



## The Windows Embedded Family: An Integrated, Scalable Platform for Building Thin Client Devices

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### White Paper

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#### **Abstract**

Thin clients are purpose-optimized devices that provide network-based access to applications hosted on remote terminal servers. Thin clients are key components in the trend toward distributed computing, where server-based computing solutions offer line-of-business (LOB) applications deployed via the Terminal Services functionality in the Windows Server™ family or via Web-based services. The Windows Embedded family of operating systems, which includes Windows CE .NET and Windows XP Embedded, provides a scalable range of functionality to build the primary types of thin client devices: basic, browser, and LOB terminals.

This white paper is written for business decision makers in embedded device manufacturing who are evaluating the Windows Embedded family of operating systems for building a thin client device.

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## **Introduction**

Thin clients are purpose-optimized devices that provide network-based access to applications hosted on remote terminal servers.

Thin clients are key components in server-based computing solutions where line-of-business (LOB) applications are deployed via the Terminal Services functionality in the Windows Server family or via Web-based services.

The Windows Embedded family of operating systems, which includes Windows CE .NET and Windows XP Embedded, provides a scalable platform to build a range of thin client terminals including: basic terminals, browser terminals, and LOB terminals.

This white paper is written for business decision makers in embedded device manufacturing who are evaluating the Windows Embedded family of operating systems as a platform to build a thin client device.

In this white paper, you will find information about thin client industry trends, Microsoft's strategy for thin clients, and an overview of the solutions that Microsoft offers to original equipment manufacturers (OEMs) who plan to bring thin client devices to market.

## Industry Trends Affecting OEMs in the Thin Client Industry Today

The primary driving factor behind server-based computing and thin client shipments today is the business customer's need to reduce the total cost of ownership (TCO) of IT solutions by provisioning task-based workers with terminals that have minimal, locked-down local applications.

According to an Intelliquest study<sup>1</sup>, the most substantial TCO savings from typical thin client deployments are realized in five key areas:

- Reduced network administration costs (55 percent of savings)
- Less “informal administration” such as workers spending time to help co-workers with technical issues (14 percent)
- Lowered hardware acquisition costs (13 percent)
- Easier deployment of application software upgrades (11 percent)
- Lowered operating-system upgrade deployment costs (3 percent)

One significant advantage of server-based computing is that client devices do not have to be capable of locally processing sophisticated Windows-based applications to access and use the application. Since a powerful central server (or multiple servers organized to work collectively) handles all application execution, processing and data storage, the client device primarily manages display updates and relays mouse clicks and keystroke inputs. These straightforward device functionality requirements allow OEMs to maintain a substantially lower bill of materials (BOM) cost on each device that they sell, because less powerful processors, more limited memory, and fewer parts overall can be used in designs.

To help meet enterprise customer expectations for lower TCO, OEMs must be able to develop a thin client solution that meets the following five key requirements:

- **Server integration.** Business customers seek an end-to-end solution that combines devices, peripherals, local and server-based applications, network protocols, management and administration tools, and Web browsing and multi-media capabilities. Increasing the level of integration between each of these components while deploying server-based applications using Terminal Services helps enterprises reduce their TCO.
- **Simplicity of deployment.** Thin clients can provide significant deployment advantages at installation and in ongoing operations. For example,

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<sup>1</sup> Intelliquest

enterprises find that server-based computing architectures allow them to rapidly roll out new LOB applications. Deployment is accomplished entirely via the server installation of that application, after which each client device simply accesses the new application using Terminal Services. The ability to centrally manage each thin client device using a systems management solution, such as Microsoft Systems Management Server, also reduces the ongoing cost of the deployment by providing integrated asset inventory, software deployment, and update services.

- **Familiarity of use.** Thin clients provide advantages in terms of ease of use and lowered training costs. Because thin clients allow users to work entirely in the familiar user interface environment of Windows and Windows-based applications, enterprises do not need to invest in training their employees to use new or non-Windows operating systems or unfamiliar user interfaces.
- **Client robustness.** Thin clients use embedded operating systems that can run on low-powered hardware with solid-state storage, and are fan-less and disk-less with no moving parts. This leads to much higher hardware reliability; lower service, maintenance, and repair costs; and a longer mean time between failure (MTBF). A second advantage of not storing data locally is increased security. For example, enterprise data is stored and managed centrally on a secure server and accessed by the thin client as needed.
- **Desktop-class local application support.** Thin clients should give customers access to in-demand functionality that is locally hosted and executed, such as local multimedia playback or Web browsing. Since many customers look to thin clients as a bridge between legacy terminal/mainframe deployments and the future wave of network-aware applications enabled by the Microsoft .NET Framework, there is also a need (in certain, more advanced thin clients) to locally run and execute a single LOB application.

## Thin Client Industry Overview

Today, the server-based computing industry has matured to the point where enterprise customers have thoroughly evaluated the underlying benefits of the solution and are beginning to deploy thin clients broadly. According to industry analyst firm IDC<sup>2</sup>, the enterprise thin client market segment is forecasted to more than double its unit volume shipments worldwide in the next several years, growing from just over 3 million units in 2002 to 7.6 million units in 2006. Windows Embedded thin client shipments are expected to grow at a 26 percent compound annual growth rate (CAGR), continuing to comprise the clear majority (75 percent) of all enterprise thin client shipments.

Enterprise thin clients have a common set of design considerations:

- **No local application processing.** In general, all application processing in thin client deployment scenarios is performed on the Terminal Server. No local application processing occurs on the thin client, with the exception of a local Internet browser and supporting plug-ins. However, this is beginning to change as more OEMs add functionality to drive local peripherals such as printers and scanners, and increasingly run local LOB applications alongside applications that employ Terminal Services.
- **Optional terminal emulators.** Thin client devices frequently include third-party terminal emulation suites, which allow the user to create a TTY or VT100 emulation mode to a remote host over an installed Telephony API (TAPI) device.
- **No moving parts, including fans and rotating media.** Many thin client designs seek to improve security for corporate data and reduce TCO through sealed-case designs that eliminate moving parts.
- **Task-oriented user interface/shell.** Thin client devices can offer connection-oriented user interfaces that simplify training and deployment in task-oriented environments.

As the volume of thin client shipments increases, so do the demands that enterprises place on these devices. Though still widely employed as replacements for legacy green-screen terminals, thin clients are increasingly used in scenarios where workers require access not only to server-based applications, but also to Web services (via a browser), multimedia services, local applications, and local attached peripherals.

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<sup>2</sup> IDC, "Thin Is In, Again: Enterprise Thin Client Forecast and Analysis, 2000-2005"

## Thin Client Device Segmentation

The growing local application functionality available in thin clients has resulted in three primary, industry-acknowledged device segments:

- **Basic Terminals.** Basic terminals are often used as terminal and green-screen replacements, offering a terminal services client and networking protocol support to connect automatically to a terminal server and access server-hosted applications. Terminals offer the lowest device acquisition cost and the least functionality, due to limited memory and storage requirements, the absence of moving parts, and overall simplicity of design.
- **Browser Terminals.** In addition to basic terminal functionality, browser terminals add a local Windows-like UI shell and browser software, providing access to Web-based and Terminal Services-hosted applications.
- **Line-of-Business (LOB) Terminals.** In addition to basic and browser terminal functionality, LOB terminals add support that enables the local execution of a limited number (typically one) of managed or unmanaged applications in environments with non-persistent network connectivity or requirements for offline use.

## Thin Client Usage Segmentation

Regardless of the functionality enabled, thin clients are most commonly and productively deployed in one of four business usage environments:

- **Rapid deployment of Windows LOB applications and Web-based services to task workers.** In this scenario, Windows 2000 Terminal Services provides the server-side infrastructure.
- **Replacement of traditional green-screen terminals.** Windows Embedded thin clients can be implemented with similar form factors as legacy green screen terminals, including a low bill of materials cost and no moving parts. With built-in terminal emulation software, these devices provide a compelling migration path from legacy environments to richer Windows and Web-based environments.
- **Kiosks.** This segment includes usage such as customer service kiosks in retail environments and in-room Internet/services access for hotels.
- **Client environments that are too harsh for conventional PCs.** For environments where the operating conditions or availability of IT support resources preclude the use of personal computers, Windows Embedded thin clients offer a durable, stable alternative.

## The Microsoft Strategy for Thin Clients

Microsoft has been delivering thin client solutions to enterprise customers since 1998, when it introduced platform software for the first instantiation of a Windows Embedded thin client called a Windows-based Terminal (WBT).

### Core Business Drivers for OEMs

Today, a wide range of OEM partners have introduced a variety of thin client products based on Windows CE .NET and are increasingly basing products on Windows XP Embedded. At the time of their original introduction in 1998, the core business and technology drivers for Windows Embedded thin client solutions were:

- The desire to run businesses within the context of financial constraints.
- The realization that a one-size-fits-all model for desktop client computing is not always viable when comparing task versus knowledge workers.
- The desire to deploy devices and applications rapidly, especially in the context of replacing old terminal infrastructure to make way for the next generation of Windows-based applications.

These factors still affect the thin client industry, especially in relation to reducing TCO in a difficult global economy. Adding to these factors is the coming transition to distributed computing, where personal computers and smart devices access next generation applications deployed as Web-based services. The shift to distributed computing is the basis for Microsoft's focus on Microsoft .NET.

### Microsoft's Strategy for OEM Partners

Microsoft's strategy for the thin client industry today is based on three primary objectives:

- Provide a scalable line of footprint-optimized operating systems for each thin client device segment—basic, browser, and LOB terminals.
- Continually enhance and extend existing thin client and server-based computing solutions with the most recent technologies and performance enhancements.
- Deliver new functionality that extends the range, features, and enterprise network manageability of thin clients used in corporate, task-based worker environments, particularly in the areas of device management, Web services, managed code support, and voice communications.

Microsoft helps OEMs succeed in the marketplace for thin client devices by providing a scalable product line of componentized operating systems. Flexible platforms help meet the requirements of customized devices while ensuring

integration between those operating systems and other Microsoft technologies that are key to server-based computing deployments.

[Windows CE .NET](#) and [Windows XP Embedded](#) each offer a sample Windows Embedded thin client configuration within the Platform Builder and Target Designer development tools, respectively. By helping OEMs jump-start their development projects and then add additional technology components to their base thin client configurations, these sample configurations and developer tools enable OEMs to quickly create highly differentiated offerings.

Combining a truly end-to-end Terminal Services implementation, rich enterprise integration capabilities, and the familiarity of Windows into a single thin client solution for OEMs, Microsoft is catalyzing the development of the thin client industry while continuing to invest heavily in the underlying technologies that will power the next generation of thin client devices. In the section that follows, you will find more detail on the Microsoft thin client solution and its benefits.

## Thin Client Solution Overview

To accommodate emerging requirements for the distributed computing environment, Windows Embedded thin client operating systems are evolving to include more sophisticated technologies that incorporate Internet standards. With this evolution in mind, Microsoft's strategy for the thin client industry today is based on three primary objectives:

- Provide a scalable line of footprint-optimized operating systems for each thin client device segment.
- Continually enhance and extend existing thin client and server-based computing solutions with the most recent technologies and performance enhancements.
- Deliver new functionality that extends the range, features, and enterprise network manageability of thin clients used in corporate, task-based worker environments, particularly in the areas of device management, Web services, managed code support, and voice communications.

This section provides a detailed overview of each of these pillars and how, together, they form a comprehensive thin client solution.

## Windows Embedded Operating Systems and Thin Client Requirements

Windows Embedded thin clients can be built to incorporate any features and components from the underlying Windows Embedded operating system on which they are based. The following chart illustrates how core thin client feature requirements are addressed by Windows CE .NET 4.2 and Windows XP Embedded.

**Table 1. Thin Client Features Supported by Windows CE .NET 4.2 and Windows XP Embedded**

Feature Name	Feature Description	Windows CE .NET	Windows XP Embedded
Terminal Services, with Microsoft Remote Desktop Protocol 5.1	A service that allows a thin client, such as a Windows-based Terminal (WBT), to communicate with a terminal server across a LAN, WAN, or by means of a dial-up, ISDN, DSL, or virtual private network (VPN) connection.	•	•
Telnet Server	A sample server that allows remote administration through a standard Telnet client.	•	•
HTTP	Hypertext Transfer Protocol	•	•
SNMPv2	A standard Internet protocol for	•	•

Feature Name	Feature Description	Windows CE .NET	Windows XP Embedded
	monitoring and managing networks.		
Full .NET Framework Support	Hardware-independent program execution environment for secure downloadable applications.		•
.NET Compact Framework Support	Hardware independent program execution environment for secure downloadable applications targeting and optimized for resource-constrained computing devices.	•	
Full Win32® API application support	A comprehensive class library and complete object-oriented application framework designed to build applications, components, and controls.		•
Windows CE Win32 variant APIs as supported in Standard Windows CE SDK	A subset and variant of the full Win32 API class libraries and object-oriented application framework designed to build applications, components, and controls.	•	
Remote Boot	Allows the booting of an image on a client device without requiring the device to have persistent storage, such as a hard drive or Flash RAM memory.	•	•
System Management Server client	A client that provides a transparent manageability solution for embedded devices.	•	•
WMI	Windows Management Instrumentation, the Microsoft implementation of Web-based Enterprise Management (WBEM), an industry initiative to develop a standard technology for accessing management information in an enterprise environment.		•
Voice over Internet Protocol (VoIP) Support	A rapidly emerging technology for voice communications that uses the ubiquity of IP-based networks.	•	•
Internet Explorer	Web browser software.	Internet Explorer 6	Internet

Feature Name	Feature Description	Windows CE .NET	Windows XP Embedded
6		for Windows CE	Explorer 6
Windows Explorer shell and Windows XP shell	A shell that is functionally equivalent to the shell on the Windows-based desktop platforms.		•
Flash Plug-ins	Plug-ins for the rendering of Macromedia Flash files.	(1) Available through third parties	•
Acrobat Plug-ins	Plug-ins for the rendering of Adobe PDF files.	•	•
Broad Windows XP plug-in compatibility	Ability to convert any Windows XP-compatible plug-in to a Windows XP Embedded component.		•
Java support via third-party technology	Support for the Java run-time environment.	•	•
ARM, MIPS, SH Processor Support	Ability to run the operating system on hardware from a variety of vendors and architectures.	•	
X86 Processor Support	Ability to run the operating system on x86 architecture-compatible hardware.	•	•
Windows CE-compatible device drivers	Support for device drivers compatible with Windows CE .NET.	•	
Full Windows XP device-driver compatibility	Support for device drivers compatible with Windows XP Embedded.		•
Power Management	Fully implemented Power Manager framework, including all APIs and features. Applications and drivers can suspend the system, control device power levels, and register for notifications of power related activities, such as suspend, absence of user/system activity, and change in battery level. Drivers can intelligently self-	•	•

Feature Name	Feature Description	Windows CE .NET	Windows XP Embedded
	manage power.		
MP3	A codec for MP3 file playback within DirectShow.	•	•
Windows Media® 8	A rich set of components, along with state-of-the-art Windows Media audio/video codecs to enable audio and video streaming.	•	•
Windows Media 9		Windows Media 9 codecs only	•

### Server and Network Technologies: Windows Server 2003 Terminal Services

Server-based computing represents an application deployment methodology. Thin clients are ideal client devices for the following server-based computing scenarios:

- **Windows-based applications deployed via Windows 2000 or Windows Server 2003 Terminal Services.** In this scenario, a Windows Embedded thin client uses Microsoft's Remote Desktop Protocol (RDP) or Citrix' ICA<sup>3</sup> (Independent Computing Architecture) protocol to access applications deployed via Terminal Services.
- **Web-based applications deployed via Web server infrastructure.** Many Windows Embedded thin clients include local Internet Explorer browser software and are ready to access LOB applications deployed on corporate intranets or as Web-based services.
- **Legacy host-based applications via terminal emulation.** Windows Embedded thin client OEMs frequently include terminal emulation software with their devices. In this scenario, a Windows Embedded thin client provides a compelling migration path from aging green-screen terminals to applications deployed as user experience-enriching Windows-based applications or Web-based services.

The Terminal Services component of the Microsoft Windows 2000/2003 Server operating system can deliver the Windows 2000/2003 desktop as well as the latest Windows-based applications to virtually any display-based computing device, including those that cannot run Windows. This functionality lets more people in an organization take advantage of the resources provided by a distributed computing environment. Terminal Services can also be used to remotely administer a Windows 2000/2003-based server.

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<sup>3</sup> Available with Citrix' Metaframe add-on product

Terminal Services client software is available for a variety of different client hardware devices, including Windows PCs and Windows Embedded thin clients. Terminal Services lets enterprises more easily and cost-efficiently accomplish the following goals:

- **Centrally deploy and manage Windows-based applications to virtually any type of client, over any type of network connection.** Organizations can use Terminal Services in Application Server mode to deliver Windows-based applications to heterogeneous desktop environments over local area networks (LAN), wide area networks (WAN), and dial-up connections. This is a cost-effective way to deploy LOB applications that are frequently updated, hard to install, or need to be accessed over low-bandwidth connections. Using Terminal Services, companies can ensure that all clients are using current versions of an application because the software is installed once on a server, rather than on each desktop throughout the company. This model reduces the costs and challenge of updating desktop machines, especially for remotely located desktops or branch office environments. In addition, Terminal Services features such as Remote Control can simplify application support.
- **Phased hardware upgrades.** By giving users access to current applications on hardware that might otherwise be of minimal use, Terminal Services can help companies gradually replace older hardware while maintaining a functional work environment.
- **Remote administration of Windows 2000/2003-based servers.** Using Terminal Services can give administrators greater flexibility and mobility. Administrators can securely manage their Windows 2000/2003-based servers over any network connection from any device using the Terminal Services Client software. The client device does not need to be running Windows 2000/2003 Professional. This lets an administrator perform tasks such as directory maintenance, virus scans, backups, reboots, and even promoting a server to be a domain controller—all from a remote location.

Terminal Services extends the model of distributed computing by allowing computing devices to operate in a server-based computing environment. With Terminal Services running on a Windows 2000/2003-based server, all client-side application execution, data processing, and data storage occur on the server. Applications and user desktops are transmitted over the network and displayed via terminal emulation software. Similarly, print streams, keyboard input, and mouse clicks are also transmitted over the network between the server and the terminal emulation software. Each user logs on and sees only his or her individual session, which is managed transparently by the server operating system and is independent of any other client session.

Windows 2000/2003 Terminal Services consists of five components, as shown in Table 2 below.

**Table 2. Windows 2000/2003 Terminal Services Components**

Component	Description
Multi-User Kernel	The multi-user kernel extensions have been enhanced and fully integrated as a standard part of the Windows 2000/2003 Server family kernel.
Remote Desktop Protocol	A key component of Windows 2000/2003 Terminal Services is the protocol that allows a client to communicate with the terminal server over a network. This protocol is based on International Telecommunications Union's (ITU) T.120, an international standard, multiple-channel protocol first used in Microsoft NetMeeting® conferencing software. It is a Unicode-compatible protocol tunable for any environment that allows for network localization, automatic disconnection, and remote configuration. It supports three levels of encryption. It also supports different bandwidth allocations by allowing client-side bitmap caching and optional compression for low-bandwidth connections.
Terminal Services Client	The client software that displays the familiar 32-bit Windows user interface on a client machine. The client software is a very small-footprint software application that establishes and maintains the connection between a client and a server running Terminal Services. It transmits all input from the user to the server, such as keystrokes and mouse movements, and all output from the server such as application display information and print streams. In addition, it enables out-of-band communications ("virtual channels") between client and server to manage interactions and data redirection with local peripherals on the client.
Terminal Services Licensing Service	This service is required whenever Terminal Services is enabled for application serving. The service allows Terminal Services to obtain and manage its Terminal Services Client Access Licenses (CALs) for connecting devices. It can manage unlicensed, pre-licensed, temporarily licensed, and client-accessed licensed clients, and supports both ordinary CAL and Internet Connector Licensing for Terminal Services. The Remote Administration mode does not use the Terminal Services Licensing service. Terminal Services Licensing is a component service of Windows 2000/2003 Server, Advanced Server, and Datacenter Server.
Terminal Services Administration Tools	The administration tools consist of software that manages Terminal Services, including Terminal Services License Manager, Terminal Services Client Creator, Terminal Services Client Configuration, and Terminal Services Manager.

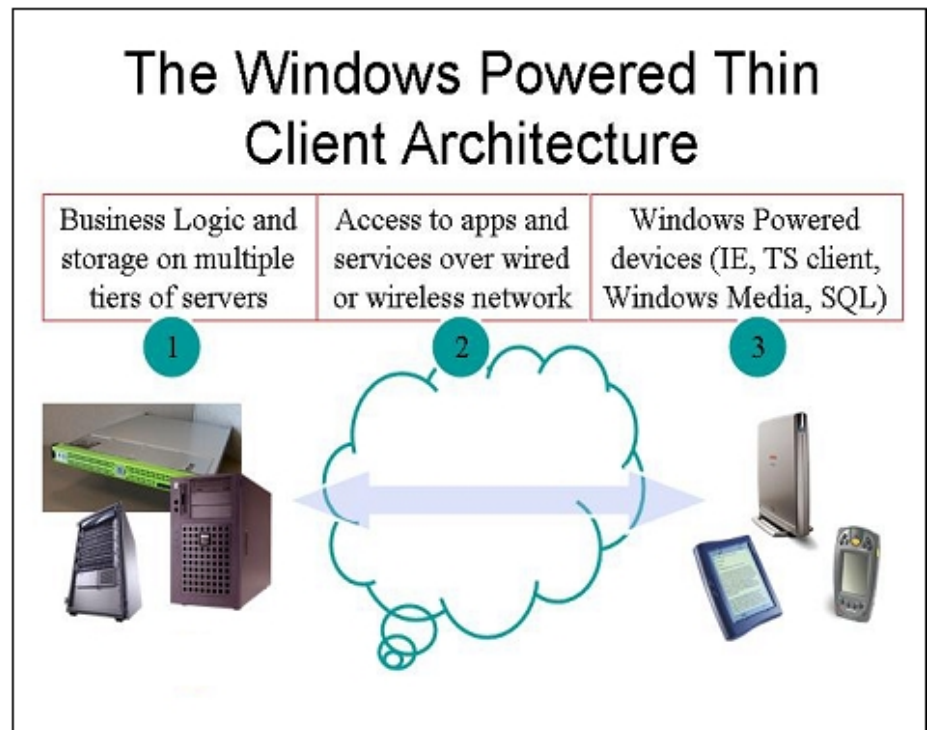


Figure 1. Typical Server-based Computing Architecture

### Emerging Technologies

Microsoft .NET is Microsoft's platform for building, deploying, and running Web services and applications, enabling software as a service and the transition of applications to XML Web-based services. Windows Embedded thin clients built on Windows CE .NET and Windows XP Embedded contain built-in support for key Internet standards and Microsoft .NET technologies, including Internet Explorer, XML, SOAP, .NET Framework or .NET Compact Framework, the Common Language Runtime (CLR), and Active Server Pages.

### Assembling an End-to-End Solution

Windows Embedded thin clients are a key element in an end-to-end server-based computing solution. In addition, however, a complete solution will include some or all of the following components:

- Server hardware and network infrastructure that supports the desired number of users
- Microsoft Windows Server and Microsoft Enterprise Server products such as Microsoft SQL Server™ 2000 or Microsoft Exchange Server 2000

- LOB and/or productivity applications such as Microsoft Office XP, Microsoft Great Plains Business Solutions, or other applications based on Win32 APIs or the .NET Framework

### How Do I Choose the Right Operating System for a Windows Embedded Thin Client?

Windows Embedded thin clients incorporate functionality from the underlying Windows Embedded operating system on which the thin client is based. Although they are each embedded operating systems, Windows CE .NET and Windows XP Embedded offer differing feature sets. Table 3 below may help you decide which Windows Embedded operating system best suits your thin client device design.

**Table 3. Thin Client Device Types and Recommended Windows Embedded Operating System**

Thin Client Device Type	Operating System Recommendation	Comment
Basic Thin Client Terminal	Windows CE .NET	The simple, low-cost Windows Embedded solution for replacement of traditional green-screen terminals and the rapid deployment of server-based LOB applications to task-oriented workers.
Browser Thin Client Terminals	Windows CE .NET or Windows XP Embedded	Choose Windows CE .NET for Browser Terminals that are deployed and used primarily for accessing defined Intranet content. Choose Windows XP Embedded for Browser Terminals that need broad access to Internet content and require the ability to download plug-ins and ActiveX® Controls.
LOB Thin Client Terminals	Windows XP Embedded	The high-end Windows Embedded thin client solution that delivers no-compromise functionality, including full Internet Explorer 6 browser, extensive device-driver availability, local Win32 application support, and the highest levels of robust performance.

## Why Windows Embedded for Thin Clients?

The opportunity to bring to market a Windows Embedded thin client offers OEMs and their customers a broad set of benefits. Table 4 below presents some of the OEM benefits.

**Table 4. Windows Embedded Benefits for Thin Client OEMs**

Benefit	Description
Terminal Services	The Windows Embedded family of operating systems offers a complete Terminal Services solution, with full support for Remote Desktop Protocol 5.1 and the Terminal Services client for seamless integration with Terminal Services in Windows Server 2000/2003. This allows the OEM to build a product that is rich in the core server-based computing functionality that enterprises are seeking to enable when they decide to deploy thin clients.
Enterprise Integration	Both Windows CE .NET and Windows XP Embedded include multiple technologies designed to ease integration with an enterprise's existing and future information technology infrastructure, including device management technologies such as SMS and WMI, security features, and authentication. This allows OEMs to market thin clients to customers who plan to deploy them in heterogeneous environments, where task-focused workers use thin clients while knowledge workers use managed PCs, without forcing IT managers to adopt dual-management paradigms to maintain both types of devices.
Familiarity of Windows	Enterprises are bombarded today with new technology platforms to choose from and deploy, so IT managers increasingly look for solutions that will lower TCO in part through reduced training costs. By delivering the familiarity of Windows, including its user interface, support for applications such as Internet Explorer or Windows Messenger, as well as compatibility with Win32 and .NET applications, Windows Embedded thin clients meet the definition of a solution that can be widely deployed without incurring large training costs for workers who are already familiar with using desktop PCs and Windows-based applications.

The Microsoft solution for thin clients offers the following platform benefits for OEMs who seek to bring the highest quality product to market, and for customers who deploy those products:

- High reliability, due in part to the absence of internal fans or rotating media as well as the highly tested reliability of the Windows Embedded family of operating systems.
- Security technologies to help protect corporate data (for devices designed without local storage).
- Simple setup right out of the box, just like a terminal.
- Relatively low capital costs and a centralized management model that reduces TCO. Gartner Group studies demonstrated that Windows Embedded thin clients could reduce TCO by 32 percent over unmanaged PCs.
- An easy transition to new applications platforms, because emulation enables the easy replacement of green-screen terminals while local Internet Explorer browser software and Terminal Services clients enable access to next-generation Windows-based applications.

## Summary

Industry requirements such as server integration, simplicity of deployment, familiarity of use, client robustness, and desktop-class application support are driving rapid adoption of thin clients in today's enterprises. Basic terminals, browser terminals, and line-of-business terminals are each being adapted to perform in the most prevalent deployment scenarios, including rapid deployment of Windows- or Web-based applications, replacement of green-screen terminals, kiosks, and environments that are too physically harsh for conventional PCs.

Microsoft's strategy for the thin client industry is designed to address these driving factors by:

- Providing a scalable line of footprint-optimized operating systems for each thin client device segment—basic, browser, and line-of-business.
- Continually enhancing and extending existing thin client and server-based computing solutions with the most recent technologies and performance enhancements.
- Delivering new functionality that extends the range, functionality, and enterprise network manageability of thin clients in corporate task-based worker environments.

The Windows Embedded family of operating systems offers a comprehensive, flexible, and robust set of solutions for thin clients. Aligned with the Microsoft strategy for thin clients, devices built on Windows Embedded operating systems offer a best-of-breed Terminal Services solution, deep integration with enterprise technologies for management, enhanced security and authentication technologies, and the familiarity of the Windows operating systems and user interfaces.

## Related Links

For the latest information on Windows Embedded thin clients, visit:

<http://www.microsoft.com/windows/powered/thinclients/>

For detailed product information on Windows CE .NET, visit:

<http://www.microsoft.com/windows/embedded/ce.net/>

For detailed product information on Windows XP Embedded, visit:

<http://www.microsoft.com/windows/embedded/xp/>

For information about device platform partners who provide hardware, software, and services to help manufacturers bring to market Windows Embedded thin client devices, visit:

<http://www.msweb.com/partner/thinclient/>

For the latest information on the Microsoft Windows 2000/2003 Server family and Terminal Services, visit:

<http://www.microsoft.com/windows2000/technologies/terminal/default.asp>

For more information about Microsoft Windows Server family and Terminal Services licensing, including special situations such as access via Application Service Providers (ASPs), visit:

<http://www.microsoft.com/windows2000/server/howtobuy/pricing/default.asp>

## Appendix A: What is the Difference Between Microsoft's Remote Desktop Protocol (RDP) and Citrix Independent Computing Architecture (ICA)?

Windows 2000/2003 Terminal Services supports the native Microsoft Remote Desktop Protocol (RDP) as well as the Citrix Independent Computing Architecture (ICA) protocol (via the Citrix MetaFrame add-on). The following table provides an overview of the features available with each of these protocols:

**Table 5. Windows 2000/2003 Terminal Services Supported Protocols and Features**

Feature	Description	RDP 5.1	ICA
Clients	Windows CE-based thin client	•	•
	Windows XP Embedded-based thin client	•	•
	ActiveX® Control	•	•
Transport	TCP/IP	•	•
	SPX, IPX, NetBEUI		•
	WAN connection	•	•
	Dial-up, VPN, xDSL	•	•
	Direct dial-up (non-RAS)		•
Audio	System beeps	•	•
	Stereo Windows audio		•
Local Printing	Printing to a local printer attached to a thin client	•	•
Local Drive Mapping	Local drives accessible from server-based applications	•	•
Local Port Redirection	Redirection of server ports (LPT/COM) to local client ports	•	•
Cut and Paste	Cut and paste of text and graphics between client and server	•	•
User-centric Session Access	Client remembers previous user's logon name for each connection	•	
	Connect to an active or disconnected session using a different screen resolution	•	

Feature	Description	RDP 5.1	ICA
	Connect directly to an application rather than to an entire desktop	•	•
	Server-based applications resize and minimize similar to local applications		•
Application Publishing	Advertise server-based applications directly to client desktops		•
Resolution	16-bit color depth	•	•
Load Balancing	Pooling of servers behind a single server address and for increased availability	• <sup>1</sup>	•
Remote Control	Viewing and interacting with other client sessions (also called "shadowing")	•	•
Bitmap Caching	Optionally cache display bitmaps in memory for improved performance	•	•
	Optionally cache display bitmaps to disk for improved performance	•	•
Encryption	Multiple-level encryption for security of client communications	•	•
	Multiple-level encryption on Windows CE thin clients	•	
Automatic Client Update	Administrative means for updating client connection software from the server	• <sup>2</sup>	•
Pre-configured Client	Predefined client with published applications, IP addresses, server names, and connection options	•	•

<sup>1</sup> Requires Windows 2000 Advanced Server or Datacenter Server

<sup>2</sup> Not available on Windows CE .NET thin clients

## Appendix B: OEMs Who Have Adopted Windows Embedded Thin Client Solutions

The following is a list of OEMs and Systems Integrators who have adopted Windows Embedded thin client solutions:



- Acer  
<http://global.acer.com>
- BSquare  
<http://www.bsquare.com>
- Compaq Computer Corporation  
<http://www.compaq.com>
- Eizo Nanao Corporation  
<http://www.eizo.com/products/wbt/index.html>
- IBM Corporation  
<http://www.ibm.com>
- National Semiconductor  
<http://www.national.com>
- Neoware Systems, Inc.  
<http://www.neoware.com>
- Network Computing Devices, Inc.  
<http://www.ncd.com>
- PRAIM, Inc.  
<http://www.praim.com>
- TeleVideo, Inc.  
<http://www.televideo.com>
- VenturCom, Inc.  
<http://www.vci.com>
- VXL Instruments Limited  
<http://www.vxl.net>
- Wyse Technology  
<http://www.wyse.com>