

# Thin Clients Are in (Again)

Server-based computing improves security, simplifies management, lowers total cost of ownership and saves the environment.

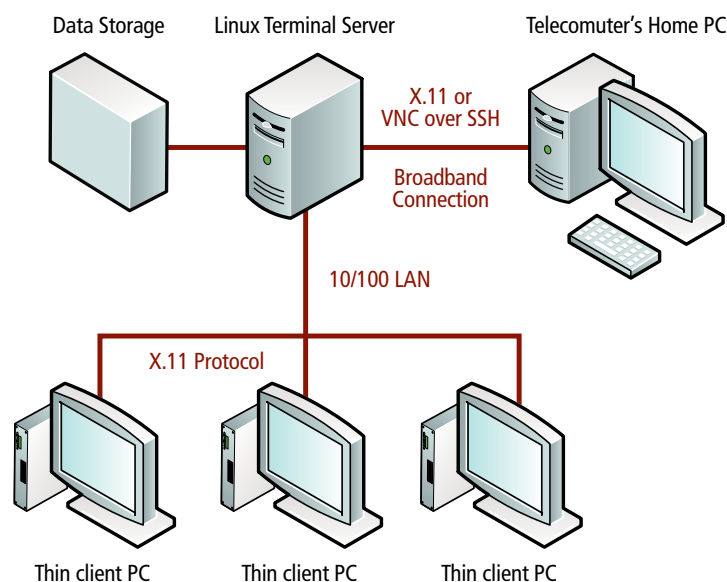
## I. Introduction

Thin clients are back in vogue, and this time it's not just hype. IT organizations today are giving thin-client computing a closer look because they are continually bombarded by daily security threats, overburdened by help-desk requests and hamstrung by the high cost of purchasing and managing PCs.

In thin-client computing, much like the old days of mainframe computers, the data center powers the computing functions and stores all the applications and data. Information flows back and forth to thin clients, which are small desktop devices with no hard drives and limited functionality. As a result, data is more secure, and hardware and software is easier to manage and update because everything is stored centrally on servers. That, in turn, will save money.

This is not the first time the technology industry has made a move to return toward server-based computing. In the mid-1990s, technology vendors such as Oracle and Sun Microsystems spent big marketing dollars to tout "network computers" as the next big thing. But it failed to gain widespread adoption because of bandwidth constraints, few applications were available and the fact that PC prices plummeted at the time, reducing the need for new, low-cost alternatives.

### Basic Thin Client Architecture Model



## Thin-Client Fact:

Network traffic between the data center and the thin client is generally miniscule because all the processing occurs on the server. As a result, downloading an e-mail with a large attachment is faster on a thin client than if a remote user tried to download the same file onto a regular notebook computer.

### Benefits Drive Growth

Over the intervening years, thin-client technology improved. Companies such as Citrix Systems and Microsoft have developed software and network protocols that allow IT departments to deliver all or most of their critical applications from servers to thin-client devices. The form factor has seen modest but steady growth over the years, reaching 2.8 million in annual unit sales in 2008, according to IDC. But it's still a small percentage of overall PC sales.

Industry analysts believe the industry is poised for larger growth in the coming years, particularly in the federal government sector, where IT departments, facing shrinking budgets, need to bolster security, simplify management of computers and lower their total cost of ownership. The technology is also highly available and reliable, which helps with continuity of operations.

New advances in the technology are also driving renewed interest in thin clients, including thin-client notebook computers and new back-end architectures that offer users the power, look and feel of regular PCs. Other drivers are the increased availability of web applications, and the fact that bandwidth is plentiful (in LAN connectivity) and corporate networks are fast. In fact, in a 2007 third-quarter survey of 565 PC, decision makers in North America and Europe, 20 percent were interested in server-based computing as an alternative to traditional PCs and another 5 percent were implementing the technology in the next 12 months, according to Forrester Research in Cambridge, Mass.

In this whitepaper, you will learn in more detail the technology's benefits, the many different options in thin-client computers and architectures, implementation best practices and key manufacturer offerings.

## II. High Availability and Tech Innovations

Technology manufacturers have developed several innovative alternatives to the traditional server-based thin-client computing model. In the traditional thin-client model, which is still the most widely deployed, keystrokes and mouse clicks are sent from the desktop thin-client device

to the data center, and the servers perform all the processing and send a view of the screen back to the user's desktop.

Manufacturers have also made advances to the thin-client devices themselves. Gone are the days of the dumb terminal. It's now packed with a processor, RAM and Flash memory, allowing some applications to run locally. It boosts the performance of some applications, including web browsing, videos and other multimedia applications. Manufacturers have also introduced thin-client notebooks that look like regular notebooks, except they have no hard drives. Users access applications and data by connecting to their servers via Wi-Fi and other network connections.

Thin-client computing has always been highly available and reliable, and the new architectures offer the same stability.

Thin clients have no moving parts, such as hard drives or fans that can fail, so they can last much longer than regular PCs. Without a hard drive, viruses and spyware have far fewer attack vectors than a Windows machine, making it much more difficult to critically damage the PC. If thin clients break down for any reason, IT departments can get the user up and running by moving them over to another thin-client device in minutes. Users face very little downtime.

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### *Ease of Management:*

*"You just don't have to have as much IT support. With PCs, we have ratios of 50 to 60 PCs per tech support person. With blades, our ratio is over 100 to 1. That's because with this architecture, my IT guys don't have to travel to all the desks," says Roger Chilcott, senior engineer at SENTEL Corp. who implemented blade PCs at Eglin Air Force Base in Florida.*

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Because of the many advantages and advances in the technology, IT departments can now overcome the barriers that prevented them from embracing thin clients in the first place. In the past, users who were used to having PCs viewed thin clients as a technology demotion, making an architectural change difficult. IT departments also shied away from the technology because it required a whole new client and server

## The New Kids on the Block:

One new thin-client alternative is blade PCs, which are actual PCs with their own processors and RAM, but are housed in data centers like servers. Users connect to the PCs through thin-client devices. A second, new thin-client offering that's created a buzz in the past year is desktop virtualization, or Virtual Desktop Infrastructure (VDI). Desktop virtualization is similar to server virtualization in that it partitions servers into different virtual machines. But in this case, the virtual machines give users a PC environment.

architecture, which takes planning, testing and implementation work.

Organizations that have deployed thin clients feel the effort is worth it. "Those who have installed thin clients really like it, and it really does make life better once it's installed," says IDC analyst Bob O'Donnell.

### Ideal for the Government

Thin clients are ideally suited for the federal government because the technology is affordable, easy to manage, and most importantly, protects data from theft. Agencies can now equip users with thin-client notebook computers, and if they get stolen, no sensitive data is lost because the data is stored on the server. Department heads no longer need to require employees to lock their computer hard drives up at day's end, fearful that someone could walk off with them in the middle of the night.

In U.S. military bases, for example, IT departments have deployed thin clients to thousands of users, from command leaders to administrative assistants, who log in by typing their user names and passwords and swiping their smart cards. Once signed in, they can access web applications, Microsoft Office and other necessary applications, as well as local printers on the network.

Also, in a post-Sept. 11 world, law enforcement and other government agencies can use thin clients to securely share data on servers. By setting access rights, people with security privileges can access data, but they can't change or manipulate the information.

## III. Adoption drivers: advantages

Here's a closer look at the four main advantages of thin clients.

**1. Increased security.** The lack of a hard drive in thin clients not only protects data from thieves but it protects the data from the users themselves. As long as the term server remains secured, the thin client itself is inherently safe. Users cannot disable antivirus software. They can't install unauthorized software or

accidentally introduce viruses or spyware through web surfing or downloads. In fact, if users download viruses by accident while web surfing, the viruses can't propagate. They will disappear from the thin client's memory once the session is over. No residual data is stored on the thin client.

Thin clients may have USB ports, but IT administrators can use their thin-client management software to lock down the ports, preventing users from plugging in USB Flash drives or CD-ROM drives.

**2. Total cost of ownership.** Thin clients are cheaper than PCs and can last five to seven years, which is twice the lifespan of a typical PC, according to Tad Bodeman, Hewlett-Packard's director of remote client solutions. IT departments also save tremendously on support costs. A blade PC, for example, will cost close to \$1,000 per user. But if an organization purchases a \$700 PC, they will spend an additional \$2,000 to \$4,000 a year just on support, Bodeman says. "Centralized architectures are so much more efficient to maintain," he says.

IDC's O'Donnell says it may take several years, but a thin-client solution can cut costs. An agency can save money immediately by swapping out PCs with thin clients, but they will need to make an initial investment on the back-end of the thin-client infrastructure, such as purchasing more servers or adding more server support.

"It's an off-set in that regard, but once you do the math, it works to a slight argument that thin clients cost less over time," he says. "There are some stories where it's clearly a financial slam-dunk benefit. In general, it may take a period of several years, but you do get cost savings."

**3. Centralized management.** IT staff can manage the computing infrastructure in one central location: the data center. IT departments can use management software to remotely manage user settings and install software and upgrades. The IT department also doesn't have to worry about backing up each user's hard drive. It's done on the server side.

Theoretically, in a PC environment, IT administrators can use management software that automatically sends software updates to users' PCs. "But that's in theory. In practice, that's not always true," O'Donnell says. "With thin clients, you have no choice. You are architecturally bound to do that, so thin clients by their very nature, force best practices."

# High-Availability Thin Clients:

On the back end, a thin-client architecture is highly available if IT staffers architect the data center with the appropriate redundancy and data backup solutions. So if a disaster strikes, preventing employees from reaching the office, they can immediately connect to the servers and access their data and applications, either at home or from another office. Similarly, with blade PCs, if one blade goes down, users can immediately get back up and running on another blade with no downtime (assuming the IT help desk can give the user another resource). With virtualization, if servers go down, management software can automatically move users to other servers.

Again, because thin clients have no moving parts, help-desk support doesn't have to regularly visit employees' desks to troubleshoot potential hardware problems on the computer. But if a thin-client device breaks down, they simply install another one. Users log in and they're up and running again. Gone are the days of reconfiguring a new computer by installing or re-installing the operating system, software drivers and applications. According to IDC, IT staff productivity is increased by 78 percent, while user downtime is cut by 88 percent.

#### 4. Environmentally friendly computing.

Government leaders are looking for ways to reduce energy consumption and be more environmentally friendly. And it turns out that thin clients are far more eco-friendly than PCs. Thin clients use less energy, have a longer lifespan, and are smaller and require fewer parts, such as plastics, metals and electronics. As a result, thin clients can reduce the amount of hazardous materials that end up in landfills.

According to Forrester Research, a thin-client terminal uses 6 to 50 watts, compared with a regular PC that uses 150 to 350 watts. In an organization with 5,000 users, thin-client devices combined with the required server and cooling infrastructure, will use 24 percent less energy than a PC environment, according to the research firm. Thin clients also produce 23 percent fewer carbon emissions.

## IV. Implementing Thin Clients and Architectural Considerations

IT departments have numerous software and hardware from which to choose. This section will highlight the different software, architectures and operating systems available, as well as provide best practices and tips on how to implement the right thin-client system for your organization.

### Software

For thin-client computing to work, IT administrators must deploy software that provides centralized, server-based application delivery to thin clients. With the software, an agency can host common desktop applications,

such as Microsoft Office, on a server. Through a communications protocol, users with thin clients can then remotely access the applications from the servers.

Three application-delivery software programs are:

**Citrix XenApp** (formerly called Citrix Presentation Server). Citrix XenApp, which supports multiple operating systems, including Windows 2003 Server, Unix and Linux, uses the Independent Computing Architecture (ICA) communications protocol. The ICA protocol, built by Citrix, transfers a user's mouse and keyboard clicks to the servers, which in turn, send the graphical output to the user's thin-client terminal. Users establish the thin-client session using ICA client software on their terminals. ICA is an efficient protocol that requires small amounts of network bandwidth, typically 5 to 20Kbps.

**Microsoft Terminal Services.** The software provides access to Windows applications through a network using Remote Display Protocol (RDP). The protocol, developed by Microsoft, provides communication between a terminal server and a thin-client terminal. Users connect to a session through a remote display client on their thin-client devices. Terminal Services is less expensive than Citrix because it's built into the Windows Server operating system.

**The Linux Terminal Server Project (LTSP).** The software provides thin-client support to Linux servers. Applications are delivered using the X11 protocol, an open-source protocol that was initially developed in the late 1980s by the Massachusetts Institute of Technology. The nonprofit organization X.Org Foundation and the freedesktop.org community continue development work on X11 and released a new version in 2007.

IT departments can also use host emulation software to connect to legacy applications, as well as use regular TCP/IP to access their web applications through a web browser.

### Thin-client Architectures: Choices Abound

Now, let's take a look at the four different thin-client architectures available:

**1. Traditional thin-client computing.** As previously explained, this is good for task workers who need access to a fixed set of

“Data is one of the biggest assets government can have, and they need to get away from leaving data on the local desktop. It’s a security and management nightmare,” says Eric Grayson, vice president of VXL Americas. “Servers are very heavily fortified from a security standpoint. And managing everything on the servers is so much easier that from a total cost of ownership picture, it offers a tremendous amount of cost savings.”

applications that users use repeatedly, such as Microsoft Office. This is still the most popular form of thin-client computing deployed today.

For organizations that plan to deploy new applications regularly or have users who need a richer, fuller PC experience, including web browsing and graphics-intensive programs, there are several more powerful thin-client alternatives.

**2. OS streaming.** Combined with high-end thin-client devices with a fast processor and RAM, this software allows users to perform computing locally on the thin-client devices, while the data is still stored on the servers. When users log in, the server delivers a computer image — including the full operating system and applications — to the thin client over the network. The operating system and applications run locally on the thin client, but all the data is still stored on the server. IT administrators can create different computer images for different users or groups of users.

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### *Choosing an OS — XP Embedded vs. CE:*

*“XP Embedded gives you the ability to do a bit more on the device. It’s like the difference between XP on a computer and a Windows CE device,” says Brett Scott, president of the Kraft Technology Group, a technology consulting firm in Nashville, Tenn.*

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**3. Blade PCs.** Blade PCs give IT departments the best of both computing worlds: Users get the full power of PCs, but because they are located in the data center, IT staffers get the security and ease of management of thin clients. Blade PCs have the standard PC parts, including processors, memory, hard drives and video cards. Vendors also sell a chassis and offer software for troubleshooting and monitoring the health of the blades.

**4. Desktop virtualization.** Desktop virtualization or VDI software is similar to server virtualization in that a server runs multiple Virtual Machines (VMs) simultaneously. The VMs share the same server resources, such as processor and memory, but each VM gives each user a “virtual computer” with a full operating

system and applications. Unlike blade PCs, this is a shared environment, but it gives knowledge workers a near PC-like experience. Manufacturers in this space include VMware and Citrix. VDI can typically support four to six VMs per processor core, vendors say.

Another benefit of the alternative thin-client models is access to software.

Federal agencies have a huge number of applications, and 90 to 95 percent of them work in a typical Citrix or Terminal Services environment. The remaining 5 to 10 percent of applications may be critical, in-house custom applications that may handle HR or accounting functions, IDC’s O’Donnell says. Those custom applications may require that they run locally on a computer. New alternatives, such as streaming OS or desktop virtualization can give users access to those applications in a thin-client environment, he says.

### Operating Systems

As for the thin clients themselves, IT departments have a mix of choices, from low- to high-end as well as a choice of operating systems, depending on their needs. Operating system choices include: Microsoft Windows CE, Microsoft Windows XP Embedded, Linux and custom OSes.

**Windows CE.** The OS has a smaller footprint than XP Embedded, and is also capable of Internet browsing and multimedia applications. It supports Windows, mainframe and basic web applications, but it has limited support for printers and peripherals. It, too, requires an OS license.

**XP Embedded.** The OS features an interface similar to XP, is good for Windows 32-bit applications, and supports multimedia applications, Internet browsing and has extensive hardware peripheral support. It also supports connectivity to mainframe and feature-rich web applications. On the negative side, it has a large memory requirement and requires an OS license.

**Linux.** An embedded Linux operating system requires a small amount of memory and requires no licensing. It’s customizable with open-source software and components, and supports Internet browsing and multimedia capabilities. On the negative side, it has limited printer and peripheral support.

## Future Innovations:

Thin-client manufacturers continue to innovate. "Within the next year or two, it will not be surprising to see thin clients powered via an Ethernet connection. For example, Wyse's entry-level S class thin client uses 6 or 7 watts of electricity. A few more tweaks by our engineers and we'll be there," says Mike Brunner, Wyse's vice president of worldwide channel sales and marketing.

Full versions of operating systems can also be deployed onto thin clients if the IT department decides on the blade PCs, OS streaming and VDI architectures.

### Best Practices

Thin-client computing may require upfront costs because organizations need new hardware on the server side to house blade PCs, virtual desktops or applications to be accessible via Citrix or Microsoft Terminal Services. They may also need to purchase storage — either a storage area network or networked storage — to house users' home folder information and to ensure high availability to data that can easily be backed up, says Kelly Sather, CDW's HP Partner Specialist, who specializes on thin clients and blade PCs.

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### *General Thin-client Benefits:*

*"Think of a thin client as an appliance that is optimized to deliver the same user experience as a PC, at less cost and without all the major headaches PCs create from a manageability and security standpoint," says Mike Brunner, Wyse's vice president of worldwide channel sales and marketing.*

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The first, and most critical, task is to determine who your users are and what their applications needs are — and that will determine what kind of thin-client architecture and thin-client devices you choose to purchase, Sather says. It will also determine the amount of infrastructure spending you will require. For example, because the IT department will be putting all its processing power in a single room, make sure you have the power and cooling available to support it, says Roger Chilcott, senior engineer at SENTEL Corp. who implemented blade PCs at Eglin Air Force Base in Florida.

Sather says thin clients are not a one-size-fits-all solution. Sometimes federal agencies need a mixed environment of thin-client architectures, and sometimes they need to keep regular PCs because some applications simply work better with them.

For example, not every application can be accessed through Citrix or Terminal Services, whether they are legacy or too graphics-oriented. In those cases, they can connect through simple terminal emulation software, through OS streaming or VDI, says Erhard Behnke, president of IGEL, a thin-client vendor.

Federal government customers tend to buy thin clients featuring XP Embedded with higher RAM and Flash requirements, says Eric Grayson, vice president of VXL Americas, a thin-client vendor. "It may be overkill for today, but it gives them options for the future. If they're just doing server-based computing today, they can move to streaming or full VDI in the future," he says.

Sather recommends Citrix XenApp and the ICA protocol over the Microsoft Terminal Server. Citrix is more robust and its protocol is more efficient. In addition, Citrix makes it much easier to build specific software images, giving different users or groups of users rights to a specific set of applications, he says.

CDW's large team of trained and certified specialists and partners can offer federal government agencies all the services and support they need to identify and implement thin clients, from consultations in choosing the right thin-client architectures and onsite integration to 24x7 technical phone support.

## V. Key Offerings

Thin-client manufacturers Wyse, HP, IGEL and VXL all offer a large portfolio of desktop and notebook thin-client devices that feature a wide range of specifications. They ship models that support Wi-Fi access and offer management software to help IT departments centrally manage their thin-client environment.

**Wyse Technology.** Wyse Technology is one of the leaders in the thin-computing space and actually holds the patent for the first thin client. Wyse has more thin clients deployed than any other company in the world.

Wyse's thin-client portfolio supports Linux, CE, XP Embedded, and Wyse's proprietary operating system, Wyse Thin OS. The company offers three classes of thin clients: The S class offers the smallest form factor and features a 366MHz processor, and the basic ports for peripheral

support. This model is aimed at users with a small number of applications.

The V class gives two processor options — either 800MHz or 1.2GHz, while offering more ports and the ability to run Wyse's TCX software portfolio, which supports multi-display capabilities, as well as USB virtualization and multimedia enhancements. TCX stands for Thin Client Extensions, enabling a much richer and smoother user experience. "This is where we've distanced ourselves from the competition," says Mike Brunner, Wyse's vice president of worldwide channel sales and marketing.

The X class is Wyse's family of thin notebooks. The X90 and X90e feature a 12.1-inch screen, and each weighs less than four pounds. Both models run XP Embedded, and utilize 1.2GHz processors and have built-in Wi-Fi. Both the X90e and the X90LE have smart-card readers and Bluetooth support. The X90L and X90LE feature a 15-inch screen and are available with 1GB or 2GB of Flash and RAM.

Wyse thin clients include Wyse Device Manager workgroup edition, and can be upgraded to an Enterprise edition for deployments over 1,000 units. With this software, IT administrators can update, troubleshoot and monitor the health of their entire network of thin clients from a central location. Wyse also has support for third-party management tools including SMS, IBM Tivoli and CA Unicenter. The company also has the ability to stream operating systems and applications with Wyse WSM.

**Hewlett-Packard.** HP, which recently purchased thin-client vendor Neoware and bolstered its Linux capabilities in the process, has the broadest portfolio of thin-client products. Not only does HP sell thin-client devices, but it also offers all the back-end solutions necessary to architect a system: from servers and networked storage to networking equipment and management software, says Eric Croswhite, marketing manager for HP's thin clients.

HP, which has integrated Neoware devices into its product line, includes a choice of four operating systems and specialty platforms for unique environments.

1. In the "essential" thin-client category, HP offers the t5135 with the Linux-based ThinConnect operating system, starting at \$199. It's a low-end device aimed at ICA or RDP connections of applications. It features a 400MHz

chip, 128MB of RAM and 64MB of Flash RAM. The t5135 with HP ThinConnect is a simple, straightforward network access solution with integrated connection brokers and support for a basic set of peripheral options.

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### *Desktop Virtualization:*

*"Desktop virtualization will change the face of the computing landscape forever. It's simply a question of when. It's the natural progression from the profitability gains and success seen in the server virtualization space. It becomes a very difficult argument for someone to justify putting a traditional PC on the desk in a virtualized desktop environment," says Mike Brunner, Wyse's vice president of worldwide channel sales and marketing.*

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2. In its "mainstream" thin-client category, HP sells several models for mainstream business use, including the HP Compaq t5530, the HP Neoware e140, e90 and c50 products. They support Windows CE and NeoLinux operating systems. NeoLinux is binary compatible with industry standard Linux, and it's so intuitive you don't have to know anything about Linux to set up or use it. The HP Neoware thin client offers a 1GHz processor, 256MB to 1GB of RAM and 128MB to 1GB of Flash memory.

3. The company's third class of thin clients is the "flexible" series, which includes recently announced thin-client models: The HP Compaq T5730 features an AMD Sempron 2100+ processor, 512MB of RAM and 1GB of Flash RAM. It comes standard with XP Embedded and includes a full web browser, wireless LAN support and support for local applications. The new HP Compaq t5735 thin client features the same specs, but runs Debian Linux 4.0.

"It has more processing capabilities and more Flash and memory support," Croswhite says. Many models include a PCI expansion module for peripherals and support for dual and quad monitors.

4. Finally, HP offers mobile thin clients as part of its specialty product line. The T6720 thin-client notebook weighs 5.4 pounds and features a 15.4-inch screen, Windows XP Embedded, Wi-Fi

support, PC card reader and a full Internet Explorer web browser. HP's blade PC specs are similar to regular PCs. For example, its HP BladeSystem bc2500 model features an AMD Athlon 64 processor, 4GB of RAM and an 80GB hard drive.

HP Image Manager is HP's streaming software that delivers full operating systems onto a thin client, where the software locally runs. For management, HP users have a variety of options to manage their thin clients centrally, including Altiris and HP Device Manager.

**IGEL Technology.** IGEL's thin clients take what the company calls a "universal desktop" approach, which allows thin clients to simultaneously support multiple protocols for accessing applications and data on the server, including ICA, RDP, VDI and others, says IGEL's Behnke.

That's important because IT departments often have to support heterogeneous application environments. "Our unique multiple protocol technology delivers a more robust, reliable solution, and our 'Universal Desktop' approach means customers can access a variety of digital services, including Voice over IP, SAP, mainframe terminal emulation and web browsing, all through one desktop appliance," Behnke says. IGEL's full line of thin clients supports the major desktop virtualization protocols, including VMware and Citrix.

IGEL offers several lines of thin clients, including the Smart Series, which is a small, affordable client aimed at general office workers or call-center employees who need access to server-based applications.

The Compact Series is more sophisticated and supports legacy connectivity, including mainframes, AS400 and other Unix environments. This series offers more security and includes an integrated smart-card reader. The Linux version includes the Firefox browser, while the Windows XP Embedded and CE versions feature Internet Explorer and Windows Media Player.

For example, the Compact 3210 LX model features a 600MHz processor, 128MB of Flash memory and 256MB of RAM. All IGEL thin clients support dual-monitor capability. Specific models offer Wi-Fi access. Every IGEL thin client comes with the IGEL Remote Management Suite 2 for central management of thin clients, including automatic set-up, instant roll-out of device updates, diagnostics and support.

**VXL Instruments.** VXL manufactures its own thin-client products, and as a result, can custom build specialized versions of its thin clients to customers, from changing the software image and ruggedizing the form factor to including peripheral devices, such as smart-card readers, web cams and other capabilities, Grayson says.

VXL offers a broad product line that includes desktops, wireless desktops, integrated devices that feature built-in monitors and notebook computers. Its product line runs on XP Embedded, CE and GIO Linux. They support applications running in server-based computing, virtualization and legacy systems.

The Itona TC7321-XP desktop, for example, features XP Embedded and 512MB of Flash memory and 512MB of RAM, but both are upgradeable to 4GB, Grayson says. The Itona TL3321-XP notebook computer features a 15-inch screen, Intel Celeron M processor (1.6GHz speeds), and 512MB of Flash memory and 512MB of RAM. The VXL clients can be centrally administered through VXL's XLManage software.

## VI. Future of Thin Clients

Today, no one will ever make the brash prediction that thin clients will ever dominate or completely replace the corporate computer market. But thin clients will continue to have a strong, steady annual growth rate of about 15 to 20 percent a year, says IDC's O'Donnell. In fact, by 2010, thin clients should make up about 13 percent of corporate desktop computer deployments, he says.

Many headlines say thin clients are making a comeback. But in reality, the technology has never gone away. It's just getting a lot of buzz right now because the technology has gotten better, and IT administrators are taking notice. They are realizing that they should strongly consider thin clients because of their benefits: the improved security, ease of manageability and lower costs. They are also highly available and more environmentally friendly.

Thin-client computing has its place, and it does have its business value, and that's why the technology is making inroads into the corporate, educational and government sectors. ♦