



Introduction to Client/Server Networking



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Syngress Media

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■ What Will You Learn?

In this book, you'll learn about client/server networking, in which the various underlying tasks involved in a networked environment are divided among computers that provide services (servers) and computers that consume services (clients). Client/server networking concepts are distinct from peer-to-peer networking concepts, although to some extent the two can co-exist. Generally, very small networks use peer-to-peer networking arrangements, while medium and large networks use client/server arrangement arrangements.

In addition to learning about client/server networking in general, you will learn about the key hardware and software involved in client/server networking, including Windows NT, Windows 2000, Novell NetWare, and Red Hat Linux. Finally, you will learn about some aspects of client/server networking that transcend the specific operating system a network uses, such as network security concepts and practices.

This book is organized into nine chapters:

- Chapter 1, *Designing a Network*, presents client/server and peer-to-peer networking concepts, teaches you about the key theoretical model underpinning networks, and explains the process of designing a network and estimating resource needs.
- Chapter 2, *Networking with Unix and Linux*, covers installing and configuring Red Hat Linux in both a server and a client configuration and also teaches you about the administration and use of Red Hat Linux.
- Chapter 3, *Networking with Novell NetWare 6*, discusses the installation and configuration of Novell NetWare 6, a dedicated network operating system. It also teaches you how to set up a Windows client to access a NetWare 6 server and about basic administration of NetWare 6.
- Chapter 4, *Networking with Windows NT*, gives you an opportunity to plan and perform a Windows NT Server installation. Then you will learn about configuring a network in Windows NT Server and administering a Windows NT Server system.
- Chapter 5, *Networking with Windows 2000*, provides you with a fundamental introduction to preparing to install and installing Windows 2000 Server. Next, you will learn how to administer Windows 2000 Server, share folders across a network, and install network printers. This chapter wraps up by showing you how Windows 2000 Server's built-in backup software works.
- Chapter 6, *Connecting Client Workstations*, covers a myriad of subjects involved in setting up client computers to access servers. On top of

learning about networking Windows-based clients to Windows servers, you will learn different ways of accessing Windows and NetWare servers from a Macintosh, as well as accessing a Linux server from a Windows client computer.

- Chapter 7, *TCP/IP*, introduces the “mother of all Internet protocols,” TCP/IP. The TCP/IP networking protocol is the foundation of how modern networks work, and understanding it in detail will vastly improve your ability to design, install, maintain, and troubleshoot virtually every type of network in the world. In addition to learning about TCP/IP itself, you will learn how TCP/IP packets get routed over complex networks and how to use TCP/IP-oriented commands in Unix or Linux.
- Chapter 8, *Configuring Hard Drives*, teaches you everything you need to know about this most important resource on any network. You will learn how hard drives work, how data is structured on them, and how to maintain and troubleshoot them.
- Chapter 9, *Securing a Network*, teaches you how to approach the subject of network security and is packed with important information to help you understand what many consider to be the most important responsibility of any networking professional: keeping the data stored on the organization’s network safe and secure.

You Will Learn to...

Working in the networking field often requires you to have an extensive and constantly updated encyclopedia of information. Starting out that way would require you to learn networking information at an enormous rate, similar to drinking water by putting your face in front of an opened fire hydrant! Rather, you will find that this book presents just the key points about client/server networking and helps guide you as you continue to explore the specifics of the field. This book is also designed to teach you basic skills that you’ll need in order to be successful as you begin working with client/server networks.

Walk and Talk Like a Pro

Each chapter starts with a list of learning objectives. These are followed by lucid explanations of each topic, supported by real-world scenarios and enhanced by liberal use of graphics and tables. To give you hands-on experience and help you “walk the walk,” you’ll find detailed step-by-step tutorials and short Try This! exercises that enable you to practice the concepts. To help you “talk the talk,” each chapter contains definitions of networking terms, summarized in a Key Terms list. Be ready for a Key Term Quiz at the end of each chapter!

Troubleshoot Like a Pro

While there is a lot of useful information in this book, a single book simply can't give you everything you need to know about client/server networking. In addition to providing you with a solid introduction to the client/server networking field, we give you some of the tools that will help you help yourself, which is a valuable skill whether you're on the job or working at home. For example, we show you how to use help files and perform updates to your new operating systems, and we teach you how to use the Internet to find even more information that will help you with potential troubleshooting problems.

Think Like a Pro

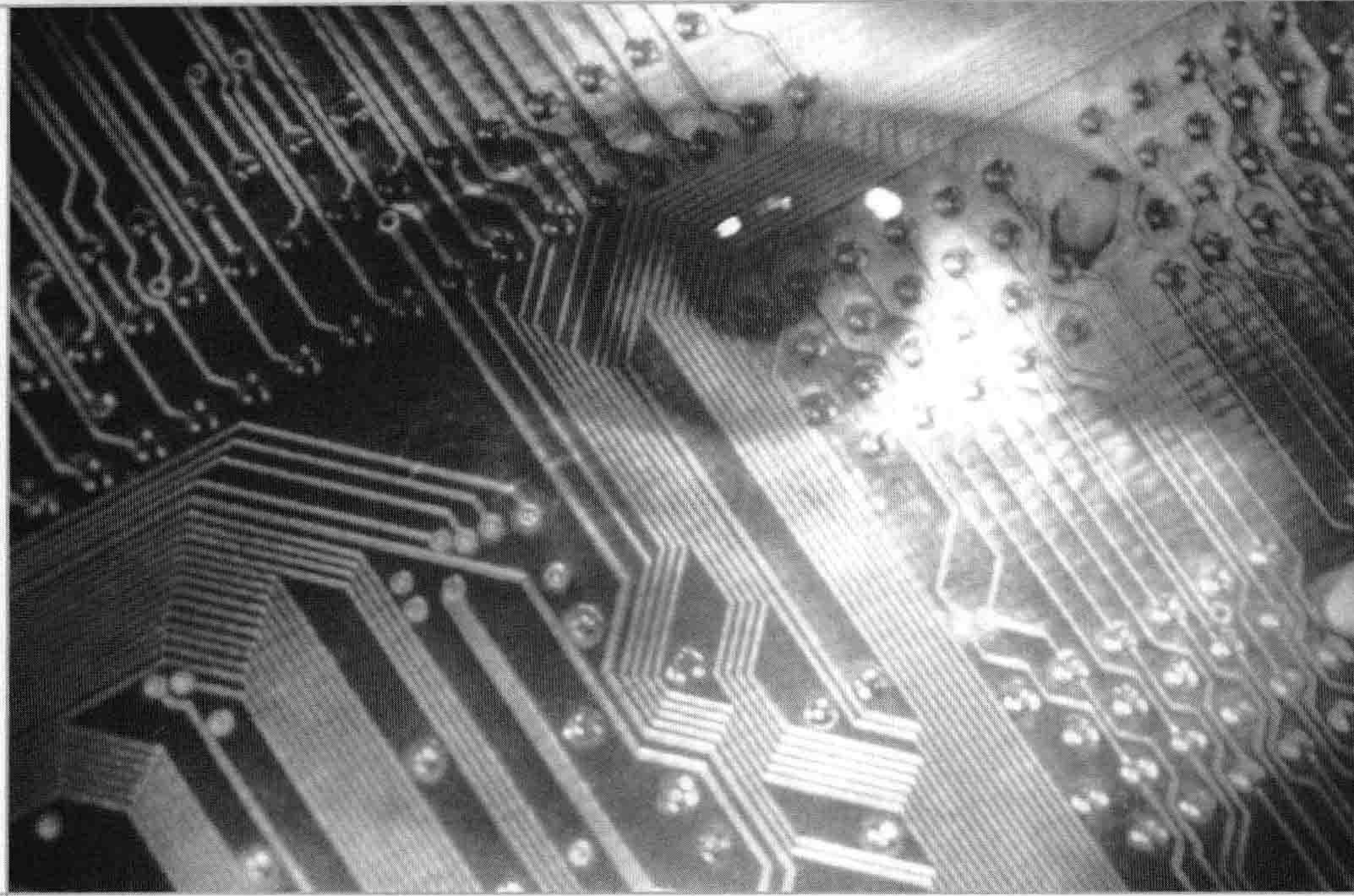
We've also included Inside Information sidebars, which provide insight into some of the subtleties of working with networks. Notes and Tips are sprinkled throughout the chapters, and Warnings help prevent mishaps (or an emotional meltdown). At the end of each chapter, a Key Term Quiz, Multiple-Choice Quiz, and Essay Quiz help you measure what you've learned and hone your ability to present information on paper. The Lab Projects challenge you to independently complete tasks related to what you've just learned.

■ Resources for Teachers

Teachers are our heroes, to whom we give our thanks and for whom we have created a powerful collection of time-saving teaching tools. The following tools are available:

- An Instructor's Manual that maps to the organization of the textbook
- Testbank in Blackboard, which generates a wide array of paper or network-based tests and features automatic grading
- Hundreds of questions, written by experienced IT instructors
- A wide variety of question types and difficulty levels, allowing teachers to customize each test to maximize student progress

Designing a Network



In this chapter, you will learn how to

- **Conceptualize client/server networking and the OSI networking model**
- **Discuss common network features and components**
- **Design a network**
- **Perform a disk space estimation for a new network**

Networking professionals rarely have the opportunity to walk into a company and design a new network from the ground up, but those who do are certainly lucky. While such an effort involves long hours, stress, deadlines, and the nagging worry that maybe they're forgetting something, in return they get to shape the computing environment of a large number of users, and—in many companies—set the tone for how efficiently the company itself can function in coming years.

However, most of the time you will enter a company with a functioning network that has grown organically over time and that has the capability to support a number of different applications, operating systems, hardware platforms, and design decisions woven into its fabric.

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In either scenario, whether designing a new network from the ground up or taking over the evolution of an existing network, you need to have a firm grasp on how to design a network and the factors that go into network design. In this chapter, you learn about the foundations of the knowledge you need to acquire, starting with a discussion of client/server networking, which is followed by a discussion of what services most networks provide for their users, and then moves into a straight-forward approach to designing a network. This should provide you a framework into which you can fit more detailed knowledge of all the aspects that are required in detail, such as how the different operating systems work, how network protocols work, and how security in a network works.

■ Understanding Client/Server Networking

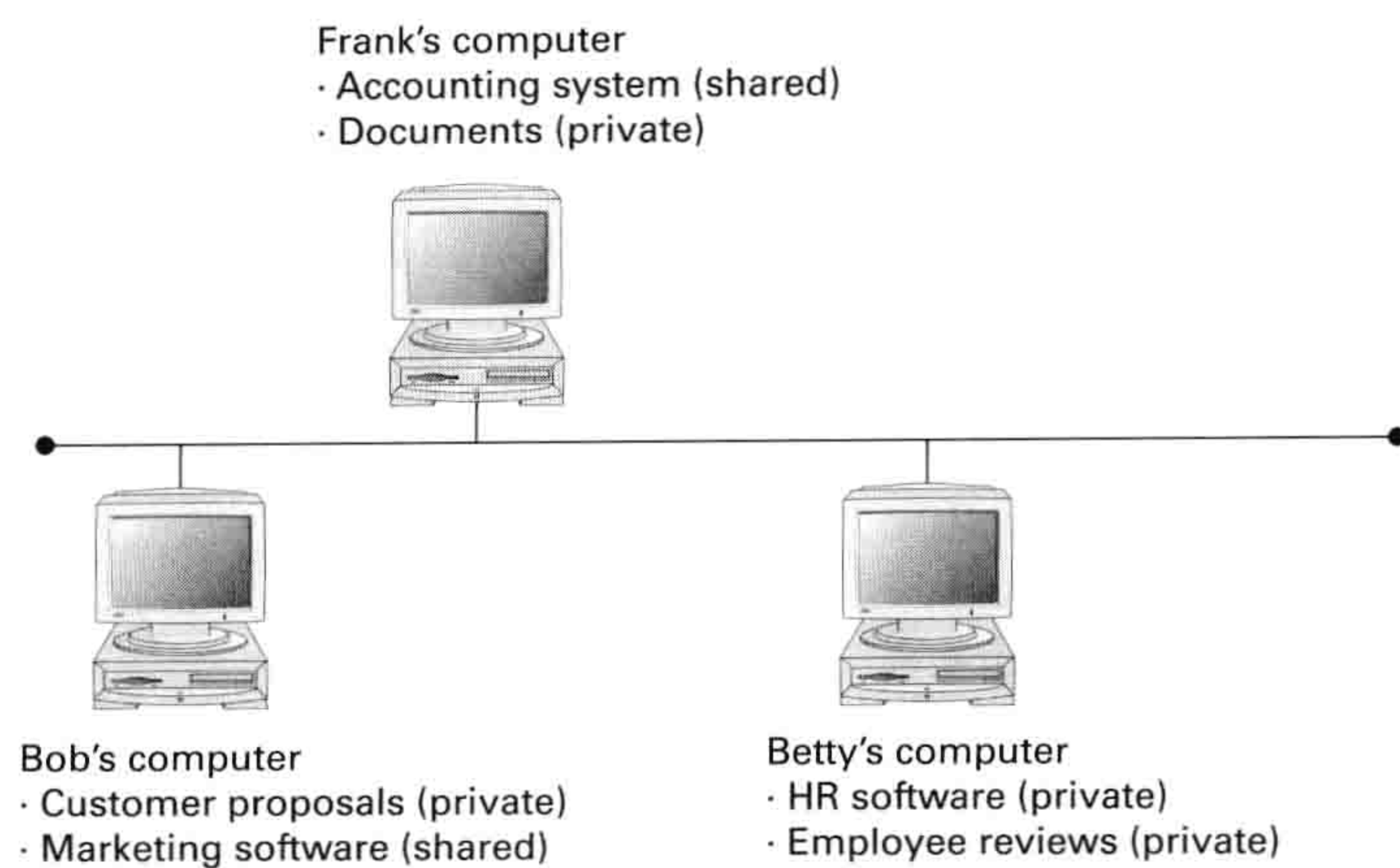
The term **network relationship** refers to two different concepts about how one computer makes use of another computer's resources over the network.

Two fundamental types of network relationships exist: peer-to-peer and client/server. These two types of network relationships (in fact, you could almost refer to them as different *network philosophies*) define the very structure of a network. To understand them better, you might compare them to different business management philosophies. A *peer-to-peer network* is much like a company run by a decentralized management philosophy, where decisions are made locally and resources are managed according to the most immediate needs. A client/server network is more like a company that works on centralized management, where decisions are made in a central location by a relatively small group of people. Circumstances exist where both peer-to-peer and client/server relationships are appropriate (just like different business management philosophies) and many networks have aspects of both types within them.

Both peer-to-peer and client/server networks require that certain network **layers** be common. Both types require a physical network connection between the computers and that the same network protocols be used, and so forth. In this respect, no difference exists between the two types of network relationships. The difference comes in whether you spread the shared network resources around to all the computers on the network or use centralized network servers.

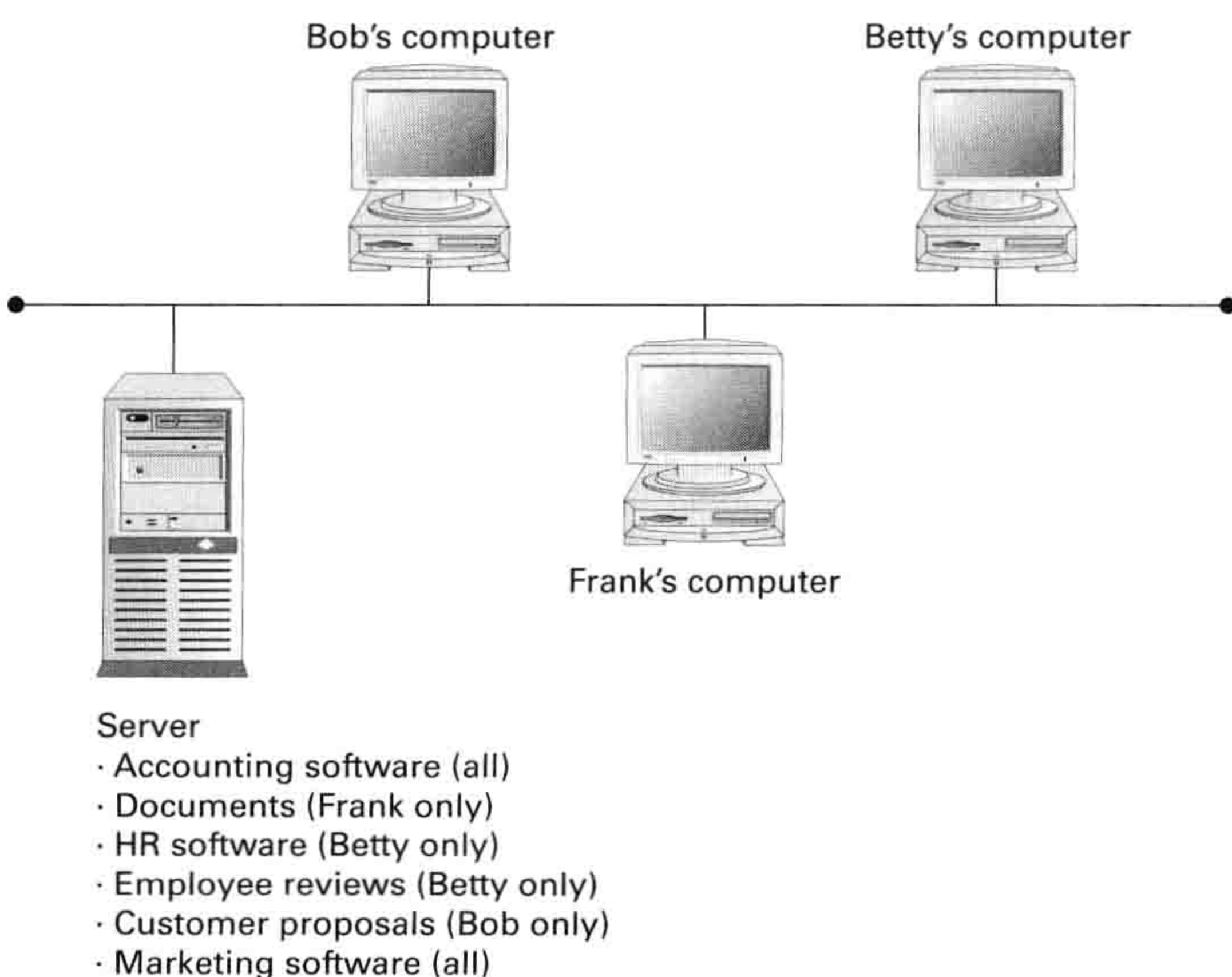
Peer-to-Peer Network Relationships

A **peer-to-peer network relationship** defines one in which computers on the network communicate with each other as equals. Each computer is responsible for making its own resources available to other computers on the network. These resources might be files, directories, application programs, or devices such as printers, modems, or fax cards, or any combination thereof. Each computer is also responsible for setting up and maintaining its own security for those resources. Finally, each computer is responsible for accessing the network resources it needs from other peer-to-peer computers and



• **Figure 1.1** A peer-to-peer network with resources spread across computers

Even in a pure peer-to-peer network, using a dedicated computer for certain frequently accessed resources is possible. For example, you might host the application and data files for an accounting system on a single workstation and not use that computer for typical workstation tasks, such as word processing, so that all the computer's performance is available for the accounting system. The computer is still working in a peer-to-peer fashion; it's just not used for any other purposes.



• **Figure 1.2** A client/server network keeps resources centralized.

for knowing where those resources are and what security is required to access them. Figure 1.1 illustrates how this works.

Client/Server Network Relationships

A **client/server network relationship** is one in which a distinction exists between the computers that make available network resources (the servers) and the computers that use the resources (the *clients*, or *workstations*). A pure client/server network is one in which *all* available network resources—such as files, directories, applications, and shared devices—are centrally managed and hosted, and then are accessed by the client computers. No client computers

share their resources with other client computers or with the servers. Instead, the client computers are pure “consumers” of these resources.

The server computers in a client/server network are responsible for making available and managing appropriate shared resources, and for administering the security of those resources. Figure 1.2 shows how resources would be located in such a network.

Pros for Client/Server Networks

Client/server networks offer the opportunity for centralized administration, using equipment best suited to managing and offering each resource. Client/server networks are the type that you almost always see for networks larger than about ten users, and there are quite a few good reasons for this, as follows:

- **Very secure** A client/server network's security comes from several things. First, because the shared resources are located in a centralized area, they can be administered at that point.

Managing a number of resources is much easier if those resources are all located on one or two server computers, as opposed to having to administer resources across tens or hundreds of computers. Second, usually the servers are physically in a secure location, such as a lockable server closet. **Physical security** is an important aspect of network security, and it cannot be achieved with a peer-to-peer network. Third, the operating systems on which one runs a client/server network are designed to be secure. Provided that good security and administration practices are in place, the servers cannot be easily “hacked.”

- **Better performance** While dedicated server computers are more expensive than standard computer workstations, they also offer

considerably better performance and they are optimized to handle the needs of many users simultaneously. They also tend to be more reliable than standard workstation computers.

- **Centralized backup** Backing up a company's critical data is much easier when it is located on a centralized server. Often, such backup jobs can even be run overnight when the server is not being used and the data is static. Aside from being easier, centralized backups are also much faster than decentralized backups.
- **Very reliable** While it is true more built-in redundancy exists with a peer-to-peer network, it is also true a good client/server network can be more reliable, overall. Dedicated servers often have much more built-in redundancy than standard workstations. They can handle the failure of a disk drive, power supply, or processor, and continue to operate until the failed component can be replaced. Also, because a dedicated server has only one relatively simple job to do, its complexity is reduced and its reliability increased.

Cons for Client/Server Networks

Balancing the pros of client/server networks, you also need to realize that there are drawbacks, particularly for companies that don't have their own in-house network administration, or who want to minimize the expense of the network as much as possible, as follows:

- **Require professional administration** Client/server networks usually need some level of professional administration, even for small networks. You can hire a network administrator or you can use a company that provides professional network administration services, but it's important to remember that professional administration is usually required. Knowing the ins and outs of a network operating system is important and requires experience and training.
- **More hardware-intensive** In addition to the client computers, you also need a server computer; this usually needs to be a pretty "beefy" computer with lots of memory and disk space. Plus, you need a network operating system and an appropriate number of client licenses, which adds at least several thousand dollars to the cost of the server. For large networks, it adds tens of thousands of dollars.

Network Features

Now that you understand the two basic ways computers on a network can interact with each other, understanding the types of things you can do with a network is important. The following sections discuss common network features and capabilities.

File Sharing

Originally, file sharing was the primary reason to have a network. In fact, small and mid-size companies in the mid-1980s usually installed networks



Don't confuse client/server networks with client/server database systems. While the two mean essentially the same thing (conceptually), a client/server database is one where the processing of the database application is divided between the database server and the database clients. The server is responsible for responding to data requests from the clients and supplying them with the appropriate data, while the clients are responsible for formatting, displaying, and printing that data for the user. For example, Novell NetWare or Windows 2000 Server are both client/server **network operating systems (NOSs)**, while Oracle's database or Microsoft's SQL Server are client/server database systems.



In a nutshell, choose a peer-to-peer network for smaller networks with fewer than 10–15 users, and choose a client/server network for anything larger. Because most networks are built on a client/server concept, most of this book assumes such a network.

just so they could perform this function. Often, this was driven by the need to computerize their accounting systems. Of course, when the networks were in place, sharing other types of files becomes easier as well, such as word processing files, spreadsheets, or other types of files to which many people need regular access.

File sharing requires a shared **directory** or **disk drive** to which many users can access over the network, along with the logic needed to make sure more than one person doesn't make different conflicting changes to a file at the same time (called *file locking*). The reason you don't want more than one person making changes to a file at the same time is that they might both be making *conflicting* changes simultaneously, without either person realizing the problem. Most software programs don't have the ability to allow multiple changes to a single file at the same time and to resolve problems that might arise. (The exception to this rule is that most database programs allow multiple users to access a database simultaneously.)

Additionally, network operating systems that perform file sharing (basically, all of them) also administer the security for these shared files. This security can control, with a fine level of detail, who has access to which files and what kinds of access they have. For example, some users might have permission to view only certain shared files, while others have permission to edit or even delete certain shared files.

Printer Sharing

A close runner-up in importance to file sharing is printer sharing. While it is true that laser printers are currently so inexpensive you can afford to put one in every office, if you wish, sharing laser printers among the users on the network is still more economical overall. Printer sharing enables you to reduce the number of printers you need and also enables you to offer much higher-quality printers. For example, a high-end color laser printer costs about \$5,000. Newer digital copiers that can handle large printouts at more than 60 pages per minute can cost more than \$30,000. Sharing such printers among many users makes sense.

Printer sharing can be done in several different ways on a network. The most common way is to use **printer queues** on a server. A printer queue holds print jobs until any currently running print jobs are finished and then automatically sends the waiting jobs to the printer. Using a printer queue is efficient for the workstations because they can quickly print to the printer queue without having to wait for the printer to process their job. Another way to share printers on a network is to let each workstation access the printer directly (most printers can be configured so they are connected to the network just like a network workstation), but each must wait its turn if many users are vying for the printer at once.

Networked printers that use printer queues always have a **print server** that handles the job of sending each print job to the printer in turn. The print server function can be filled in a number of ways:

- By a file server with the printer connected directly to it (this option is not usually recommended because it can adversely affect the file server's performance).