Understanding Thin-Client/Server Computing

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Chapter 1: The Thin-Client/Server Computing Model

During my tenure as a Microsoft product manager, members of the Windows Strategy group introduced me to Citrix Systems' thin-client/server computing model, which consists of the WinFrame server and Independent Computing Architecture (ICA) client software. To me, the greatest appeal of this model was the removal of hardware barriers to the introduction of the most current 32-bit software, which included both development and productivity tools. I immediately realized the impact this computing model would have on total cost of ownership, including application access from any hardware platform, bandwidth-independent performance, and additional levels of data security.

I could envision the model having important benefits for small and large corporations, organizations, schools, system administrators, and even the user relationship to an Internet Service Provider (ISP). Although WinFrame was already an authorized extension to Microsoft Windows NT Server, Microsoft further validated the thin-client/server model by licensing Citrix's MultiWin technology for future versions of Windows NT Server, a project referred to by Microsoft as "Hydra."

The phrase that everyone is working with these days is "total cost of ownership" (TCO), which really boils down to getting the most out of your technology investment with the least amount of unnecessary effort. To that end, a thin-client/server solution might well be the best thing that ever happened to your IS department. With thin-client/server computing, your IS people can deploy applications instantly, without ever needing to "touch" every desktop. No, you're not dreaming: mission-critical applications can be deployed and updated on one central server. This TCO benefit saves IS organizations literally months in rollout time. Such rapid application deployment is just one of the many management benefits that can revolutionize your IS department and your way of doing business. I'll cover the management issues that pertain to the thin-client/server model in more detail in the "Addressing the Issues: Management and Scalability, Access, Performance, Security, and Total Cost of Ownership" section later in this chapter.

Another boon to your company as a result of adopting the thin-client/server model will be your ability to give your employees access to the most current software

applications without breaking your budget. Currently, corporations that supply their employees with personal computers must upgrade or purchase new hardware before testing and rolling out new, more robust 32-bit software applications. If the Information Systems (IS) department wants to deploy custom internal applications, it needs to create and test client software for each operating system and version thereof that the company uses. The thin-client/server model, using technologies from Citrix Systems built on Microsoft Windows NT Server, allows rapid application deployment regardless of platform. The application executes completely on the server--only mouse clicks and keystrokes are sent to the server for processing, and video display is returned to the client device via an efficient networking protocol and thin-client software on the local device. As I've become more familiar with the technology and seen it im-plemented across a variety of business situations, I've seen how quickly IS departments become better able to serve their users: the deployment of applications becomes easier to manage; users have greater access to applications and data, which increases their performance; and security is enhanced because all data is maintained on the network.

In this chapter, you'll be introduced to the basics of thin-client/server computing. Chapter 2 gets into the relationship of the thin-client/server model to two-and three-tier client/server computing and the download-and-run model used for Java computing. But for now, let's start with an overview of thin-client/server computing--a model of computing that's sure to catch on because it allows IS professionals and organizations to maximize their resources and save time while providing quality services to their users.

What Is Thin-Client/Server Computing?

The thin-client/server computing model involves connecting thin-client software or a thin-client hardware device with the server side using a highly efficient network protocol such as Citrix's ICA. The thin-client/server architecture enables 100 percent server-based processing, management, deployment, and support for mission-critical, productivity, Web-based, or other custom applications across any type of connection to any type of client hardware, regardless of platform. The client hardware can include Windows-based terminals, PCs, NetPCs, network computers, Apple Macintosh computers, or UNIX devices.

Using the thin-client/server computing model, you won't need to purchase or upgrade hardware just to run the latest software--instead, you'll be able to let it comfortably evolve, leveraging your existing hardware, operating systems, software, networks, and standards. Thin-client/server computing extends the life of your computing infrastructure considerably.

How Does Thin-Client/Server Computing Work?

To see how thin-client/server computing really works, you need to start with the server part of the model. To put it simply, in thin-client/server computing, all your applications and data are deployed, managed, and supported at the server. In addition, 100 percent of the application executes at the server. The application logic is separated from the user interface at the server and transported to the client. (See Figure 1-1.) This separation means that only screen updates, mouse clicks, and keystrokes travel the network to the server.

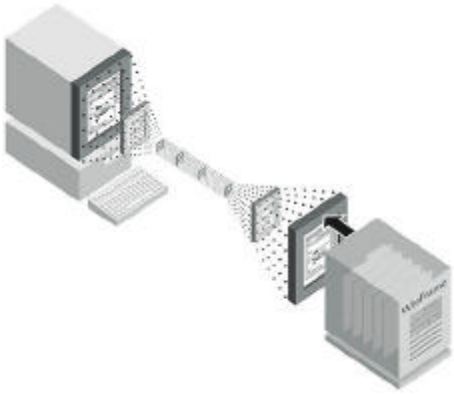

FIGURE 1-1 The application executes on the server, and screen updates are sent to the client device.

The thin-client software accesses and takes advantage of the server system software. MultiWin, the extension to Windows NT Server, allows multiple concurrent thin-client users to log on and run applications in separate, protected Windows sessions on the server.

The ICA thin-client software that works with MultiWin enables a wide variety of client devices to access the same applications--without special emulation software, changes in system configuration, or application rewrites. Figure 1-2 depicts a server running with four different computing devices that use thin-client/server software.

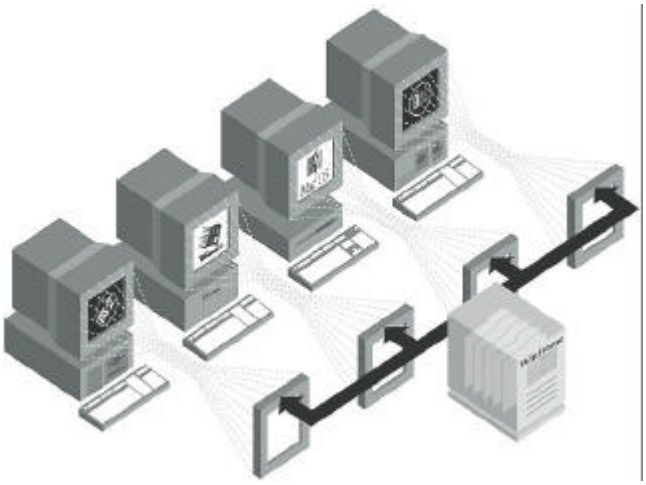

FIGURE 1-2 The Citrix WinFrame product line with the Citrix MultiWin technology enables a wide variety of devices to access your applications.

With the server splitting the execution and display logic, only keystrokes, mouse clicks, and screen updates travel the network. Thus, applications consume just a fraction of the normal network bandwidth usually required. Because applications require fewer resources, they can be extended from one location across any type of connection to any type of client with exceptional performance.

About Citrix MultiWin

Citrix created MultiWin as an authorized multiuser extension to Microsoft Windows NT Server for its WinFrame server. The MultiWin technology is currently available from Citrix Systems in WinFrame Enterprise version 1.7, built on the Windows NT Server 3.51 platform. In mid-1997, Citrix licensed the MultiWin technology to Microsoft as part of a cooperative development agreement for creating native multiuser capabilities in Windows NT Server version 4 and future versions.

If you compare bandwidth requirements across shared Ethernet, wireless Ethernet, ISDN (Integrated Services Digital Network), and modem speeds, you'll find a thin-client/server protocol such as Citrix ICA extremely efficient. (See Figure 1-3.)

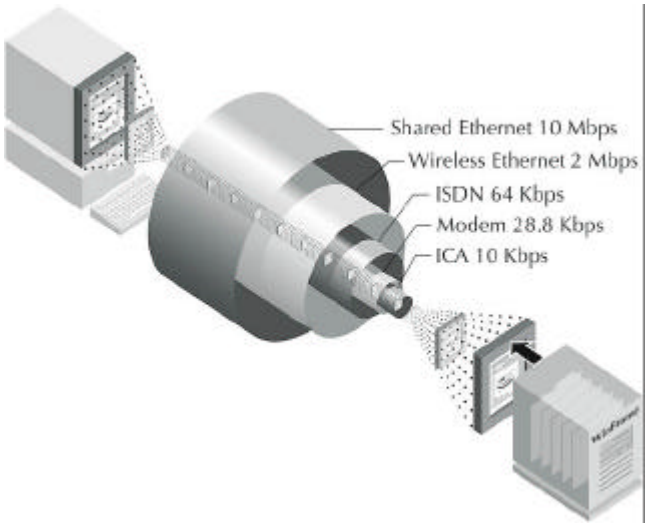

FIGURE 1-3 Using just a fraction of network bandwidth, ICA enables robust 32-bit applications to generate consistent perfor-mance through any connection.

Using a protocol such as ICA with a local area network (LAN) or a wide area network (WAN) connection, the user experience with many software applications is the same for applications running on a WinFrame server as it is for applications running on a local computer with a full complement of application and operating system software. In a thin-client/server session, users can cut and paste between sessions, save to local storage devices, and print to local or network printers.

In summary, the thin-client/server architecture includes three components sitting on top of the Microsoft Windows NT Server:

- MultiWin, a multiuser layer on the server that simulates local application processing
- ICA display services on the multiuser layer that divide the application execution from the display logic
- Thin-client software, such as the ICA client, on the client device that sends mouse movements and keystrokes to the server while accepting display images

Separation of the application execution from the display logic reduces the amount of data that needs to be communicated across the network, allowing efficient use of available bandwidth--and in the case of ICA, very efficient use of low-bandwidth situations.

What Do You Need to Do, and Where Do You Need to Do It?

Thin-client/server computing is not necessarily for everyone, everywhere, all the time. It should not be perceived as a religious technology war to see which company survives the next great era in the information age. Less of that type of noise would help customers make better decisions about what they need to accomplish. Ideally, to figure out what form of technology is best suited to a particular business situation, an IS department should conduct a functional assessment of the company's installed base and projected needs. To that end, the thin-client/server computing model allows the use of most recent versions of

line-of-business, mission-critical, or information applications on different devices along with existing native applications. IS departments will be able to deploy and integrate these applications on existing systems where needed.

The thin-client software, especially the Citrix ICA client, can reside on any device: a handheld computer, a network computer, JavaStation, NetPC, a Windows terminal, a PC running any Microsoft Windows operating system (Windows 3.*x*, Windows 95, or Windows NT), a Macintosh, or a UNIX workstation. You can also choose to run Windows applications either locally or from a server.

A Personal Experience

In my previous positions as product manager, instructional designer, and technical writer at Microsoft, I always outgrew the capacity of the equipment issued to do my work. Arriving at Microsoft in December 1988, I was given a Compaq 386/20E with a 120-MB hard drive and a Mac II with 5 MB of RAM and an 80-MB hard drive for my technical writing. By the time I left Microsoft in October 1996, I was using a Toshiba notebook with a P75 processor, 24 MB of RAM, and an 850-MB hard drive. Between testing different Microsoft products in alpha and beta stages and dealing with huge e-mail files and an ever-increasing number of internal custom information and requisition types of applications, my machines were forever at maximum capacity. My e-mail files often reached the 100-MB limit.

Microsoft internal information and eform applications were written at different times with different tools by various groups within the company and often increased the size of my system directory. Occasionally, the applications conflicted because of different DLL versions and didn't work well together. At the same time, I regularly used Microsoft Office applications such as Microsoft Excel, Word, PowerPoint, Access, and Internet Explorer and development tools such as Microsoft Visual Basic. As a knowledge worker with creative application needs, I was always working with macros or using Office applications in some exotic manner for which they weren't intended. While I couldn't imagine giving up local control of my applications, I would have been far better off not only keeping my e-mail files on a server but also executing the mail client there as well and viewing my mail through a thin client. I could also have better accessed a number of the many Microsoft internal applications (for example, benefits, Help desk, product information) using a thin client residing on my desktop. And rather than running Internet Explorer locally, I would have made better use of my hard drive space and system resources if I had run Inter-net Explorer on a server and accessed it with thin-client software on my desktop.

At Microsoft, thousands of users worldwide are serviced by ITG, Microsoft's IS group. ITG is responsible for deploying and maintaining corporate applications. The thin-client/server model would facilitate the rollout of the myriad applications used by Microsoft employees. At the same time, this model would help maximize the use of each employee's computing resources.

The following table lists various user scenarios for thin-client/server computing. In the next four sections, you'll see how each type of user mentioned in this table might actually work within a company or organization.

User Scenarios

	Tasks, Settings, User	Devices	Application or Job Titles	Thin-Client/Server Type vs. Local Apps. (%)
Mobile task-based user	Handheld or mobile thin-client device	Writing traffic tickets, monitoring car rental returns, taking restaurant orders, reading gas/water meters, tracking	Line-of-business applications	0% local/100% thin-client

		deliveries		
Office task-based user computer	Windows terminal, NetPC, or network marketers, insurance claim	Traditional office environments, with workers ranging from temporary to administrative; bank tellers, tele-applications adjustors; fast food service; automobile service departments; information kiosks	Word processing, line-of-business applications, information	0% local/100% thin-client
Knowledge workers	Notebook PC and/or desktop PC, handheld devices	Project management, financial reporting, proposal writing, sales, presentations, e-mail, scheduling, contact management	Productivity applications; groupware and communications; Internet, intranet, and extranet infor-mation; documents and applications	50% local/ 50% thin- client
Power users with creative, analytic, or engineering task needs	Notebook PC and/or desktop PC, and/or high-end workstation; handheld devices	Knowledge worker tasks, with the addition of statistical or scientific analysis and research; periodical or book publishing; graphics; multi- media and Web authoring; software application development	All of the software used by the knowledge worker with the addition of desktop publishing applications, graphics software, and software development tools	70% local/ 30% thin- client

Mobile Task-Based User

An example of a mobile task-based user is a police officer with a thin-client mobile device in her car. As the officer requires information, she can access any of the applications on the server through her terminal via wireless communications. For example, she might be giving a traffic ticket and need to check with the registry of motor vehicles. Other officers might use maps or other information that is updated daily. The server that the police officers are logged on to can be powerful and robust and connected directly to national databases through high-speed lines. The device in the police car doesn't carry any confidential information; all transactions are executed on the server and displayed on the mobile device.

An express delivery carrier is another excellent example of a person who uses a mobile client device with thin-client software. As this person picks up and delivers packages, he enters the latest tracking and status data into his handheld device. The thin client in the handheld device encrypts and transmits the information back to the driver's base of operations, where all data is consolidated for quick processing and where the carrier has access to the most up-to-date data. Again, no confidential information exists on the local device because 100 percent of the application executes on the server.

Office Task-Based User

Imagine that you're the head of IS at a large insurance company. You need to provide the claims department access to customized forms and tables, and you need to allow the company access to a centralized database that contains current data. Although the claims workers and other company personnel might need to use e-mail or scheduling software, they would be unnecessarily distracted by any other software. These users don't need to spend any time with the intricacies of an operating system. In settings such as this, employees could be using a Windows-based terminal, NetPC, or network computer with the applications completely developed, deployed, and maintained by an internal IS department. Your company could even use Citrix ICA thin-client/server software with some older PCs and effectively turn them into Windows terminals with just a network card and a VGA video card and monitor. The insurance industry is certainly not the only type of industry that can greatly benefit from using thin-client/server-based applications. IS professionals who plan, deploy, and support systems for all types of customer service professionals can increase their productivity and streamline their computing infrastructure with this new technology. Whether providing information, taking orders, troubleshooting, tracking customer information, or using group scheduling and communications, customer service professionals are a segment of task-based workers whose computing needs can be most efficiently met with thin-client/server technology.

Knowledge Workers

Are you responsible for providing IS services to knowledge workers? Knowledge workers might include writers, editors, planners, managers, lawyers, doctors, clergy, and faculty teaching at any level of education. Knowledge work is work that is based on researching, extending, applying, and distributing information in one form or another. This type of worker might prefer to use a desktop or notebook PC with a full complement of productivity software. Even though the work of knowledge workers doesn't tax the limits of the operating system or of locally run software, these workers might prefer storing documents locally and having the choice of using this software with or without a network. They could be using their notebook computers not only at work but also while on the road or at home. On the other hand, many of these professionals might be equally well served by a thin-client/server device and software solutions. It's a matter of how you, the IS professional, balance the needs and work habits of your user base with IS resources.

As the table on page 9 indicates, knowledge workers might prefer to have about half their tasks executed locally and half through a thin-client/server solution. I would say that tasks might logically be divided along these lines: frequently used productivity tools are used locally, and infrequently used productivity tools are run on the server. This split assumes that other kinds of tasks--such as e-mail, information management, scheduling, and any applications specific to the company--can save local resources by being run in a thin-client/server scenario. Desktop icons for e-mail and other thin-client/server applications would look identical to the icons for starting local applications. The only difference would be in the execution: whether the application executed locally or on the server. Again, deciding how and when to use thin-client/server technology is a matter of optimizing the professional's time and computing resources, and of making sure that mission-critical applications are always available, regardless of the proverbial rain, snow, sleet, or hail.

Power Users with Creative and Analytic Task Needs

Power users share certain characteristics: they are often professionally interested in technology; they push the limits of the software they regularly use; and they sometimes need high-end tools that require robust, high-powered hardware that can handle intensive local application processing. Because of their interest or their job requirements, some

knowledge workers also reach the limits of their computing capacity and become a population of power users demanding not only performance but also storage capacity. These users might require creative, analytic, or engineering applications. They often push productivity tools beyond the limit that an IS group is prepared to support. Power users can include artists requiring high-end graphics applications; researchers and engineers running modeling, simulation, or intensive number-crunching applications; and software engineers using development tools to create software for distribution to a small group or a wide audience.

Hardware used by the power user can include high-end PCs, high-end notebook computers, and dedicated workstations. Power users might even use a combination of devices along with a handheld PC. Although power users would prefer to have a complement of tools on their local devices, they might be best served if applications such as e-mail, scheduling, an Internet browser, internal information, and form applications are run from a server in a thin-client/server scenario. These applications need not take up either system resources or space on the local computer. Power users would also benefit from having a backup set of tools on a server that they could access through thin-client software. All tools executed on the server are the ones that would be most easily supported by an IS department. Rather than having to go to user sites, the support staff would be able to deploy, maintain, and troubleshoot these applications from the server. In the table on page 9, the speculation that power users might run up to 30 percent of their applications through a thin-client/server scenario is a guess that these users spend most of their time with a core set of tools that are best run locally. It also suggests that they would be best served if the other applications, such as e-mail, scheduling, and information applications, didn't detract from either CPU usage or storage; and software that didn't need to be on the local computer would not conflict with applications that were required to be there.

Figure 1-4 illustrates how thin-client/server computing holds a place within the computing environment of almost any user

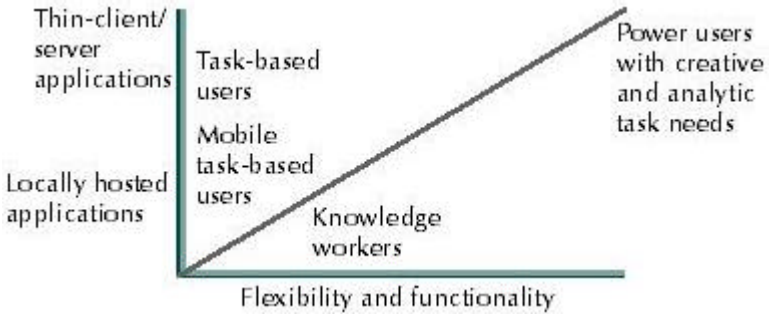

FIGURE 1-4 This figure compares different user types, showing an estimate of the proportion of time spent with locally run applications vs. thin-client/server solutions. within an organization. From 100 percent of the applications for task-specific functions to approximately 30 percent for the most intense power user, this computing model can help you make the most of your available computing resources.

Addressing the Issues: Management and Scalability, Access, Performance, Security, and Total Cost of Ownership

So now you know the basics of how the thin-client/server model works, where it might be used, and who might use it. You've also seen how this model will allow you to use your computing equipment efficiently and your IS support and maintenance resources wisely. In this section, I'll present the issues involved in using the thin-client/server model from the IS perspective. Certainly, TCO is important to IS professionals. But just as key to them is

what the thin-client/server solution can offer to the company in terms of management and scalability, access, performance, and security.

Management and Scalability

IS professionals clearly prefer single-point control. They don't want to travel around a company providing support for each desktop computer that has an operating system. The thin-client/server architecture allows IS departments to consolidate databases, file servers, and application servers in the same location in which they manage user access. This consolidation means that users worldwide can access the same centralized information and that companies can avoid the security, cost, reliability, and management issues involved in having widely dispersed databases. At the same time, workstations with a full complement of software, including a desktop operating system and locally run applications, can be deployed as required for a particular job. Figure 1-5 illustrates the way in which the server is connected to file, application, and database servers.

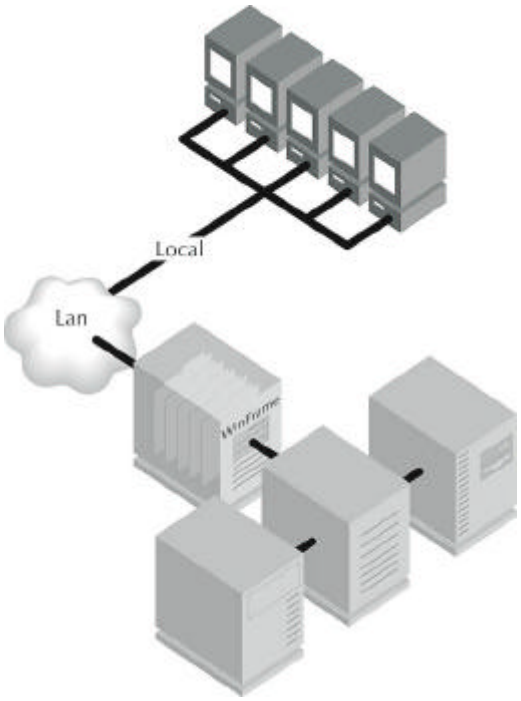

FIGURE 1-5 Using the thin-client/server model, you can consolidate databases, file servers, and application servers at one location while managing user access.

Scalability presents another challenge to IS professionals, who might need to scale a growing enterprise from dozens to thousands of users. You'll find that Citrix's WinFrame load-balancing option allows for extremely reliable deployment of thin-client application solutions from a server "farm." With the WinFrame load-balancing scenario, users are dynamically routed to the WinFrame server that offers the best application performance. System administrators will still see and manage a single system image for the entire network. Figure 1-6 shows a cluster of clients attached to a server farm using WinFrame load balancing.

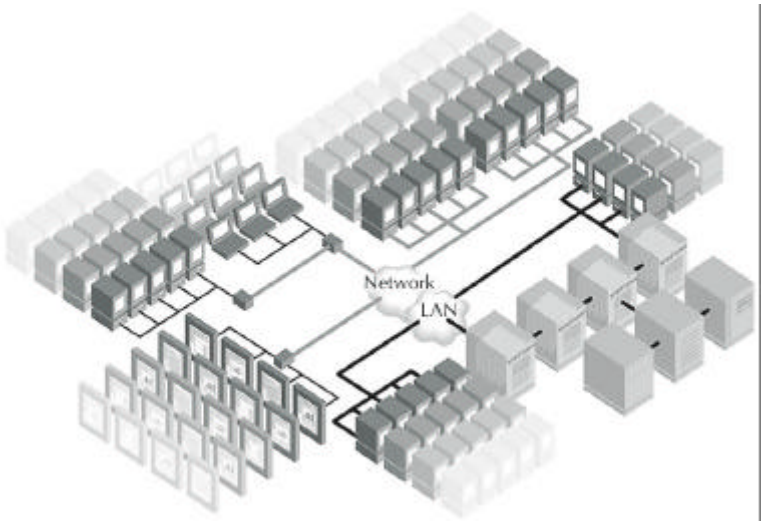

FIGURE 1-6 The Citrix load-balancing feature enables multiple WinFrame Servers with the Citrix add-on to be grouped together to meet the needs of thousands of users.

Access

From that single location that houses all of your application ser-vers, file servers, and databases, you can manage not only the users on your LAN but also the users in branch offices, telecommuters, and mobile professionals. Because of the efficiency of not only processing on the server but also of using network bandwidth, applications run extremely well over existing remote-node servers and branch-office routers. Figure 1-7 shows a WinFrame server farm.

Performance

In developing WinFrame and the ICA client, Citrix has optimized network performance for connections as low as 9600 baud for use over a cellular modem. Because ICA clients are sending only mouse clicks and keystrokes to the server and receiving only screen updates, ICA clients maximize the use of your bandwidth whether you're on a LAN or using an analog or ISDN modem.

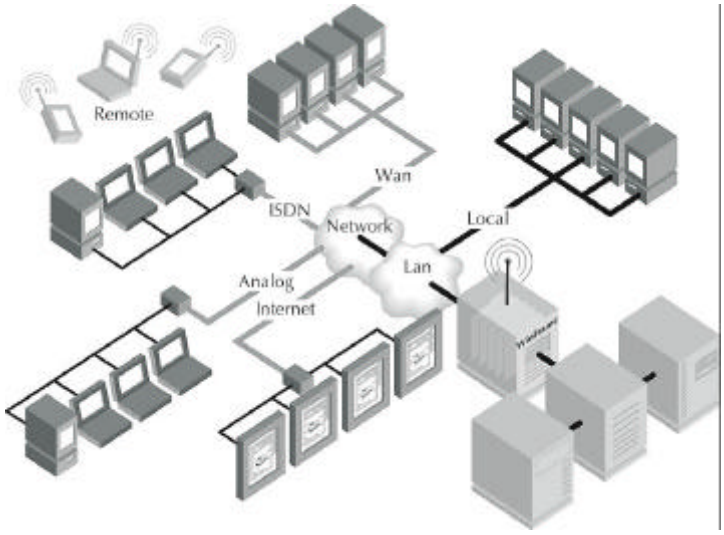

FIGURE 1-7 The thin-client/server computing model gives you the power of single-point control to extend applications over any connection to any client with increased performance and security.

Ironically, it takes a while for users to understand how this system software works because application performance is something they take for granted. However, when you add the ICA client to an old 386 with 2 MB of RAM and demonstrate the use of the latest 32-bit version of your software, eyes light up.

Security

Security for thin-client/server computing comes from WinFrame's base of services provided by Microsoft Windows NT Server. Windows NT Server provides security through individual and group accounts, user profiles, and the differing levels of security required for the U.S. Department of Defense's C2 security specification. In addition, regardless of whether the user has the latest PC or a Windows-based terminal, sensitive data can be maintained in a single secure place on the server.

Performance Research

Citrix commissioned the Tolly Group to evaluate the performance and scalability of the Citrix WinFrame Enterprise (version 1.6) application server when supporting clients running 32-bit Windows applications. Among the tests, the Tolly Group measured the time required for a Windows 95 client using a 28.8 modem connection to complete some common Microsoft Excel tasks when an increasing number of LAN clients were running on the WinFrame server.

The results showed that up to 30 clients--29 LAN clients and 1 WAN client--could run Excel from a dual-processor Pentium 90 WinFrame server without significant degradation. The WAN client took about 30 seconds to perform a group of common Excel tasks with no other clients accessing the WinFrame server. With 19 LAN clients simultaneously accessing the WinFrame server, the WAN client's response times in Excel were degraded by less than 10 percent. With 29 LAN clients simultaneously accessing the server, response time on the dial-up client was degraded by less than 35 percent.

The Tolly Group found that the WinFrame server provides a scalable solution that is capable of supporting up to 30 clients on a dual-processor Pentium server, without significant degradation in response times for any one client. The Tolly Group also found that the WinFrame architecture makes efficient use of bandwidth, indicating that it is a good solution for bandwidth-constrained environments such as dial-up analog modem connections.

Total Cost of Ownership

Zona Research, quoted on both the Boundless and NCD Web sites, calculates a 54-57 percent savings by using the thin-client/server model over a comparable number of networked PCs. The savings were projected over a five-year period by comparing the costs of setting up and maintaining 15 PCs and 15 Windows terminal solutions using ICA clients and a WinFrame server.

Leading research firms are seeing the impact that thin-client/server computing can make in extended enterprises. Gartner Group, Intelliquest, IDC, and Zona Research are all conducting comprehensive studies on the market potential and user and enterprise benefits of the thin-client/server computing solution.

In summary, the thin-client/server architecture provides IS departments and professionals with an excellent solution for managing databases, file servers, and application servers in one location while providing a central point for user configurations and security. It provides access to different types of users, including local users, remote users, and telecommuters. In addition, IS professionals will be able to scale services from a small number of users on a LAN to thousands of users worldwide. Corporations currently deploying applications using Citrix's WinFrame include AT&T Wireless, Chevron, GE

Capital Services, and Sears. In the case studies in Chapter 8, you'll find even more companies that are taking advantage of thin-client/server computing using Citrix technology, including LaSalle Partners, Omnes, Honeywell Europe S.A., Pyramid Breweries, Standard Forms, Anne E. Biedel & Associates, Clarion Health, Mecon, Claimsnet.com, Pro Staff, Relo-Action, Bell Mobility, and Vodac. Organizations as varied as the Orange County Public Defender's Office, Florida Water Services, Goodwill Industries of Southern Arizona, the Tulsa City-County Library, and Idaho State University are also benefiting from this technology.

In Conclusion

The thin-client/server architecture can bring the best of different computing models and architectures together. You can instantly provide access to virtually any business-critical application, including 16-bit and 32-bit Windows applications, across any type of network connection to any type of client. You get the power of single-point control for deploying, managing, and supporting applications, including enterprise-wide rollouts, updates, and additions. Users get the universal access to the applications they need, the exceptional performance they require, and the familiarity and ease of use they're accustomed to. Plus, this technology is cost-effective and secure. IS administrators can optimize resources by providing thin-client/server solutions to task-based users via thin-client devices, or thin-client/server software solutions to knowledge workers and power users.
