICs (network interface cards), 58-59, 202-206
NNI (network-network interface), 99
No Access, 164
nodes, 10
nonrepudiation, 322
NOSs (network operating systems)
client licensing, 343
Microsoft Windows Server 2003 licensing, 344
Microsoft Windows Server 2008 licensing, 344-345
Linux, 195-196
Microsoft Windows Server, 194-195
Novell NetWare, 192-194
UNIX, 195-196
Novell GroupWise, 223-224
Novell NetWare, 83-84, 192-194
NS resource record, 254
nslookup command, 371
number terminology, 49-50

O

open-standards email, 215
Open Systems Interconnection (OSI) protocols, 15
opening computer cases, 201
operating systems (OSs)
device drivers, 68
Linux, 67-68, 86-87, 188, 195-196
file sharing, 295-296
growth of, 383-384
as network platform, 292-293
network service configuration, 293-294
upgrading, 296
Macintosh OS X, 66-67, 189
Microsoft Windows, 189-192
Microsoft Windows Server, 194-195
Microsoft Windows Server 2003, 84-85
Microsoft Windows Server 2008, 85
multitasking, 63
NOSs (network operating systems), 192-196
Novell NetWare, 83-84, 192-194
overview, 62-65, 83
SOSs (server operating systems), 83-87
startup process, 63-65
UNIX, 67-68, 85-86, 195-196
files, 291
hierarchical file system, 292
history and development, 289-290
interoperability, 292
as network platform, 292-293
redirection, 291
Windows and Vista, 66
optical fiber, 90
.org domain name, 249
OSI (Open Systems Interconnection) model, 15
development of, 30
illustration, 31
Layer 1 (physical), 35
Layer 2 (data link), 33-34
Layer 3 (network), 33
Layer 4 (transport), 32
Layer 5 (session), 32
Layer 6 (presentation), 32
Layer 7 (application), 31
overview, 30-31
relationship between layers, 34-35
OSs. *See* operating systems
Outlook, 225-227

P

packets, 10, 44
frames, 34-35
identifying type of, 36
packet filtering, 331
packet switching, 21-24

paging, 74
Palo Alto Research Center (PARC), 67
PAP (Password Authentication Protocol), 332
PARC (Palo Alto Research Center), 67
passwords, 324-325
patch cords, 208
payloads, 104
PCI (peripheral component interconnect) cards, 58
PDU (protocol data unit), 36, 110-111
peer-to-peer networks, 161-162
  OS (operating system) software
    Linux, 188
    Macintosh OS X, 189
    Microsoft Windows, 188-192
  when to use, 187-188
peering, 235-237
peripheral component interconnect (PCI) cards, 58
permanent virtual circuits, 109-110
permissions, 287, 327-328
physical layer (OSI model), 35
physical network, 8-9, 29
  bus topology, 10
  cellular topology, 10
  physical network diagrams, 171-174
  ring topology, 10
  star topology, 9
ping command, 367-368
planning networks
  best practices
    applying, 147-149
    benefits of, 144-145
    definition of, 143-144
    design, 146
    implementation, 146
    planning, 146
    tuning, 147
  disaster recovery planning
    assessing business impact, 350-351
    assessing computing environment vulnerabilities, 351
    defining computing infrastructure, 350
    developing plan, 351-353
    overview, 349-350
  overview, 143
  security
    monitoring, 152-153
    overview, 150-151
    secure behaviors, defining, 151-152
    usage policies and procedures, 151
  standards, 149-150
Point-to-Point Protocol (PPP), 133-135
Point-to-Point Tunneling Protocol (PPTP), 333
policies
  establishing, 379-380
  usage policies and procedures, 151
POP3, 214
ports, 240-241
Post Office Protocol 3 (POP3), 214
PPP (Point-to-Point Protocol), 133-135
PPTP (Point-to-Point Tunneling Protocol), 333
preemptive multitasking, 63
prefixes, 38
presentation layer (OSI model), 32
print servers, 163, 297
printers, sharing, 26, 282-285
privacy, 322
private addresses, 38
private key encryption, 320
private ports, 240
.pro domain name, 250
processors, 52-53
  troubleshooting, 358-361
project management, 315-317
proprietary mail systems, 214-215
proprietary modems, 131
protocol converters, 5
protocol data unit (PDU), 36
protocols. *See* communications protocols
provisioning T1 trunks, 106
PTR resource record, 254
public key encryption, 320-321

Q-R

QoS (quality of service), 110

RADIUS (Remote Authentication Dial-In Service), 136, 332-333

RAID (redundant arrays of inexpensive disks)
- RAID 0, 80
- RAID 1, 80
- RAID 5, 81
- RAID 6, 81

RAM (random access memory), 53-54

read-only memoy (ROM), 50

Read-Write Access, 164

Red Hat Certification Program, 312

redirection in UNIX, 291

redundant arrays of inexpensive disks, 80

regional Internet registries (RIRs), 258

registered ports, 240

relaying traffic with addresses, 40-42

remote access hardware, 138-140

Remote Authentication Dial-In Service (RADIUS), 136, 332-333

remote networking, 131
- history of, 129-130
- L2TP (Layer 2 Tunneling Protocol), 135-136
- overview, 129, 132-133
- PPP (Point-to-Point Protocol), 133-135
- remote access hardware, 138-140
- security, 136
- system administration, 130
- VPNs (virtual private networks), 137-138

replay, 322

Request for Comments (RFCs), 15

residential broadband
- cable modem, 102-103
- definition of, 101
- DSL, 101-102
- satellite services, 103

resource permissions, 327-328

resource records (RRs), 253-254

reviewing specification documents, 176

RFCs (Request for Comments), 15

RIB (routing information base), 75

ring topology, 10

RIRs (regional Internet registries), 258

RJ-45 jacks, 207

ROM (read-only memory), 50

root name servers (DNS), 250

routers, 9
- capabilities of, 78
- choosing, 182
- definition of, 74-75
- forwarding, 77-78
- routing, 75-76
- troubleshooting, 356-357

routing, 75-76
- route aggregation, 39
- route discovery, 75-76
- route filtering, 235
- routing information base (RIB), 75
- routing tables, 75

RRs (resource records), 253-254

S

***Sams Teach Yourself Microsoft Windows Server 2008 in 24 Hours* (Habraken), 287**

SATA (Serial Advanced Technology Attachment), 56

satellite services, 103

scheduling, 219-221

SCP (Sun Certified Professional), 312

secure behaviors, defining, 151-152

Secure Shell (SSH), 333

Secure Socket Tunneling Protocol (SSTP), 333

Secure Sockets Layer (SSL), 333

security
- access control, 322-323
- audits, 326-327
- authentication, 322
- best practices, 336-337
- bombs, 322
- certificates, 321
- CHAP (Challenge Handshake Authentication Protocol), 332
- digital signatures, 321

DNSSEC (DNS Security Protocol), 334
encryption
private key, 320
public key, 320-321
external attacks, 330
file servers, 164-165
firewalls
overview, 330-331
packet filtering, 331
Windows Firewall settings, 331-332
inheritance, 164
integrity, 322
IPSec (Internet Security Protocol), 334
mobile wireless networks, 125-126
monitoring, 152-153
nonrepudiation, 322
overview, 150-151, 319-320
PAP (Password Authentication Protocol), 332
passwords, 324-325
permissions, 287
PPTP (Point-to-Point Tunneling Protocol), 333
privacy, 322
RADIUS (Remote Authentication Dial In User Service), 332-333
remote networking, 136
replay, 322
resource permissions, 327-328
secure behaviors, defining, 151-152
SSH (Secure Shell), 333
SSL (Secure Sockets Layer), 333
SSTP (Secure Socket Tunneling Protocol), 333
Trojan horses, 321
usage policies and procedures, 151
viruses, 321, 328-329
wireless networks, 335-336
worms, 321
sendmail, 213
sequence numbers, 24
Serial Advanced Technology Attachment (SATA), 56
server-based networks
application servers, 163
authentication servers, 164
backups, 165
communication servers, 163
configuration management, 166
file servers, 163-165
mail servers, 164
print servers, 163
web servers, 164
server operating systems (SOSs), 83-87
servers
application servers, 163, 297
authentication servers, 164, 298
choosing, 180-181
communication servers, 163, 297
DHCP servers, 297
DNS servers, 297
fault tolerance, 81-82
file servers, 163-165, 297
high availability, 81-82
Linux. *See* Linux
mail servers, 164
Microsoft Windows NT Server 4.0, 272
Microsoft Windows Server 2003
domain client configuration, 279-280
folder sharing, 282-285
future of, 286
installing, 274-276
logical network structure, 272-274
managing, 285-286
overview, 271
printers sharing, 282-285
protocol configuration, 280-282
server configuration, 276-278
Window client configuration, 279
Microsoft Windows Server 2008, 287
name servers, 267
overview, 80
print servers, 163, 297
RAID (redundant arrays of inexpensive disks), 80-81
server-based networks, 163-164
backups, 165
configuration management, 166

SOSs (server operating systems), 83-87
static IP settings, 259-260
troubleshooting, 357-358
web servers, 164, 297
service set identifier (SSID), 335
session layer (OSI model), 32
sharing
files on Linux networks, 295-296
folders on Microsoft Windows Server 2003, 282-285
printers, 26 on Microsoft Windows Server 2003, 282-285
software, 25-26
***Showstopper* (Zachary), 84**
signal interference, 118
signatures, digital, 321
SIMMs (Single Inline Memory Modules), 54
Simple Mail Transport Protocol (SMTP), 214
Simple Network Management Protocol (SNMP), 356
Single Inline Memory Modules (SIMMs), 54
single-tasking systems, 63
single-user systems, 63
Smartmodem, 131
SMTP (Simple Mail Transfer Protocol), 214
SNMP (Simple Network Management Protocol), 356
SOA resource record, 253
sockets, 241-242, 304-305
software
definition of, 50
device drivers, 68
firmware, 50
groupware, 25
killer apps, 26
OSs (operating systems)
device drivers, 68
LINUX, 67-68
Mac OS, 66-67
multitasking, 63
overview, 62-65
startup process, 63-65
UNIX, 67-68
Windows and Vista, 66
sharing, 25-26
speed, 73-74
upgrades, 341-343
solid state drives (SSDs), 56-57
SONET (Synchronous Optical Network), 90, 103-104, 107-108, 236
***SONET and T1: Architectures for Digital Transport Networks* (Black and Waters), 104**
SonicWALL, 219
SOSs (server operating systems), 83-87
source addresses, 24
spam, 218-219
SpamAssassin, 219
specification documents
reviewing with users, 176
writing, 174-175
speed, 27, 72-74
SSDs (solid state drives), 56-57
SSH (Secure Shell), 333
SSID (service set identifier), 335
SSL (Secure Sockets Layer), 333
SSTP (Secure Socket Tunneling Protocol), 333
standards, 149-150
star topology, 9
startup process, 63-65
static electricity, 199-200
subnet masks, 257-258
subnetting, 255-256
Sun Certified Professional (SCP), 312
support specialists, 310
switches, 9, 182, 208
synchronization, T1, 105
Synchronous Optical Network (SONET), 90, 236
system calls, 62
system logs, 364-366

T

T1, 103-104
leased lines, 106
provisioning trunks, 106
synchronization of signals, 105
T-carrier family, 105-106
uses for T1 lines, 106
tables, routing, 75
TCP (Transmission Control Protocol), 243-244

TCP/IP, 238-240
nslookup command, 371
ping command, 367-368
traceroute command, 370-371
Telnet, 129-130
templates (website), 268-269
threats to security
bombs, 322
external attacks, 330
replay, 322
Trojan horses, 321
viruses, 321, 328-329
worms, 321
time-division multiplexing, 24
Time to Live (TTL), 43, 242
Tocqueville, Alexis de, 19
Token Ring, 43
topologies, 9-10, 166-167
Torvalds, Linus, 86-87
TOS (Type of Service), 43, 242
traceroute command, 370-371
traffic, 10
flow of, 112-113
relaying with addresses, 40-42
Transmission Control Protocol (TCP), 243-244
transport layer (OSI model), 32
Trojan horses, 321
troubleshooting
email, 217-218
hard drive performance, 361-362
memory utilization, 363-364
MIBs (Management Information Bases), 355-356
overview, 355
processor performance, 358-361
routers, 356-357
server hardware, 357-358
SNMP (Simple Network Management Protocol), 356
tools
event logs, 364-366
FTP (File Transfer Protocol), 369-370
nslookup command, 371
ping command, 367-368
traceroute command, 370-371
trusts, 272
TTL (Time to Live), 43, 242
tuning, 147
twisted-pair wires, 88-89
Type of Service (TOS), 43, 242

U

UDP (User Datagram Protocol), 244
Ultra DMA, 56
UNI (user-network interface), 99
universal serial bus (USB), 60-62
UNIX, 67-68, 85-86, 195-196
files, 291
history and development, 289-290
interoperability, 292
as network platform, 292-293
redirection, 291-292
unplugging computers, 200
upgrading
hardware, 340-341
Linux server, 296
networks, 339-340
software, 341-343
usage policies and procedures, 151
USB (universal serial bus), 60-62
User Datagram Protocol (UDP), 244
user-network interface (UNI), 99
user support advisors, 310
users
needs, determining, 159-161
reviewing specification documents with, 176
usernames, 323

V

V-Series modems, 131
video adapter cards, 59-60
virtual circuit/path IDs, 44
virtual private networks (VPNs), 7, 137-138
viruses, 321, 328-329
Vista, 66
VoIP (Voice over IP), 102
VPNs (virtual private networks), 7, 137-138
vulnerabilities, assessing, 351

W-X-Y-Z

WANs (wide area networks)
components
ATM, 108-111
frame relay, 111
MPLS, 111-112
overview, 97-99
SONET, 103-104, 107-108
T1, 103-106
examples, 13, 97
interfaces, 99-101
overview, 12-13, 95-97
residential broadband
cable modem, 102-103
definition of, 101
DSL, 101-102
satellite services, 103
traffic flow, 112-113
WAPs (wireless access points), 182
wardriving, 335
Waters, Sharleen, 104
Web
HTML (Hypertext Markup Language), 265-266
HTTP (Hypertext Transfer Protocol), 266-267
overview, 264-265
websites, 4, 267-269
web servers, 164, 297
well-known ports, 240
WEP, 336
Wi-Fi, 8, 91, 122-123
802.11a standard, 122
802.11b standard, 122
802.11g standard, 123
802.11n standard, 123
DSSS (direct sequence spread spectrum), 122
FHSS (frequency hopping spread spectrum), 122
frequency interference between W-Fi and Bluetooth, 125
Wi-Fi Alliance, 336
wide area networks. *See* WANs
Wikipedia, 4
Wild Blue, 103
WiMax, 384
Windows Internet Naming Service (WINS), 260
Windows, 188-190, 192
Windows Firewall, 331-332
Windows NT Server 4.0, 272
Windows Server 2003, 84-85, 194-195
domain client configuration, 279-280
folder sharing, 282-285
future of, 286
installing, 274-276
licensing, 344
logical network structure, 272-274
managing, 285-286
overview, 271
printers sharing, 282-285
protocol configuration, 280-282
server configuration, 276-278
Window client configuration, 279
Windows Server 2008, 85, 287, 344-345
Windows XP, 66
WINS (Windows Internet Naming Service), 260
wireless access points (WAPs), 182
wireless networking, 8
mobile wireless networking
Bluetooth, 91, 123-125
cell concept, 120-121
history of, 119-120
hybrid networks, 118
implementing, 126-127
overview, 117-119
security, 125-126
signal interference, 118
Wi-Fi, 91, 122-125
WLANs (wireless LANs), 118
network assembly, 210
security, 335-336
WAPs (wireless access points), 182
WiMax, 384
wiring closets, 207-209
WLANs (wireless LANs), 118
worms, 321
WPA, 336
wrist straps, 200
writing specification documents, 174-175

Xerox Network Services (XNS), 45

Zachar, Pascal, 84