



64 bit Editions of Windows Evaluation Guide

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Published: September 2001

Abstract

This guide explains the 64 bit Editions of the Microsoft® Windows® operating system including major technical benefits, comparisons with 32 bit functionality, tuning and optimization, and conversion of applications to the 64 bit Windows environment. This guide is intended for executives and technical professionals.

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Introducing the 64 bit Editions of Windows

Introducing the 64 bit Editions of Windows

Building upon the success of earlier versions of the Windows® operating system, Microsoft has released two new 64 bit Editions of Windows, namely Windows XP, 64 bit Edition for the Workstation and Windows Advanced Server, Limited Edition for the Server. These products continue Microsoft's trend of developing software that takes advantage of improvements in hardware technologies. These versions of Windows extend the capabilities of previous versions as an enterprise class operating system, adding support for Intel's new 64 bit Itanium™ processor and 64 bit processing. Since a total migration to the 64 bit environment will not happen overnight, the 64 bit Editions of Windows provide interoperability with 32 bit applications.

Organizations interested in improving employee productivity and lowering capital costs should look into the merits of the 64 bit Editions of Windows. The combination of either of the 64 bit Editions of Windows products and the Itanium™ processor provide the following:

- **Greater throughput** by supporting parallel processing and increased memory capacity.
- **Application performance improvements** for engineering, graphics, and encryption applications through enhanced mathematical computational ability.
- **Ability of servers to handle an increased number of users and connections** through an increase in memory capacity and support for faster processors and parallel processing.
- **Increased hardware reliability** through predictive error checking and notification of failures.
- **Improvements in network administration** through new tools for managing the Active Directory™ service and for deploying servers.

The 64 bit Editions of Windows offer significant performance advantages for applications that can take advantage of the 64 bit architecture. The 64 bit platform increases the performance of these applications by providing high availability, advanced scalability, and large memory support. These features can be leveraged to provide benefits in the following areas:

- **Technical Computing** where managing large and complex drawing and assembly models is necessary. Applications include:
 - CAD/CAM (Computer Aided Design/Manufacturing)
 - Engineering Analysis
- **Digital Content Creation** where complex models and scenes are created which need fast rendering at high resolution. Applications include:
 - Photo/Image editing
 - Video composition and editing
 - 3D Animation and rendering

- **Enterprise Database** where fast access and processing of data is required. The types of applications that would benefit include the following:
 - Applications that access very large databases
 - Data Warehousing
 - Business Intelligence applications
 - Decision Support Systems (DSS)
 - Scientific and financial modeling applications
- **Web Services** where performance and support for a large number of users is necessary. Typical scenarios include:
 - Internet / Intranet Web sites
 - Web hosting
- **Business / Transaction Processing** where complex business needs are addressed. The 64 bit Editions of Windows on the Itanium™ processor allow more efficient processing of transaction and query operations for:
 - Complex business applications and electronic resource planning systems (such as PeopleSoft, SAP, and Baan)
 - Online transaction processing (OLTP)
 - Data mining
- **Security** where access to on-line transactions and corporate resources requires protection. The protection capabilities of the 64 bit Editions of Windows can be realized by organizations that provide the following:
 - E-commerce and E-business applications
 - Extranets
 - Access to corporate data and Intranets by mobile and/or remote users
 - Web hosting

As the use of 64 bit Editions of Windows continues to grow, the features can be leveraged while current IT investments are protected through support of 32 bit applications. Within the next calendar year, Enterprise and Datacenter versions of the software will be released which are members of the next generation of Microsoft's Windows Server family, Windows.net.

Reference Materials

- Windows 2000 Advanced Server, Limited Edition Web site - <http://www.microsoft.com/WINDOWS2000/64bit/overview>
- Windows XP Web site - <http://www.microsoft.com/windowsxp/>

Purpose of this Evaluation Guide

“Begin with the end in mind.”

Covey

Purpose of this Evaluation Guide

The purpose of this guide is to furnish the information necessary to evaluate Microsoft's 64 bit Editions of Windows. Specifically, this comprehensive guide delivers on four major areas:

- How to evaluate the 64 bit Editions of Windows
- The major technical benefits of the 64 bit Editions of Windows
- Evaluating the 64 bit Editions of Windows in a prototype lab environment
- Evaluating specific software applications for the 64 bit Editions of Windows

This guide is directed towards executives and technical professionals who are familiar with the 32 bit Windows 2000 Operating System. In-depth technical information is provided to assist with the evaluation, including:

- Comparing the 64 bit Editions of Windows environment with 32 bit Windows
- Tuning and optimizing the 64 bit Editions of Windows
- Converting (porting) applications to the 64 bit Editions of Windows environment

This guide is divided into sections by topic, allowing the reader to easily refer to specific areas of interest. Each section begins with an overview of what is covered in the section and concludes with sources for related and referenced material.

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64 bit Editions of Windows Evaluation Guide

Section 1 **How to Evaluate the 64 bit Editions of Windows**

Section Summary

■ *The successful evaluation of a new operating system is more than just installing the software in a lab and looking for “cool features” and new games. The “Setup Wizard” does allow an engineer to install the 64 bit Editions of Windows with little or no planning; however, a careful evaluation requires that the engineer know what to look for, how it fits with their business needs, how to validate it, and how to measure it. This requires a sound methodology.*

Employing a well-constructed methodology will greatly enhance the quality of the evaluation. Alternatively, a haphazard and unsystematic evaluation will tend to produce random and unconstructive data.

This section outlines a methodology for evaluating the 64 bit Editions of Windows, producing results that are meaningful and useful for making a well-founded business decision about Microsoft’s next generation operating system.

Methodology to evaluate the 64 bit Editions of Windows

Both Windows XP 64 bit Edition and Windows Advanced Server, Limited Edition contain many new features and enhancements (detailed in the following sections). Some of these features may prove to be compelling reasons to adopt the 64 bit Editions of Windows; some of these features may have limited benefit, while other features may have little impact in the decision process. A carefully planned evaluation can determine the impact of the 64 bit Editions of Windows in your environment.

- 1. Understand your technical and business needs**
 - a) Understand Information Technology (IT) related tasks currently performed
 - b) Determine which applications are business critical
 - c) Identify strengths and problems in your current IT environment
 - d) Determine the cost to provide IT related services
 - e) Estimate growth (scalability) over the next one to five years
- 2. Review the 64 bit Editions of Windows**
 - a) Review the features of the 64 bit Editions of Windows (see Sections 2 through 4)
 - b) Review the "Feature Guide" found on the product CD
 - c) Review the hardware requirements
 - d) Review the compatibility with 32 bit applications
- 3. Align these features with your business needs**
 - a) Determine which features may address your business needs
 - b) Determine which features may enhance your IT related services
 - c) Determine which features may solve IT related problems
 - d) Prioritize these features as they relate to impacting your business
- 4. Align specific applications with the business needs**
 - a) Identify 64 bit server applications to evaluate (e.g. SQL 2000)
 - b) Identify 64 bit services to evaluate (e.g. IIS)
 - c) Identify 64 bit desktop applications to evaluate (e.g. CAD/CAM, graphics, etc)
- 5. Build a prototype lab**
 - a) Assemble a prototype lab based on Itanium™ based servers and workstations (see Section 6)
 - b) Install and configure the 64 bit Editions of Windows (see Section 7)
 - c) Perform performance tuning and optimization (see Section 8)
 - d) Install and configure applications and services to be evaluated
 - e) Add 32 bit servers and workstations to perform comparative analysis
- 6. Perform a detailed analysis of OS and specific applications**
 - a) Verify new reliability features (see Section 4)
 - b) Verify compatibility and interoperability with 32 bit applications (if necessary)
 - c) Verify performance of 32 bit applications (if necessary)
 - d) Quantify performance and/or scalability features (using performance tools (e.g. Perfmon, Intel's SPEC, WinBench, etc)
 - e) Look for abnormalities in OS or applications (if any)
- 7. Document the results**
 - a) Reliability (and reliability features)
 - b) Compatibility with 32 bit applications
 - c) Scalability (number of connections, number of sessions, number of users, etc)
 - d) Performance (search times, task completion, rendering time, etc.)

- e) Abnormalities in OS or applications (if any)
- f) Compare data from 64 bit and 32 bit platforms

8. Determine the costs and benefits of moving to the 64 bit Editions of Windows Operating System

- a) Translate performance results to benefits (e.g. 35% performance gain reduces computational time, increases engineering productivity)
- b) Translate scalability to business benefits (e.g. 23% more sessions allow for 20% fewer servers and the cost associated with them)
- c) Determine the value of other benefits of the 64 bit Editions of Windows (e.g. increased reliability, increased customer satisfaction, reduction in management costs, etc.)
- d) Determine cost and effort to deploy the 64 bit Editions of Windows (hardware, application software, labor, etc.)

9. Plan the next steps

- a) Plan additional prototyping as needed (more applications, more detailed analysis, etc.)
- b) Determine timing of deployment by considering
 - i) Hardware availability
 - ii) OS availability
 - iii) Application availability
 - iv) End of life cycle for current hardware and applications
 - v) Other business requirements (budget, staffing, other projects, etc.)
- c) Identify additional resources (training, publications, Microsoft Partners, etc.)

The methodology outlined above can be used to perform a thorough evaluation of the 64 bit Editions of Windows. A complete evaluation plan would also include a deeper level of detail including resources, responsibilities, and scheduling of tasks. And because each organization is unique, additional steps and considerations will likely be required to meet your specific business needs. Having a well-conceived methodology and plan will add great value to your evaluation.

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64 bit Editions of Windows Evaluation Guide

Section 2

64 bit Editions of Windows Background Information

Section Summary

■ *Powered by Intel's new Itanium™ 64 bit Processor, Microsoft's 64 bit Editions of Windows capitalize on the capabilities of the new processor technology. The 64 bit Editions of Windows, coupled with the 64 bit Itanium™ processor, are designed to address the most demanding needs of today's business. The 64 bit Editions of Windows provide a solid platform for workstation and server applications that require high-level processing and memory bandwidth. The 64 bit Editions of Windows platform will benefit both the developers and end-users by empowering them with a high-performing, reliable and feature-rich operating system. The 64 bit Editions of Windows also meet performance and scalability needs of mission critical e-business applications and large databases.*

The 64 bit Editions of Windows add value to business by improving employee productivity and lowering total cost of ownership. Workers will increase their productivity by spending less time waiting for the software to finish its tasks. Each server can support larger numbers of users and applications, so your business will require fewer servers. This translates directly into less management overhead, one of the highest costs in any computing environment.

Introduction to the 64 bit Editions of Windows

The Windows operating system has evolved from an 8 and 16 bit graphical user interface for file and data organization in an MS-DOS®-based environment, to the highly successful 32 bit Windows operating system that spans the desktop (Windows 95, Windows 98, Windows ME, Windows NT®, and Windows 2000 Professional) to the high-end server infrastructure (Windows NT Server, Windows 2000 Server / Advanced Server / Datacenter). With the release of the Itanium™ 64 bit Processor, Microsoft's Windows operating system again evolves to capitalize on the capabilities of the processor technology. The 64 bit Editions of Windows are available in both a desktop version (Windows XP 64 bit Edition) and a server version (Windows Advanced Server, Limited Edition).

Introduction to the Intel Itanium™ Processor

The Itanium™ processor is Intel's first 64 bit microprocessor. It was designed to meet the demanding computing needs of today's business. Based on the Explicitly Parallel Instruction Computing (EPIC) design technology, the Itanium™ processor enables greater instruction parallelism than previous Intel processors. EPIC enables the Itanium™ processor to perform up to 20 processes simultaneously through advanced compiling techniques and large processor resources. EPIC technology includes features like predication (ability to maximize parallel processes by "predicting" lines of code before they go through the compiler) and speculation (ability of the processor to cache instructions and data), as well as large system resource support of 128 integer and 128 floating point registers (allows the processor to process more data and numerical computations at one time).

The Itanium™ processor also provides 2MB or 4MB of L3cache and 64 bit addressability. The performance of the Itanium™ processor is targeted toward high-end workstation and server applications needs such as large database management, data mining, secure e-Commerce, computer-aided engineering, and high-performance scientific and engineering computing.

Why the 64 bit Editions of Windows

The 64 bit Editions of Windows platform provides a scalable and high-performance solution for today's computing environment. Its architecture allows more efficient processing of extremely large amounts of data, supporting up to 16 terabytes of virtual memory. With the 64 bit Editions of Windows, applications can pre-load substantially more data into virtual memory to enable rapid access by the Itanium™ processor. This reduces the time for loading data into virtual memory, as well as seeking, reading, and writing time to data storage devices, thereby allowing applications to run faster and more efficiently. The 64 bit Editions of Windows platform will also bring the following benefits to developers and end users:

- The full advantage of Itanium's™ reliable, high-performance, and high-availability architecture.
- Compatibility with Windows 2000-based applications and existing 32 bit applications.
- Compatibility between the Win64™ API and Win32® API environments.
- Scalability of virtual memory up to 16 terabytes.
- Interoperability with systems based on existing 32 bit architectures

Target Market for the 64 bit Editions of Windows

The 64 bit Editions of Windows offer significant performance advantages for applications where the 64 bit architecture is most effective. These include large database applications, business processing applications, and technical computing applications. The 64 bit Editions of Windows platform increases the performance of these applications by providing high availability, advanced scalability and large memory support. The Intel 64 bit Itanium™ processor offers added performance with its extensive multiprocessing features, powerful floating-point arithmetic extensions, and multimedia-specific instructions. The 64 bit Editions of Windows can significantly exceed the performance of a 32 bit system in both workstation and server environments.

Workstation Applications

Workstation performance will improve significantly with the Windows XP 64 bit Edition architecture due to the increased processing capability and increased memory support. Workstation applications in the technical computing and digital content creation market will benefit most from the Windows XP 64 bit Edition. Features of the 64 bit Editions of Windows, such as increased floating-point performance, memory bandwidth, and ability to handle large data sets, will significantly enhance performance and lead to improvements in the workstation market. The Windows XP 64 bit Edition architecture can be leveraged for:

- **Technical Computing** where managing large and complex drawing and assembly models is required. Technical and engineering applications that can benefit from the 64 bit architecture include:
 - CAD/CAM (Computer Aided Design/Manufacturing)
 - Engineering Analysis
- **Digital Content Creation** by providing the capability to work with large and complex models and scenes that require fast rendering at high resolution.
 - Photo/Image editing
 - Video composition and editing
 - 3D Animation and rendering

Server Applications

The Windows Advanced Server, Limited Edition provides a solid platform for 64 bit applications and meets high-end server needs. The Windows Advanced Server, Limited Edition is an ideal platform for server-based applications and services such as large databases, e-business and security applications. Significant advancements in scalability for large databases and e-business applications are easily attainable due to the Windows Advanced Server, Limited Edition's high memory bandwidth and ability to fully integrate into existing IT infrastructures. These features are best leveraged in the following areas:

- **Enterprise Database** where fast access and processing of data is necessary. More memory for data storage and manipulation is available under the 64 bit Editions of Windows, thus providing improved performance for data access. In addition, features of the Itanium processors such as instruction pipelining and large register set capability enable transactions and query operations to be processed more efficiently under the 64 bit Editions of Windows. The types of applications that would benefit include the following:
 - Applications that access very large databases
 - Data Warehousing

■ 64 bit Editions of Windows Evaluation Guide

- Business Intelligence applications
- Decision Support Systems (DSS)
- Modeling for scientific and financial applications

- **Web Services** where performance and support for a large number of users is necessary. The large amount of memory that the Windows Advanced Server, Limited Edition supports enables the ability to cache large numbers of Web pages and directories in a large virtual address space, resulting in faster throughput. Faster throughput increases the number of concurrent connections that servers can support. Typical scenarios include:
 - Internet / intranet Web sites
 - Web page hosting

- **Business / Transaction Processing** where complex business needs are addressed. The Windows Advanced Server, Limited Edition on the Itanium™ processor allows more efficient processing of transaction and query operations for:
 - Complex business applications and electronic resource planning systems (such as PeopleSoft, SAP, and Baan)
 - Online transaction processing (OLTP)
 - Data mining

- **Security** where access to on-line transactions and corporate resources requires protection. Web environments often use software that relies on security algorithms that require high-end processing capabilities. E-commerce and business environments also require protocols for authentication, data protection, and transaction monitoring. The Windows Advanced Server, Limited Edition, in conjunction with the Itanium™ processor speeds up the authentication and encryption process. Common protocols and technologies supported include Secure Socket Layer encryption (SSL), Public Key Infrastructure (PKI), virtual private networking (VPN).

The protection capabilities of the Windows Advanced Server, Limited Edition can be realized by organizations that provide the following:

- E-commerce and E-business applications
- Extranets
- Access to corporate data and Intranets by mobile and/or remote users
- Web hosting

64 bit: the Operating System of Choice

The 32 bit Operating System platform will remain the workhorse of the industry for several years. Currently, systems with 32 bit processors are more affordable and enjoy a greater availability of 32 bit applications. Also, the availability of a mobile version of the 32 bit processor benefits the growing mobile workforce. There will be 32 bit mainstay applications, desktops, and servers running side-by-side with extremely focused 64 bit systems. However, like all previous processors, once a critical mass is achieved based on price, availability, flexibility, and functionality, 64 bit processors will replace 32 bit processors on the desktop and server platforms. 64 bit computing is inevitable.

Another major driving force to the 64 bit Editions of Windows is the commitment by Independent Software Vendors (ISVs) to develop their applications to leverage the capabilities of 64 bit Editions of Windows.

32 bit versus 64 bit Applications

The 64 bit Editions of Windows include features that overcome many of the limitations of the 32 bit Windows system. For example, the 64 bit Editions of Windows support far more physical memory than a 32 bit operating system (32 bit Windows supports 4 gigabytes of memory, while the 64 bit Editions of Windows supports 16 terabytes of memory). Increased physical memory allows more applications to run simultaneously and remain completely resident in the system's main memory. This reduces or eliminates the performance penalty of swapping pages to and from disk.

Win32-based applications run on the 64 bit Editions of Windows using an emulation layer. However, 32 bit applications will run significantly slower on the 64 bit Editions of Windows than on 32 bit systems. Running 32 bit applications is not recommended for organizations looking for the best price and performance benefits of the 64 bit Editions of Windows. In summary, performance for 32 bit applications will be greater on 32 bit hardware.

In general, only applications that require the increased power of 64 bit technology should be developed in 64 bit and run on a 64 bit Itanium™ processor. The 32 bit emulator in the 64 bit Editions of Windows is designed to run 32 bit productivity applications needed by software developers and administrators, not to run 32 bit applications for the end user.

Microsoft is working with Independent Software Vendors in conjunction with the 64 bit product development programs to develop software that will run unmodified on both 32 bit and 64 bit Editions of Windows-based computers. This will give companies the ability to add 64 bit Editions of Windows-based systems to existing networks without changing the 32 bit applications currently in use.

As organizations begin to deploy the 64 bit Editions of Windows, most of the applications they run on 32 bit Windows-based computers will need to be ported over to the 64 bit environment, allowing applications to leverage the new benefits of the 64 bit platform. Microsoft provides the Software Development Kit (SDK) and the Driver Development Kit (DDK) to easily migrate applications to the new 64 bit Editions of Windows on Itanium™ Processor systems. (More information about Microsoft's SDK and DDK is provided in the section "Porting Your Applications to 64 bit".) Microsoft also supports migrating applications using the 64 bit Editions of Windows data model. This data model provides the capability to write a single-source code that can run on both 32 bit and 64 bit computers.

Technical Summary

The following chart lists the benefits of the 64 bit Editions of Windows on the Itanium™ processor.

Feature	Benefit
Itanium processor-EPIC (Explicitly Parallel Instruction Computing) technology	Enables greater floating point processing, performs up to 20 processes simultaneously, 2MB or 4MB of L3 cache, 64 bit addressability
Memory Support	Virtual memory support up to 16 terabytes, Reduces swapping pages to disk
64 bit Editions of Windows Compatibility / Interoperability	Compatible with Windows 2000-based and existing 32 bit applications, Win64 and Win32 API compatibility, Interoperability with existing 32 bit architectures

Reference Materials

- Technical article – Introducing 64 bit Editions of Windows, MSDN
- Windows 2000 Advanced Server, Limited Edition Web site - <http://www.microsoft.com/WINDOWS2000/64bit/overview>
- Windows XP Web site - <http://www.microsoft.com/windowsxp/>
- White Paper – IA-64 Architecture and Itanium™, WWW.Dell.com/r&d
- White Paper - Microsoft® Windows® Advanced Server Limited Edition, Microsoft
- Technical article – What is 64 bit computing? <http://devresource.hp.com>
- [White Paper - Intel's Itanium: Who Benefits from Early Adoption](http://developer.intel.com/design/ia-64/downloads/ia64rev2.htm) <http://developer.intel.com/design/ia-64/downloads/ia64rev2.htm>



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Section 3 Getting Familiar with the 64 bit Editions of Windows

Section Summary

■ *This section provides an overview of the new features, functions, and tools of Windows XP 64 bit Edition and Windows Advanced Server, Limited Edition. These enhancements are designed to improve the end user experience and enhance IT administration.*

Features that are unique to the 64 bit Editions of Windows are highlighted. Next, new features that are common to both 32 bit and 64 bit systems are explored. Finally, a list of features that are not yet available to the 64 bit Editions of Windows is provided.

Features Unique to the 64 bit Editions of Windows

One of the major differences between 32 bit and 64 bit Editions of Windows-based servers is in memory support. Currently, 32 bit Windows can support up to 64 GB of system memory on Windows 2000 Datacenter Server, with up to 2 GB of dedicated memory per process. Windows Advanced Server, Limited Edition currently supports up to 16 terabytes of virtual memory.

The table below highlights features unique to the 64 bit Editions of Windows:

Feature	Benefit
<p>Group policy: Support for 64 bit software deployment</p>	<p>This feature provides support for 64 bit software deployment with Group Policy. New options in the Application Deployment Editor (ADE) will help determine if 32 bit applications should be deployed to 64 bit clients. The ADE will also allow existing Windows 2000 deployments to be managed with the same level of functionality provided by Windows Advanced Server, Limited Edition.</p> <p>For example, an IT administrator is planning to deploy a Windows Installer package to a group of users. The Windows Installer package is for 32 bit operating systems and applications but some of the users have 64 bit computers and operating systems. The IT administrator knows the 32 bit package works correctly on 64 bit computers and operating systems and uses the new Make 32 bit x86 Windows Installer Application Available to Itanium™ machines option in ADE and the package is deployed to all users.</p>
<p>Printing: 32 bit and 64 bit interoperability</p>	<p>This feature allows 32 bit applications to print to a 64 bit print server. An IT administrator running a 32 bit management application on a computer with 32 bit operating system can add, delete and configure ports of a 64 bit print server.</p> <p>A user changes from a 32 bit application on a 32 bit operating system to the 64 bit Editions of Windows. This ability to display driver pages, query device capabilities and print is still available.</p> <p>A user with a 32 bit application on the 64 bit Editions of Windows can add or delete printer connections.</p>
<p>Driver installation for 64 bit</p>	<p>To allow for the installation of device drivers on both 32 bit and 64 bit computers, the INF file definition supports the new .NTIA64 platform extension to designate a driver for installation only on 64 bit computers. Thus, a developer can create an INF file that installs a 64 bit driver only on 64 bit computers.</p>
<p>Windows installer: Support for installing 64 bit applications</p>	<p>This feature enables the 64 bit Editions of Windows Installer packages to include both 32 bit and 64 bit components. The installer will correctly install and register 32 bit components with the WOW64 subsystem when they are installed.</p>
<p>Cluster services: 64 bit support</p>	<p>This feature provides 64 bit support of clustering services on Windows Advanced Server, Limited Edition.</p>

Feature Guide for the 64 bit Editions of Windows

Note: The complete feature set for Windows XP 64 bit Edition and Windows Advanced Server, Limited Edition can be found on the Windows Advanced Server, Limited Edition CD.

This section highlights some of the features available to both the 32 and 64 bit versions of Windows. Because some major new features will be of interest to end users and others to users of the server family, this section is divided into the following categories:

- Improving the end user Experience.
- Enhancements for IT Administration.

Improving the End User Experience

A New Look

Windows XP 64 bit Edition provides two visual styles: the classic Windows style and the new style.

In the new style, the task bar has been completely overhauled to address the problem of finite space on the task bar. If a user has so many windows open at one time that the buttons become too small, Windows XP 64 bit Edition will begin to group the buttons. For example, if the user has five Microsoft Word documents currently open, rather than having five buttons displayed, there is only one. Clicking the button opens another menu opens listing all of the open Word documents.

The notification area has also been redesigned. It is no longer a place for notifying the user of current issues; it is now a place for launching applications. Windows XP 64 bit Edition reduces clutter by hiding icons that are not actively notifying the user. The user exposes hidden icons with chevrons and can decide to override this behavior, choosing which icons to always show and always hide.

Also, the way in which Windows opens has changed. To reduce desktop clutter, all icons except the Recycle bin are moved to the new, larger start menu, where system-supplied functions appear in a separate blue section, alongside a display of the user's most frequently used applications. To further reduce desktop clutter, Windows XP 64 bit Edition periodically searches the desktop for unused application icons, and a desktop wizard then prompts the user to remove them from the desktop. Any data kept on the desktop remains unchanged.

Internet Explorer 6.0

Internet Explorer 6.0, a component of Windows XP 64 bit Edition, includes the following enhancements:

- Visual refresh and enhanced support for Document Object Model (DOM) Level 1 and Cascading Style Sheet (CSS) Level 1.
- Media Acquisition enhancements – includes a new pop-up menu to make saving images more discoverable and support for My Videos and My Music folders as defaults for those media types.

Built-in playback support for Flash and Shockwave files.

Networking enhancements include changes to cookie handling to enhance privacy and changes to Passport and other authentication dialogs in line with Windows credential management.

Dynamic Update

Dynamic Update provides application and device compatibility updates, some driver updates, and emergency fixes for setup or security issues at operating system Setup time. Once the need for a Dynamic Update package has been determined by Microsoft, it is provided from Windows Update. Internet access and, at minimum, Internet Explorer 4.01 are required to download a Dynamic Update package.

System Restore

System Restore enables users to restore their computers to a previous state in the event of a problem without losing personal data files such as documents, drawings, or e-mail. System Restore actively monitors changes to the system and some application files and automatically creates easily identifiable restore points so users do not have to remember to back up. Restore points are created at the time of significant system events (such as application or driver installation) and periodically (every day). Users can also create and name their own restore points at any time.

Enhancements for IT Administration

New Command Line Tools

New command line tools or utilities are provided in Windows Advanced Server, Limited Edition to improve management and administration of computers. A new and updated command line help file (A-Z) is included as well to document the CMD.exe shell and every tool. Command line tools include:

- **Bootcfg.exe** – Used to view or set the properties (such as debug on/off) of the boot.ini file on a local or remote server (not on 64 bit).
- **DriverQuery.exe** - Used to view the currently loaded device drivers and their memory usage.
- **bitscli.exe** - Used to manage Background Intelligent Transfer Service (BITS) downloads.
- **dsadd** - Used to create an object instance of a specified type to the Active Directory.
- **dsmmod** - Used to modify select attributes of an existing object in the Active Directory.
- **dsrm** - Used to remove an object or the complete sub-tree under an object in the Active Directory.
- **dsmove** - Used to move an object from its current location to a new parent location within the same naming context or to rename an object in the Active Directory.
- **dsquery** - Used to find objects in the Active Directory that match specified search criteria.
- **dsget** - Used to get or view select properties of an existing object in the Active Directory when the location of the object to be viewed is specifically known.
- **Eventtriggers.exe** - Used to launch a process based on the occurrence of an event written to the event log.

- **Eventquery.vbs** - Used to specify the type of events to extract from the event log and to display the selected events on the screen or save to a file.
- **Eventcreate.exe** - Used to write a user-defined event to any of the event logs.
- **GPresult.exe** - Used to get the Resulting Set of Policies (RSOP) and list of policies that are applied to a computer or user.
- **IIS scripts** - Many new scripts (IISWeb.vbs, IISVdir.vbs, etc.) provide command line tools to configure, provision, and manage Internet Information Services (IIS) server and Active Server Page (ASP) applications.
- **Ipseccmd.exe** - Used to view and modify the policies and properties of Internet Protocol (IP) security.
- **NetDom.exe** – Used to get/set the Machine Name, set the computer name and Domain Name System (DNS) first label of a machine.
- **NetSh.exe** - Extensive network configuration tool now adds the basic network diagnostic features provided by older NetDiag.exe tool.
- **Openfiles.exe** - Used to view the list of connected users and files in use per share on a computer.
- **Pagefileconfig.vbs** - Used to get the current pagefile size or set a new pagefile size.
- **Print scripts** - Many new scripts (prncnfg.vbs, prnjobs.vbs, etc.) used to manage printer services, drivers and queues.
- **Reg.exe** - Used to view, set and edit registry keys.
- **SC.exe** - Used to start/stop and manage Win32 services.
- **SchTasks.exe** - Used to get, set or edit a scheduled task using the existing Win32 scheduling service.
- **Shutdown.exe** - Used to shut down or re-start a computer and allows a re-start explanation to be written to the event log.
- **Systeminfo.exe** - Used to view basic properties of a machine (such as CPU and memory).
- **TaskKill.exe** - Used to kill or stop a running process.
- **TaskList.exe** - Used to view or identify all running processes with PIDs.
- **Tsecimp.exe** - Used to import Telephony Application Programming Interface (TAPI) user account properties and access rights.

Automated System Recovery

The Automated System Recovery (ASR) feature provides the ability to save and restore applications. This feature also provides the Plug and Play mechanism required by ASR to back up Plug and Play portions of the registry and restore that information to the registry.

The benefit of this new feature can be demonstrated with the following example: an IT administrator finds a server has had a hard disk failure and has lost all configuration parameters and information. Once ASR is applied, the backup of the server's data is restored automatically.

Industry Update Controls

The Industry Update Controls extends coverage of driver updates and retrievals to third-party vendors. It also provides other software updates.

- This allows IT administrators to improve management of computers, as the Industry Updates helps them keep up-to-date with third-party drivers.
- A developer can install components using the dependency mechanism in Industry Update.

Features to be Added to the 64 bit Editions of Windows

The following table lists features that are present in the 32 bit versions of Windows XP that are not yet available in the 64 bit Editions of Windows. There are plans to have these features included in future releases of the 64 bit Editions of Windows. For a detailed description of each feature, please refer to the Feature Guide on the Windows Advanced Server, Limited Edition CD:

Category	Feature
Improving the End User Experience	CD-Burning, Compressed Zip Folders, Digital Media: Movie Maker, Files and Settings Transfer Wizard, Internet Connection Sharing, Internet Home Networking Wizard, Search Companion Integration, Windows Media Player 8
Enhancements for Developers	Speech Recognition and Text-to-Speech API, DirectMusic, Digital Media: Microsoft TV Technologies for Windows, Digital Media: Video Mixing Renderer, Universal Plug and Play: Control Point
Improving Fundamentals and Technology	Internet Network Bridge Networking: Infrared Modem Networking: Media Bridge Windows Error Reporting Windows Product Activation
Enhancements for IT Administration	User State Migration Tool

Feature Guide

The complete feature set is too long to include here, but can be found on the Windows Advanced Server, Limited Edition CD. The feature guide organizes all new features into the following sub-categories:

- Improving the End User Experience
- Improving the Fundamentals and Technology

- Enhancements for IT Administration
- Enhancements for Developers
- Of Interest to Original Equipment Manufacturers (OEMs)

Each feature in the guide is presented in a format that includes the following elements:

- **Feature Name** –short title of the feature.
- **Description** –briefly explains the feature.
- **Scenario** – provides some example uses of the feature. There may be instances where a scenario is not provided.
- **Product** – provides information on which product the feature is found. Products include: Personal, Professional, and Server. Note: Server includes the family of server products.
- **Other Information** –identifies whether the feature applies to the 32 bit and 64 bit Editions of Windows or to 32 bit only.

Reference Materials

- Document - Whistler Feature Guide for Beta 2. Whistler Advanced Server Limited Edition CD. June 11, 2001.
- Document - Windows Advanced Server Limited Edition White Paper. May 2001.

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64 bit Editions of Windows Evaluation Guide

Section 4 **64 bit Editions of Windows and Active Directory**

Section Summary

■ *Windows Advanced Server, Limited Edition on an Itanium™-based platform supports Microsoft's Active Directory service. Several enhancements have been added to the Active Directory with Windows Advanced Server, Limited Edition that will improve IT administration and reduce costs. For example, the interoperability of 64 bit and 32 bit Active Directory infrastructure components will save time and prevent costly upgrades when considering adding 64 bit technology into a business environment. Also, user migration from a 32 bit Active Directory environment to a 64 bit Active Directory environment does not require changing security access control lists.*

Active Directory

Active Directory is a Windows 2000-based directory service designed for distributed networking environments and is the foundation for a broad range of Intranet services. Though current Active Directory deployments on 32 bit Windows 2000 environments offer many beneficial features and technologies, it is likely that increased performance demands will require significant capacity relief in the future. Active Directory on an Itanium™ based platform can be a key component in addressing these needs.

New Features and Enhancements

Object Picker User Interface

The Object Picker is a component User Interface (UI) that other administrative UIs can launch to allow an administrator to select one or more users, computers, groups, or contacts from the Active Directory. The Object Picker is used by numerous UIs and is available for use by third-party developers. It provides public and private interfaces that the launcher can use to customize the behavior to fill their needs. For example, it can be launched in single-select mode or in multi-select mode. It can also be launched to allow only one specific type of object (such as Users) to be selected.

For Windows Advanced Server, Limited Edition, the Object Picker has been redesigned and enhanced, as follows:

- Optimized administrator workflow allows for very quick finding of directory objects.
- Directory Service impact on a network is reduced.
- Ability to scope a search down to a specific Organizational Unit (OU) within the directory.
- More flexible querying capabilities for finding objects in the directory based upon their attributes.

WMI Providers for Replication and Trust Monitoring

Windows Management Instrumentation (WMI) classes monitor whether Domain Controllers are successfully replicating Active Directory information. Because many Windows 2000 components, such as Active Directory replication, rely on inter-domain trust, this feature also provides a method for monitoring that trusts are functioning correctly.

Global Catalog not required for Logon

When processing a logon for a user in a native mode domain under Windows 2000 32 bit version, a Domain Controller (DC) had to contact a Global Catalog (GC) server to expand a user's Universal Group membership. This requirement compelled some organizations to deploy GC servers in remote offices to avoid logon failures if the network link that connected the remote site to the rest of the organization was disconnected.

In Windows Advanced Server, Limited Edition, DCs in a site that does not contain a GC server can be configured to cache Universal Group membership lookups when processing user logons. This allows a DC to process logons when a GC server is unavailable. Group memberships for users that log on to the DC in the site will be cached. The cache will be refreshed on a periodic basis as determined by the replication schedule.

Group Membership Replication Improvements

In Windows 2000 Active Directory, the membership of a group is stored and replicated as a single unit. As a result, a change to a group with large membership caused the entire membership to replicate, consuming a less-than-optimal amount of network bandwidth and processor load. In addition, if the membership of a group was updated simultaneously on two or more domain controllers, some of the membership updates could be lost during replication conflict resolution.

When a forest is switched to Windows Advanced Server, Limited Edition Forest Native Mode, group membership is changed to store and replicate values for individual members instead of treating the entire membership as a single unit. This results in lower network bandwidth and processor usage during replication and virtually eliminates the possibility of lost updates during simultaneous updates.

Improved Inter-Site Replication Topology Generator

In Windows 2000 32 bit, the process that automatically created replication connections between Domain Controllers in different sites could not be used when a forest contained a large number of sites. Instead, administrators had to create and maintain manual inter-site replication topologies.

In Windows Advanced Server, Limited Edition, the Inter-Site Topology Generator (ISTG) has been updated to use improved algorithms and will scale to support forests with a greater number of sites than in 32 bit version of Windows 2000.

Install Replica from Media

This feature enables faster creation of replica Domain Controllers (DCs) for a pre-existing domain. Instead of replicating a complete copy of the Active Directory database over the network, this feature allows an administrator to use files created when backing up an existing DC or Global Catalog server to create the Active Directory database. The backup files, generated by any Active Directory-aware backup utility, can be transported to the candidate DC using media such as tape, Compact Disk (CD), Digital Video Disc (DVD), or the file can be copied over the network.

Migration Tool Enhancements

The Active Directory Migration Tool (ADMT) is enhanced in Windows Advanced Server, Limited Edition to provide:

- ADMT version 2 allows migrating passwords from Windows NT4 to Windows 2000 32 bit or from Windows 2000 32 bit to Windows Advanced Server, Limited Edition domains.
- For the most commonly used migration tasks, such as migration of users, groups and computers, a new scripting interface has been added. ADMT can now be driven from any language and supports COM interfaces, such as Visual Basic® Script, Visual Basic and Visual C++.®
- The scripting interface has also been extended to provide command line support. All scriptable tasks can be executed directly from a command line or through batch files.
- When performing the security translation, the source domain can be decommissioned at the time when security translation runs.
- ADMT allows specifying a mapping file that can be used as input for security translations.

Active Directory Users and Computers Snap-in: Saved Queries

A query is a search against a data set (the directory) for items that match particular criteria (such as directory object attribute values). This feature allows queries to be saved, reopened, refreshed and e-mailed. Query objects and results can be viewed and manipulated in the User Interface. This feature allows an administrator to perform the following tasks:

- Export the results of an attribute query for reporting or analysis. They can refresh the query on a periodic basis and save time in completing management reports.
- Select a set of users based upon their attribute properties and add them en masse to a group.
- Query the directory to find a particular set of user objects, then edit the properties on all objects at once (as described in the feature “Active Directory: Editing of Multiple User Objects”).

Examples of queries an IT administrator can conduct:

- Identify all disabled accounts
- Identify all accounts that expire on a specific date
- Identify all user accounts with non-expiring passwords
- Identify RAS-enabled system accounts
- Find user accounts with passwords older than a specific number of days
- Find accounts with RAS callback enabled
- Find all accounts without managers

Active Directory in Action

Active Directory installed on Intel Itanium™-based servers in a 32 bit environment supports the following functionality:

- Windows Advanced Server, Limited Edition on Itanium™- based servers supports Active Directory services to end-users.
- 32 bit and 64 bit Active Directory components are interoperable.
- Active Directory's security is flexible enough to support users in an isolated forest, while maintaining users' access to all production network resources.
- Internally developed 32 bit tools are portable to run as native 64 bit tools.

64 bit Active Directory

Windows Advanced Server, Limited Edition supports Active Directory services to end-users:

- All users are able to reliably use the 64 bit domain controller for all of their Active Directory security services, even with prototype servers and pre-beta versions of Microsoft's Windows Advanced Server, Limited Edition operating system.
- Users are able to log onto the corporate network and access production resources such as e-mail, enterprise applications, and shared file and print services.

Interoperability with 32 bit systems

32 bit and 64 bit Active Directory components are interoperable.

- Active Directory content is successfully replicated among domain controllers in the 64 bit domain, including both Itanium™-based servers and a 32 bit Pentium III-based server.
- Users are able to use Active Directory services transparently and easily from their 32 bit Windows 2000 clients, regardless of the platform architecture that provided the service.
- Security credentials can be migrated from the production 32 bit Active Directory to an Itanium™- based processor domain controller. It is not necessary to change the security access control lists on any of the migrated users' files, shares, or applications.

Flexibility of Active Directory Security

The flexibility of security in Active Directory permits the execution of a 64 bit domain in an isolated forest while maintaining each user's access to all resources on the production network.

- From their user accounts and client machines in the 64 bit domain, participants have complete and unrestricted access to all of their resources in the down-level Windows NT 4.0 and Windows 2000 domain infrastructures.
- There are no problems with Trust relationships, SID migration, security access control lists, or sharing resources.

32 bit Tools Ported to 64 bit

If a company has internally developed migration tools to work with their 32 bit Windows 2000 infrastructure and requires that they work with Windows Advanced Server, Limited Edition, the internally developed user migration tool can be quickly and easily ported to the Itanium™ processor architecture.

Reference Materials

- Document – Intel Information Technology Pilot of Microsoft Active Directory on the Itanium Processor Architecture. May 2001.
- Document - Whistler Feature Guide for Beta 2. Whistler Advanced Server Limited Edition.

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Section 5 Comparing 32 bit Windows to 64 bit Editions of Windows

Section Summary

■ *The 64 bit Editions of Windows environment is a solid platform for 64 bit applications and high-end server needs. The 64 bit Editions of Windows break through 32 bit Windows memory barriers and increases performance, reliability and scalability of memory-intensive applications. The 64 bit Editions of Windows architecture allows more efficient processing of extremely large data. It also supports 16 terabytes of flat virtual memory, breaking the 4GB memory limit of 32 bit Windows. The 64 bit Editions of Windows, along with the Itanium™ processor, also provide an increase in performance through more floating-point accuracy and computing capability. The 64 bit Editions of Windows also improve reliability through its Machine Check Architecture (MCA).*

Benchmark Tools

When comparing the 32 bit and 64 bit Editions of Windows, tools like Performance Monitor (perfmon), Winstone and WinBench can be used to compare and measure system counters as well as applications and system performance. A list of some performance counters to measure and compare the 32 bit and 64 bit platforms includes the following.

Object \ Counter	Description
Memory\Available Bytes	Shows the amount of physical memory available to processes running on the computer in bytes
Memory\Cache Bytes	Shows the sum of the System Cache Resident Bytes, System Driver Resident Bytes, System Code Resident Bytes, and Pool Paged Resident Bytes counters.
Memory\Pages/sec	Shows the number of pages read from or written to disk to resolve hard page faults.
Memory\Pages Input/sec	Shows the number of pages read from disk to resolve hard page faults. This counter was designed as a primary indicator of the kinds of faults that cause system wide delays.
Memory\Pages Output/sec	Shows the number of pages written to disk to free up space in physical memory.
Memory\Page Reads/sec	Shows the number of times that the disk was read to resolve hard page faults.
Processor/% Processor Time	Shows the percentage of time the processor was busy during the sampling interval.
Process (All_processes)\Working Set	Shows the current number of bytes in the working set of a process. The working set is the set of memory pages touched recently by the threads in the process.
Physical Disk\Avg. Disk Bytes/Read	Shows the average number of bytes transferred from the disk during read operations.
System/Processor Queue Length	Performs an instantaneous count of threads that are in the processor queue.

Why the 64 bit Editions of Windows is Better

The major difference between 32 bit and 64 bit Editions of Windows architecture is memory support. Currently, 32 bit Windows is capable of supporting up to 4 GB of virtual memory. The 64 bit Editions of Windows support up to 64 GB of physical memory, with the potential to support up to 16 terabytes of virtual memory as hardware capabilities and memory sizes grow. The increased memory capabilities of computers based on 64 bit Editions of Windows and the Itanium™ processor are compared with existing 32 bit capabilities in the table below.

Architectural Component	64 bit Editions of Windows 2000	32 bit Windows 2000
Virtual Memory	16 terabytes	4 GB
Paging file size	512 terabytes	16 terabytes
Hyperspace	8 GB	4 MB
Paged pool	128 GB	470 MB
Non-paged pool	128 GB	256 MB
System cache	1 terabytes	1 GB
System PTE	128 GB	660 MB

Applications will benefit greatly from the computing power of the 64 bit Editions of Windows on the Itanium platform. Features such as 64 bit addressing, arithmetic capabilities and increased system resources will improve application performance in comparison to applications based on the 32 bit platform.

The table below summarizes the differences between 64 bit and 32 bit application processing.

Feature	64 bit platform	32 bit platform
Addressing	64 bit registers, 64 bit integer data path, Flat addressing of 18 EB	32 bit registers, 32 bit integer data path, Flat memory addressing of 4GB
Integer Arithmetic	$264 = 1.84E+19$, Increased performance on large data types	$232 = 4.29E+09$
Scalability and performance	Stores single file in memory, Reduces swapping to disk	Uses multiple files to represent a single file, Requires frequent swapping to disk

Detecting Hardware Failures

The 64 bit Editions of Windows eliminate guessing about what caused a hardware failure by detecting errors and predicting hardware failures before they happen. Using the 64 bit Editions of Windows Machine Check Architecture (MCA), the CPU traps hardware errors and reports them to the Windows operating system (ex. PCI-I/O, Memory, Hardware Specific – cooling system). Hardware errors are written to the event log whether or not they are correctable. Non-correctable errors are written to the logs after restart.

Application Migration and Development

The 64 bit Editions of Windows offer a solid platform for creating new scalable 64 bit applications. Microsoft is fully committed to helping developers migrate from Win32-based to Win64-based applications, as well as developing new 64 bit application designs. Independent Software Vendors (ISVs) working on Win64-based applications will find the same Windows programming model as the Win32 environment. This makes porting existing 32 bit Windows applications to the 64 bit environment easier. Microsoft has also provided a Software Development Kit (SDK) and Driver Development Kit (DDK) to help ISVs migrate their applications as well as develop new applications for the 64 bit Editions of Windows.

Bits versus Megahertz

A processor's performance is usually associated with its clock speed, commonly measured in Megahertz (million cycles per second). The amount of data that a processor can handle per cycle is typically measured in bits (binary digits; ones and zeroes) determined by its architecture. For example, Intel's Pentium processor has a 32 bit architecture, while Intel's Itanium™ processor has a 64 bit architecture; the Itanium™ processor is capable of handling twice as much data per cycle as the Pentium processor. The actual processing throughput of a processor is a combination of the number of cycles per second and the amount of data per cycle.

The actual performance of an application, however, depends on clock speed, architecture, and the nature of the application itself. An application running on a 32 bit system may not outperform a 64 bit system, even if the 64 bit system has a slower clock speed. For example, a 32 bit 1.2 GHz system may not perform better than a 64 bit 800 MHz system.

Standard office applications such as word processing and spreadsheets may get better performance from a 32 bit Windows system if the applications were developed on the 32 bit platform and are not written to take advantage of the 64 bit Editions of Windows benefits, such as large memory support, floating point extensions and multi-processing capabilities. For applications that can take advantage of the 64 bit Editions of Windows, such as CAD, Engineering analysis and 3D imaging, the 64 bit Editions of Windows system will out-perform the 32 bit Windows system with a similar processor clock speed.

Applications perform better in Native Mode than in Emulation Mode. The 64 bit Editions of Windows provide an emulation mode to provide compatibility with applications written in the 32 bit environment. This emulation requires additional resources, which causes 32 bit applications to run slower on the 64 bit Editions of Windows system than when running Native on a 32 bit Windows system.

CPU and OS are only Part of the Equation

When configuring a system for optimum performance, the processor (CPU) and operating system are not the only factors to consider. Slow system components (input/output bus, memory bus, hard drive or slow peripherals) may affect the performance of a system.

It is important to know the difference between CPU, system bus and RAM memory speed. These speed differences are represented in megahertz (MHz), or millions of cycles per second. However, other variables like data paths, the number of instructions per cycle, bus speed and the type and speed of memory affect a system's overall performance.

A system may have different or matching MHz speeds running in different subsystems. For example, a PC may have a 350 MHz CPU with a 100 MHz bus running 100 MHz SDRAM. The data flowing within a Pentium 400 Megahertz CPU will run at 400 Megahertz. As data travels outside of the CPU and through the main memory bus to other devices, it will adjust to the lower bus speeds (e.g. 66 or 100MHz). A faster bus or system peripheral can reduce the data travel time, which will improve a system's overall performance.

The speed of storage devices should also be considered. Device type, rotational speed and transfer rates can also affect the performance of a system. There are different CPU speeds for different subsystems, but all the system components need to work as one unit to provide optimum performance.

Why some Apps are not Faster on 64 bit

All applications are not designed for or require a 64 bit Edition of Windows platform. The 64 bit Editions of Windows benefit applications that require large memory support, multiple processing and floating-point arithmetic extensions. Certain applications and services such as Microsoft Exchange and file/print, which primarily store and/or route data, do not leverage the full capabilities of the 64 bit Editions of Windows operating system.

Applications that take full advantage of 64 bit Editions of Windows and the Itanium™ processor features experience increased performance. In some cases, however, applications will perform better when compiled as 32 bit binary because when a 32 bit application is recompiled for 64 bits, the 64 bit binary will usually be larger than the 32 bit binary. As a result, with a limited system cache size, application performance will decline due to a greater number of cache misses when running in 64 bit binary.

Reference Materials

- Technical article – Introducing 64 bit Editions of Windows, MSDN
- White Paper – IA-64 Architecture and Itanium, WWW.Dell.com/r&d
- White Paper - Microsoft® Windows® Advanced Server Limited Edition, Microsoft
- Technical article – What is 64 bit computing?, <http://devresource.hp.com>,
- Technical article – The Fuss About the Bus, <http://kingston.com/tools/bits/bit21.asp>
- Technical article – Building the Perfect Box, Eric S. Raymond, December 1996

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64 bit Editions of Windows Evaluation Guide

Section 6

Preparing for the 64 bit Editions of Windows

Section Summary

■ *This section covers pre-planning steps and requirements for installing Windows XP 64 bit Edition and Windows Advanced Server, Limited Edition. To ensure a successful installation and evaluation, it is important to collect the information and resources outlined in this section before beginning the installation.*

The 64 bit Editions of Windows are covered separately, starting with Windows XP 64 bit Edition and followed by Windows Advanced Server, Limited Edition. This section also addresses issues related to upgrades as opposed to new installations.

Windows XP 64 bit Edition

When installing Windows XP 64 bit Edition, complete the following tasks to help ensure a successful deployment. Each bulleted item will be explained in more detail following the list.

- Obtain Windows XP 64 bit Edition compatible hardware and OS software, including upgrade packs, new drivers, etc.
- Verify the hardware components meet the minimum requirements
- Obtain network information (e.g. Hostname, IP address, Default Gateway, etc.)
- Obtain 64 bit application software for evaluation (e.g. CAD/CAM, 3D graphics, etc.)
- Conduct evaluation in a lab environment

Hardware Requirements

Minimum hardware requirements for Windows XP 64 bit Edition:

- 800 megahertz (MHz) Intel Itanium™ microprocessor
- 128 MB of RAM
- 1 GB of free space on a 2-GB hard disk
- VGA Monitor
- Keyboard
- Mouse or compatible pointing device
- CD-ROM or DVD drive

Hardware and Software Compatibility Check

The Windows XP 64 bit Edition Setup Wizard automatically checks your hardware and software and reports any potential conflicts. However, before attempting an installation, check the Hardware Compatibility List (HCL) to determine whether your computer hardware is compatible with Windows XP 64 bit Edition. To view the HCL, open the **HCL.txt** file in the Support folder on the Windows XP Professional CD. If your hardware is not listed, the setup process might not be successful. The most recent version of this list, visit the Microsoft Web site at:

<http://www.microsoft.com/hcl>

The HCL contains devices that Microsoft has certified; however, other devices may work. If your hardware is not listed, contact the hardware manufacturer and request a Windows XP Professional driver for the component. Drivers for Plug and Play devices are not required.

Software must be compatible with Windows XP 64 bit Edition for successful deployment. Obtain upgrade packs from the appropriate software manufacturers to use during the setup process.

Obtain Network Information

If the computer will not be connected to a network, skip this section. To connect to a network during the setup process, you must have a compatible Network Interface Card (NIC) installed on your computer. If your computer will participate in a workgroup or domain, **setup** requires the following information:

- Name of the computer

- Name of the workgroup or domain
- TCP/IP address
- Subnet mask, default gateway, DNS server, WINS

Obtain 64 bit Application Software for Evaluation

This will depend upon source code availability at the time of evaluation. Please consult your software vendor for 64 bit code, or upgrade packs appropriate to the application(s) under evaluation.

Conduct Evaluation in a Lab Environment

Dedicate lab space to evaluate Windows XP 64 bit Edition in a controlled, non-production setting. A pilot and full deployment usually follow this prototype.

Upgrade vs. New Installation

Though it is possible to upgrade to the 32 bit version Windows XP Professional from a variety of previous Microsoft personal and workstation platforms, the Windows XP 64 bit Edition requires a new installation. Upgrading is not currently an option because Intel's new Itanium™ technology does not support 32 bit operating systems. The new 64 bit hardware platform will be able to run many 32 bit applications, but the operating system must be 64 bit based.

Windows Advanced Server, Limited Edition

When installing Windows Advanced Server, Limited Edition, complete the following tasks to help ensure a successful deployment. Each bulleted item will be explained in more detail following the list.

- Obtain Windows Advanced Server, Limited Edition compatible hardware and OS software, including upgrade packs, new drivers, etc.
- Verify the hardware components meet the minimum requirements.
- Obtain network information (e.g. Hostname, IP address, Default Gateway, etc.)
- Choose components to install (e.g. Terminal Services, Internet Information Services, etc.)
- Obtain 64 bit application software for evaluation (e.g. SQL 2000 64 bit Release, etc)

Hardware Requirements

Minimum hardware requirements for Windows Advanced Server, Limited Edition:

- 800 megahertz (MHz) Intel Itanium™ microprocessor.
- 1 GB of RAM
- A hard disk partition with enough free space to accommodate the Setup process. The minimum amount of space required will be approximately 1 GB. More space may be needed, depending on the following:
 - The number of components installed
 - File system used: FAT requires 100-200 MB more free disk space than other file systems.

- Method used for installation: if installing across a network, allow 100-200 MB more space than if installing from the CD-ROM. (More driver files need to be available during installation across a network.)
 - Amount of RAM: The size of the Pagefile (which is stored on disk) is directly related to the amount of RAM installed.
- VGA Monitor
 - Keyboard
 - Mouse or compatible pointing device
 - CD-ROM or DVD drive

Note: For the development of this Evaluation Guide, Windows Advanced Server, Limited Edition was installed on a pre-production Hewlett Packard RX4610 server with 4-way processing and 4 GB RAM.

Hardware and Software Compatibility Check

The Windows Advanced Server, Limited Edition Setup Wizard automatically checks your hardware and software and reports any potential conflicts. However, before attempting an installation, check the Hardware Compatibility List (HCL) to determine whether your computer hardware is compatible with Windows Advanced Server, Limited Edition. To view the HCL, open the **HCL.txt** file in the Support folder on the Windows Advanced Server, Limited Edition CD. If your hardware is not listed, the setup process might not be successful. The most recent version of this list, visit the Microsoft Web site at:

<http://www.microsoft.com/hcl>

Windows Advanced Server, Limited Edition supports only those devices listed in the HCL. If your hardware is not listed, contact the hardware manufacturer and request a Windows Advanced Server, Limited Edition driver for the component. Drivers for Plug and Play devices are not required.

Many 32 bit software applications will run on the 64 bit platform. Check with your software vendors for compatibility and/or upgradeability of existing 32 bit applications. Some software vendors may have upgrade packs available.

Obtain Network Information

If the computer will not be connected to a network, skip this section. To connect to a network during the setup process, you must have a compatible Network Interface Card (NIC) installed. If the computer will participate in a workgroup or domain, collect the following information:

- Name of the computer
- Name of the workgroup or domain
- TCP/IP address
- Default Gateway, Subnet Mask, DNS Server, WINS

Choose Components to Install

Windows Advanced Server, Limited Edition includes a variety of core components, including a number of administrative tools, which Setup installs automatically. In addition, a number of

optional components can be selected during setup that extends the functionality of Windows Advanced Server, Limited Edition.

Components can also be added later through Add/Remove Programs in the Control Panel. Since each component requires additional disk space, select only those components that are necessary. The following table lists various server functions and the components required for those functions.

Server Function	Related Components
DHCP, DNS, and/or WINS server	Dynamic Host Configuration Protocol (DHCP), DNS, and/or Windows Internet Name Service (WINS)
Centralized administration of networks	Management and Monitoring Tools, Remote Installation Services, Terminal Services
Authentication and secure communications	Internet Authentication Service Certificate Services
File access	Indexing Service, Remote Storage
Print access	Other Network File and Print Services
Terminal Services	Terminal Services and Licensing
Application Support	Message Queuing, QoS Admission Control
Internet (Web) infrastructure	Internet Information Services, Site Server ILS Service
Dial-up access support	Connection manager Administration Kit, Connection Point Services
Multimedia communications	Windows Media Services

Obtain 64 bit Application Software for Evaluation

Contact Independent Software Vendors (ISVs) for 64 bit versions of their applications.

Conduct Evaluation in a Lab Environment

Dedicate lab space to evaluate Windows Advanced Server, Limited Edition in a controlled, non-production setting. A pilot and full deployment usually follow this prototype.

Upgrade vs. New Install

Though it is possible to upgrade to the 32 bit version Windows 2000 Advanced Server from a variety of previous Microsoft server platforms, Windows Advanced Server, Limited Edition requires a new installation. Upgrading is not currently an option because Intel's Itanium™ processor does not support 32 bit operating systems. The new 64 bit hardware platform will be able to run many 32 bit applications, but the operating system must be 64 bit based.

In addition, Windows XP 64 bit Edition cannot be upgraded to Windows Advanced Server, Limited Edition.



64 bit Editions of Windows Evaluation Guide

Section 7 **Installing** **64 bit Editions of Windows**

Section Summary

■ *This section details the installation process of the Windows XP64 bit Edition and Windows Advanced Server, Limited Edition operating systems. Installing both systems is a simple process guided by a Setup Wizard run from the CD-ROM. The Setup Wizard has a text-based stage, and a GUI stage during which the installer will be prompted for:*

- *Partition information*
- *Regional and language options*
- *Licensing information*
- *Date and time settings*
- *Computer name, user name, and network information*

For the Windows Advanced Server, Limited Edition, the installer will also have an opportunity to:

- *Install Server Components*
- *Configure Server Role*

Installing Windows XP 64 bit Edition

Using step-by-step procedures, this section guides you through installing the Windows XP 64 bit Edition on a desktop using the Setup Wizard.

Disk Partitioning Requirements for Itanium™-based Computers

Itanium-based computers that use Extensible Firmware Interface (EFI) have specific partitioning requirements. The current EFI specification is capable of understanding the FAT file system only. One FAT partition is used to store programs and information files that EFI uses to automatically start Windows XP 64 bit Edition.

The current recommended size of the FAT partition is no less than 100 megabytes (MB) and no more than 1 gigabyte (GB).

Starting an Itanium™-based Computer for the First Time

When you start an Itanium™-based computer without an installed operating system, the computer stops at the shell prompt. During startup, the EFI shell tries to identify file systems that it recognizes and assigns drive mapping similar to the MS-DOS-based drive letter assignment.

The drive mappings are listed as fs0, fs1, and so on. A list of all recognized file systems and block-accessed hardware appears above the shell prompt when the computer is started. For example, a drive mapping similar to the list below might appear:

```
fs0 : VenHw(Unknown Device:FF) /CDROM(Entry1)
blk0 : VenHw(Unknown Device:01)
blk1 : VenHw(Unknown Device:80)
```

Note: To change to a specific drive from the command prompt, type its name followed by a colon. For example, to switch to the CD-ROM drive, type fs0:

Running the Setup Wizard

The installation process for Windows systems is divided into two phases. The first phase is text-mode setup. In the second phase, the Windows Setup Wizard gathers information such as regional settings, user names and passwords, and network information.

During text-mode setup, files are copied to the computer, partitions are created, and a manual or automatic installation is done. The Setup Wizard then copies the appropriate files to the hard disk, checks the hardware, and configures the installation. When the installation is complete, Windows XP, 64 bit Edition is ready for logon. You will notice that the computer restarts several times during the setup process.

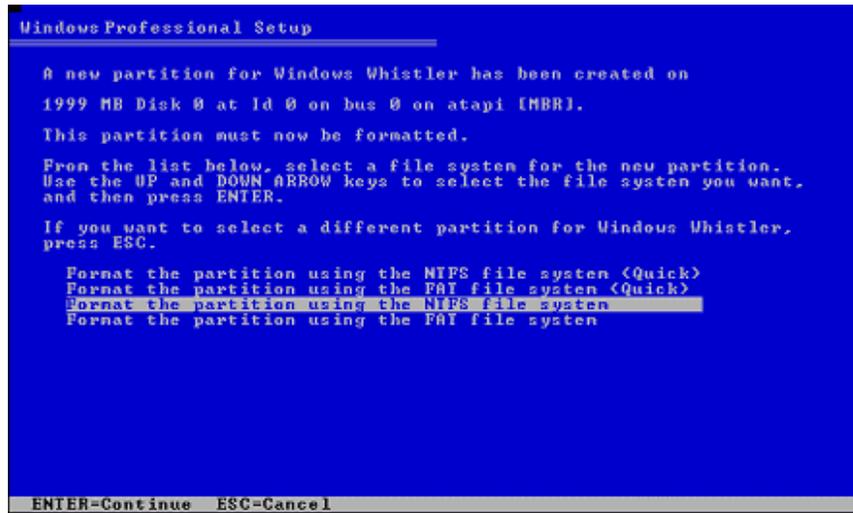
Installing from the CD

To install from a CD:

1. Turn on the computer and insert the CD into the CD-ROM drive. After approximately one minute, the EFI shell screen appears.
2. When the shell prompt appears, type Fs0 and press Enter. The command prompt now reads fs0:\>. This is the CD-ROM drive.

Note: If partitions on the hard drive already exist, the mapping for the CD-ROM might be different than the previous example. To locate the CD, look for the FS mapping that reads CD-ROM

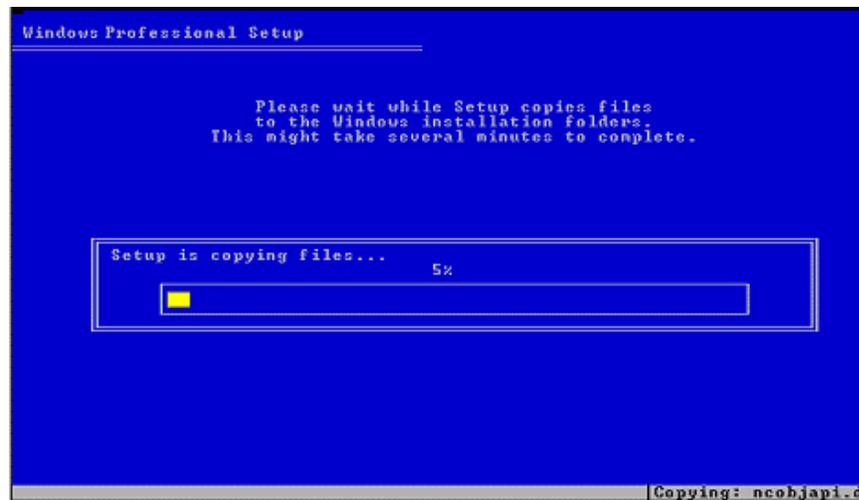
- At the `fs0:\>` prompt, type `SETUPLDR`. Text-mode setup for Windows starts.



During text-mode setup, the Wizard prompts you to create and delete partitions. There must be at least two partitions. One partition is for the operating system loader files; it must be a minimum of 100 MB and formatted as FAT.

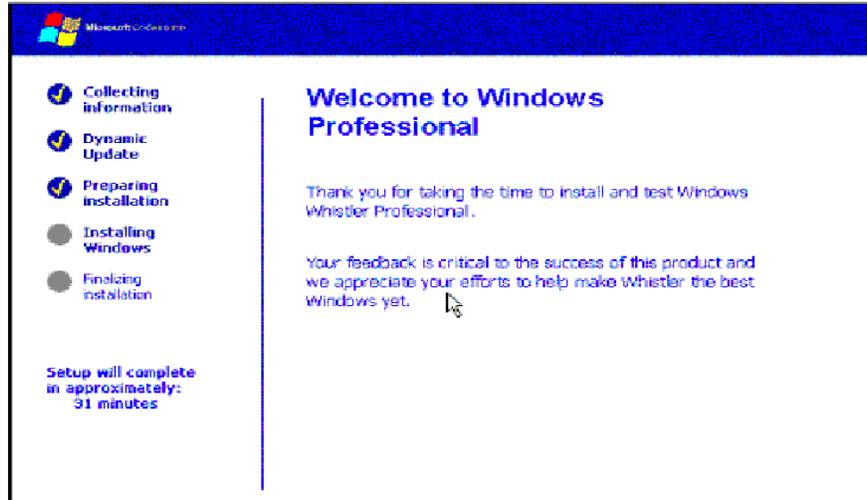
After creating the FAT partition, create additional partitions for the operating system. The file system on these partitions can be FAT, FAT32, or NTFS.

After text-mode setup completes, the computer restarts automatically. If the computer stops responding after restarting, turn off or reset the computer.

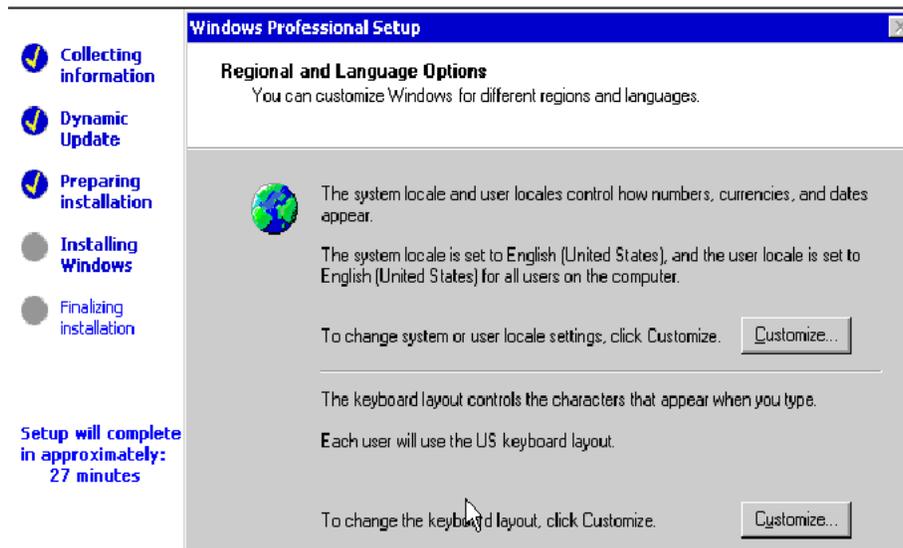


When the computer restarts, GUI-mode setup starts automatically.

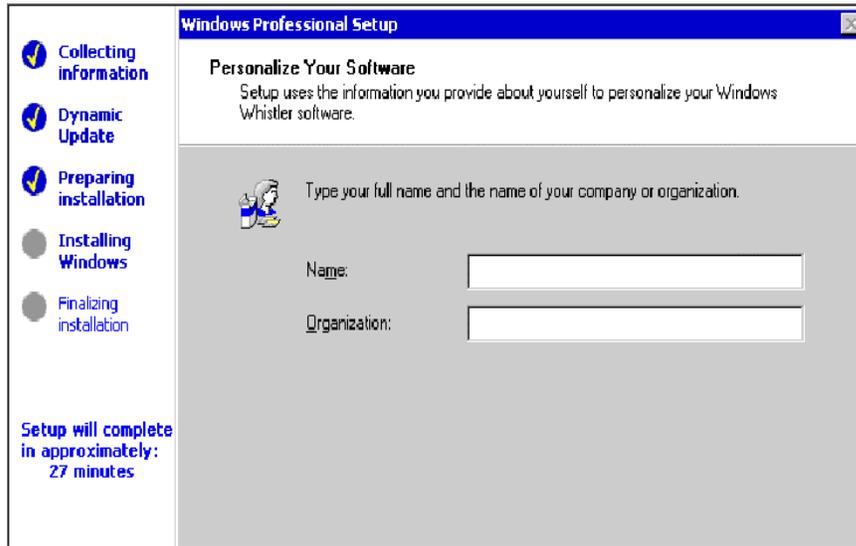
The Setup Wizard helps gather information about the user and the computer. Although much of this installation process is automatic, some information on the following Wizard pages needs to be entered, depending on the configuration of the computer.



4. Select Special Options. You can customize the installation, language, and accessibility settings for new installations. Windows can be set up to use multiple languages and regional settings.



5. Personalize the Software. Type the full name of the person to whom this copy is licensed and optionally, the organization.



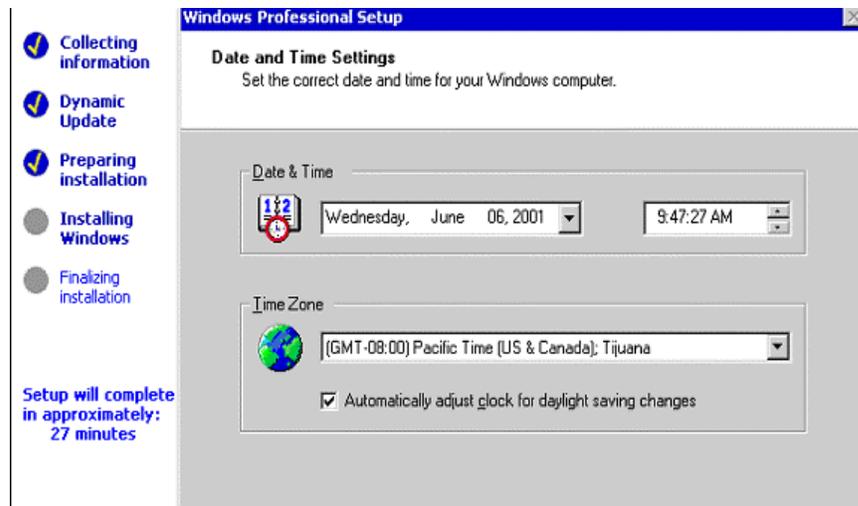
6. Enter the Product Key that accompanied the installation CD on this screen.



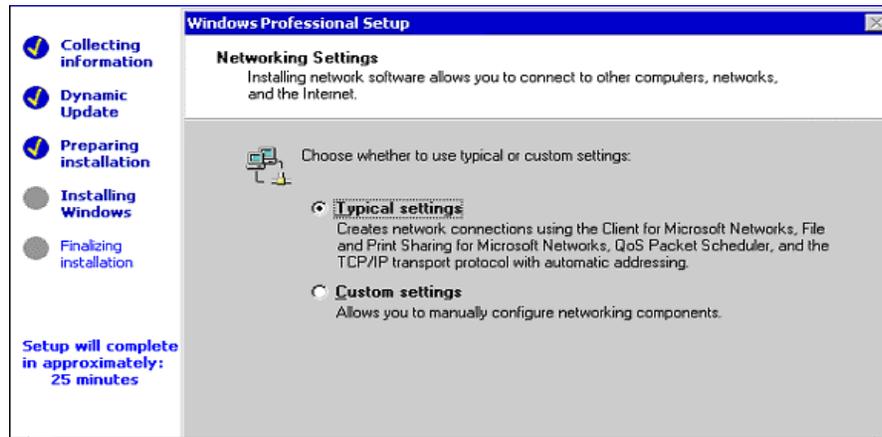
7. Computer Name and Password. A unique computer name that differs from other computers is required. The Setup Wizard suggests a computer name, but it can be changed.



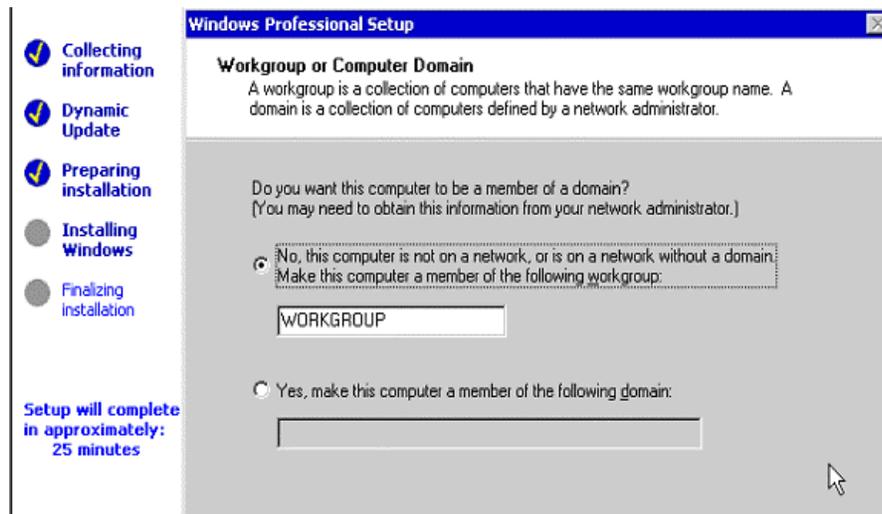
8. Date and Time Settings. Verify the date and time for the region, select the appropriate time zone, and select whether to automatically adjust for daylight-savings time.



9. Networking Settings. Select the Typical settings option for your network configuration unless custom settings are required. To manually configure network clients, services, and protocols, select the Custom settings.



10. Workgroup or Computer Domain. During the setup process, join either a workgroup or a domain. If the system will not be connected to a network, select the option to join a workgroup.



Once the GUI-mode setup is complete, the computer restarts automatically and Windows XP, 64 bit Edition is installed. You can log on with the administrator password provided during Setup.

At this point, you may wish to proceed to the "Performance Tuning and Optimization" section of this evaluation guide.

Installing Windows Advanced Server, Limited Edition

Using step-by-step procedures, this document describes how to run the Setup Wizard and install Windows Advanced Server, Limited Edition on a single computer.

Starting Setup on an Itanium™-based Computer

This section explains how to start Setup on an Itanium™-based computer.

Important: Itanium™-based computers require a minimum 100-MB FAT partition for the operation of the Extensible Firmware Interface (EFI). This EFI system partition stores programs and information files that EFI uses to start the operating system. **Do not delete or reformat this partition.**

Windows Advanced Server, Limited Edition supports a new partition style called GUID partition table (GPT). The installation partition on an Itanium™-based computer must be GPT. You can still read and write to Master Boot Record (MBR) volumes, which are common to most computers, but you cannot install on one. Dynamic MBR disks can be accessed by x86-based computers and Itanium™-based computers running Windows 2000 or XP. Dynamic GPT disks can be accessed only by Itanium-based computers running Windows XP Professional 64 bit or Windows Advanced Server, Limited Edition.

When you start an Itanium™-based computer without an installed operating system, the computer stops at the shell prompt. During startup, the EFI shell tries to identify file systems that it recognizes and assigns drive mapping similar to the MS-DOS-based drive letter assignment.

The drive mappings are listed as fs0, fs1, and so on. A list of all recognized file systems and block-accessed hardware appears above the shell prompt when the computer is started. For example, a drive mapping similar to the chart below might appear:

```
fs0 : VenHw(Unknown Device:FF) /CDROM(Entry1)
blk0 : VenHw(Unknown Device:01)
blk1 : VenHw(Unknown Device:80)
```

Note: To change to a specific drive from the command prompt, type its name followed by a colon. For example, to switch to the CD-ROM drive, type fs0:

Running the Setup Wizard

The installation process for Windows systems is divided into two phases. The first phase is text-mode setup. In the second phase, the Windows Setup Wizard gathers information such as regional settings, user names and passwords, and network information.

During text-mode setup, files are copied to the computer, partitions are created, and a manual or automatic installation is done. The Setup Wizard then copies the appropriate files to the hard disk, checks the hardware, and configures the installation. When the installation is complete, Windows Advanced Server, Limited Edition is ready for logon. You will notice that the computer restarts several times during the setup process.

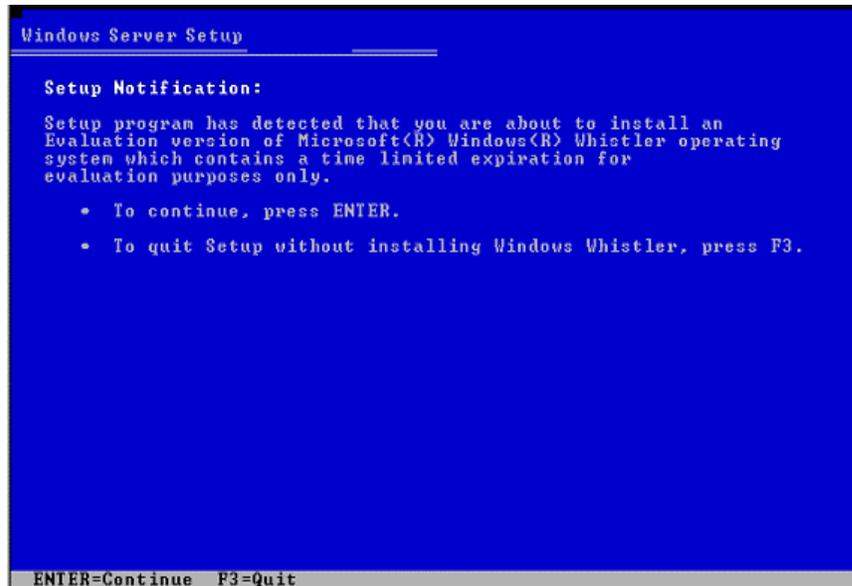
Installing from the CD

To install Windows Advanced Server, Limited Edition from a CD:

1. Turn on the computer and insert the CD into the CD-ROM drive. After approximately one minute, the EFI shell screen appears.
2. When the shell prompt appears, type Fs0 and press Enter. The command prompt now reads fs0:\>. This is the CD-ROM drive.

Note: If partitions on the hard drive already exist, the mapping for the CD-ROM might be different than the previous example. To locate the CD, look for the FS mapping that reads CD-ROM

3. At the fs0:\> prompt, type SETUPLDR. Text-mode setup starts:



```
Windows Server Setup
-----
Setup Notification:
Setup program has detected that you are about to install an
Evaluation version of Microsoft(R) Windows(R) Whistler operating
system which contains a time limited expiration for
evaluation purposes only.

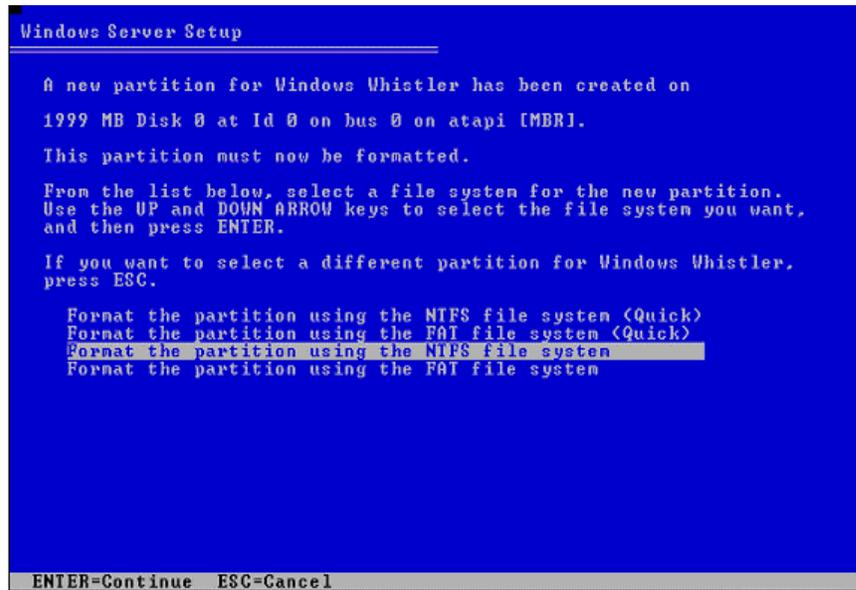
  • To continue, press ENTER.
  • To quit Setup without installing Windows Whistler, press F3.

ENTER=Continue F3=Quit
```

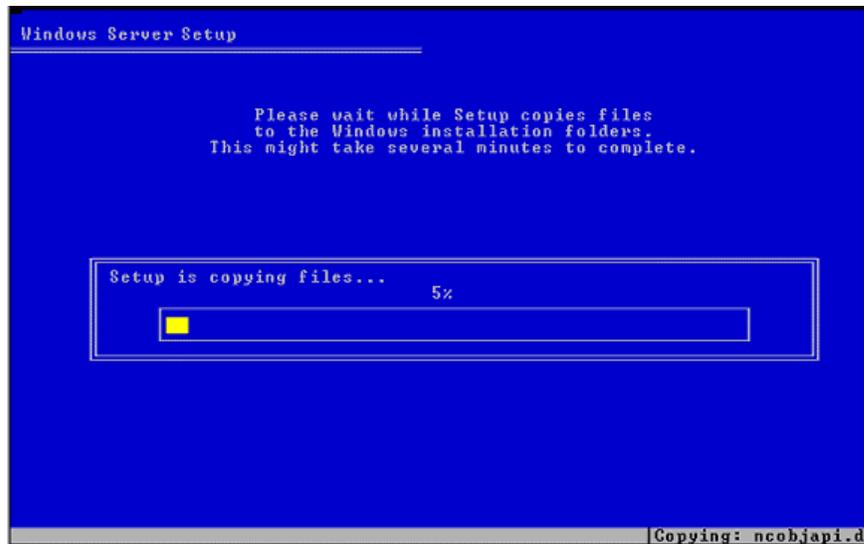
During text-mode setup, the Wizard prompts you to create and delete partitions. There must be at least two partitions. One partition is for the operating system loader files; it must be a minimum of 100 MB and must be formatted as FAT. The other partition(s) will be for the actual operating system.

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After creating the FAT partition, create additional partitions for the operating system. The file system on these partitions can be FAT, FAT32, or NTFS.

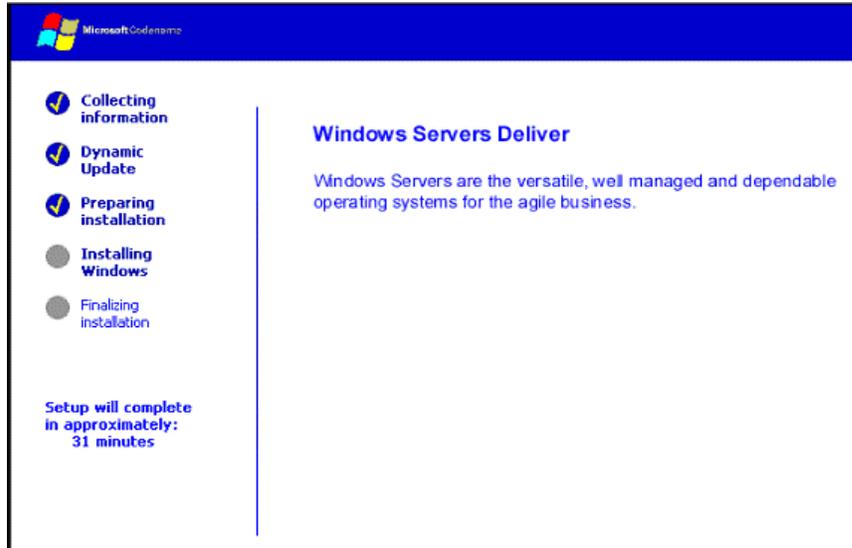


After the text-mode setup completes, the computer restarts automatically. If the computer stops responding after restarting, turn off or reset the computer.

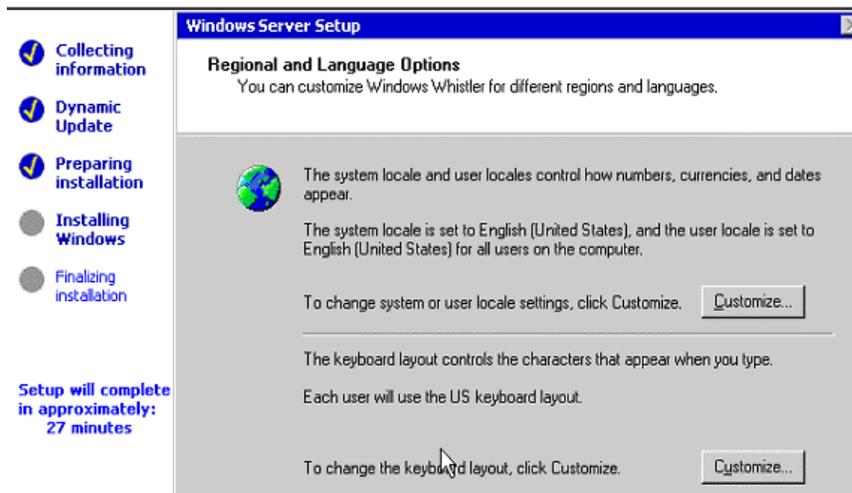


When the computer restarts, the GUI-mode setup starts automatically.

The Setup Wizard helps gather information about the user and the computer. Although much of this installation process is automatic, some information on the following Wizard pages needs to be entered, depending on the configuration of the computer.



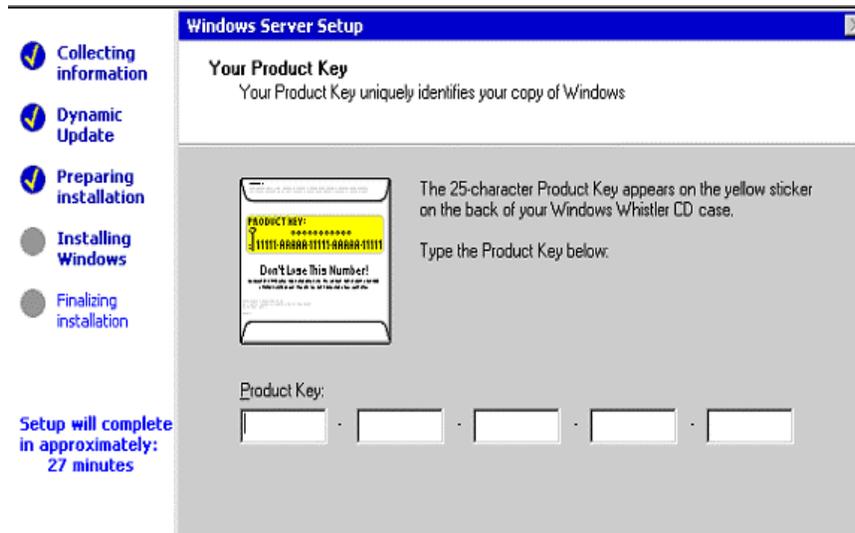
4. Select Special Options. Customize the Windows installation, language, and accessibility settings for new installations. Whistler can be set up to use multiple languages and regional settings.



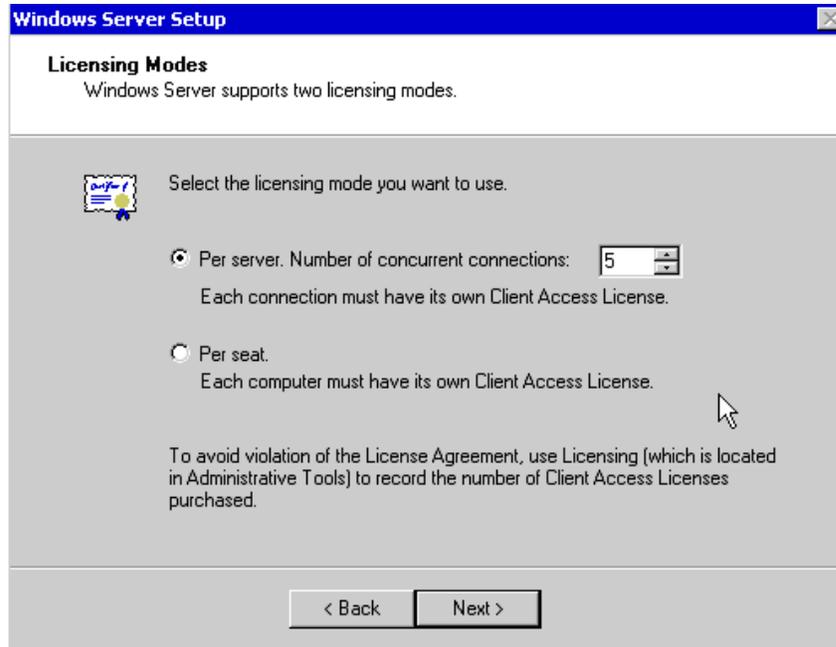
5. Personalize Your Software. Type the full name of the person to whom this copy is licensed and optionally, the organization.



6. Enter the Product Key that accompanied the installation CD.



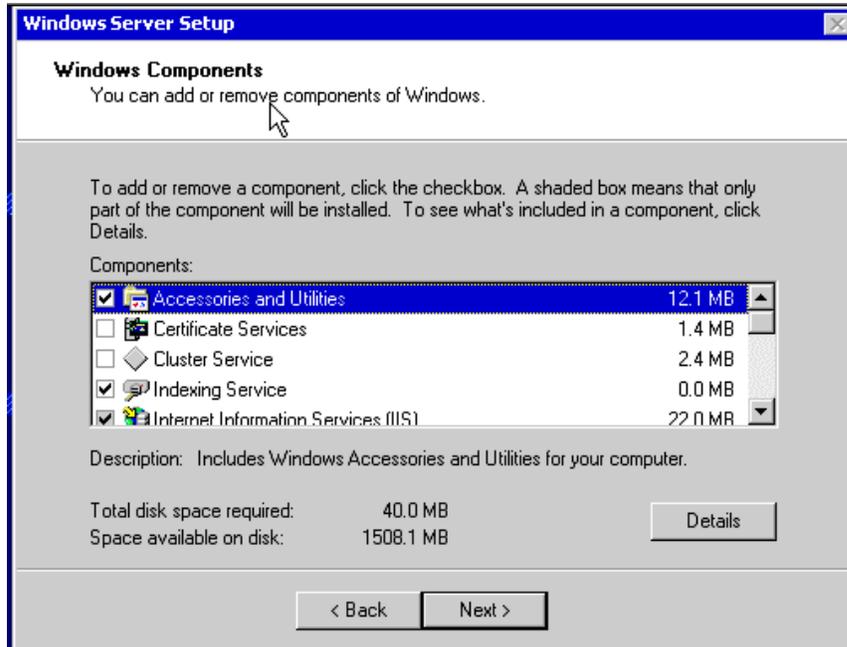
7. License Modes. Products in the Windows Server family support two licensing modes: Per Seat and Per Server. The Per Seat mode requires a separate Client Access License (CAL) for each computer that accesses a server. The Per Server mode requires a separate CAL for each concurrent connection to a server.



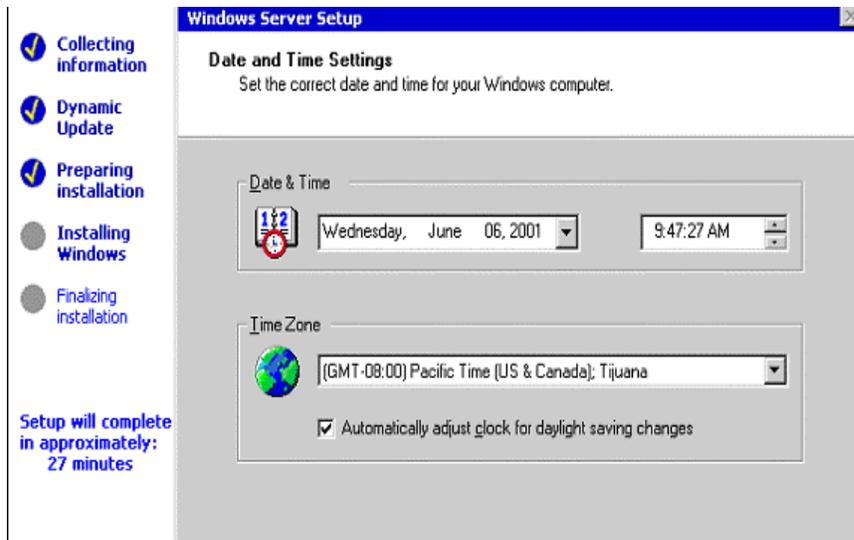
8. Computer Name and Password. Type a unique computer name that differs from other computer, workgroup, or domain names on the network. The Setup Wizard suggests a computer name, but it can be changed.



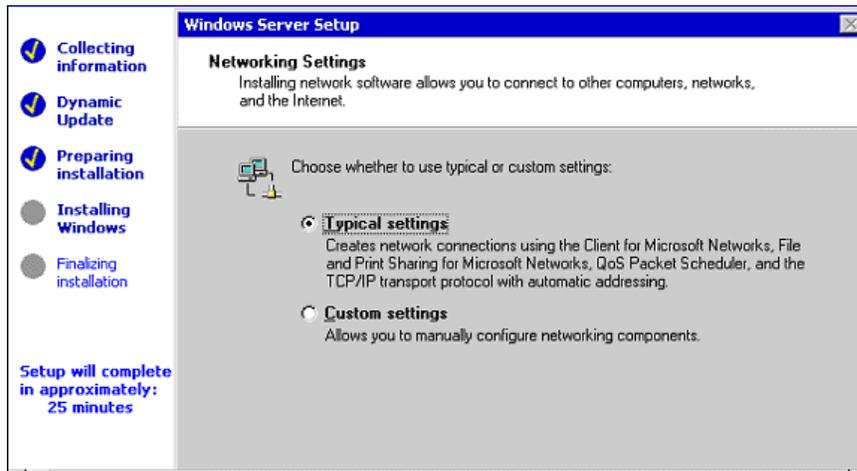
9. Install Components. Components often needed on networks using TCP/IP include DHCP, DNS, and WINS. To install these components during Setup, select Networking Services, click Details, and then select the component or components required in the Windows Components dialog box. Components can also be added after Setup completes.



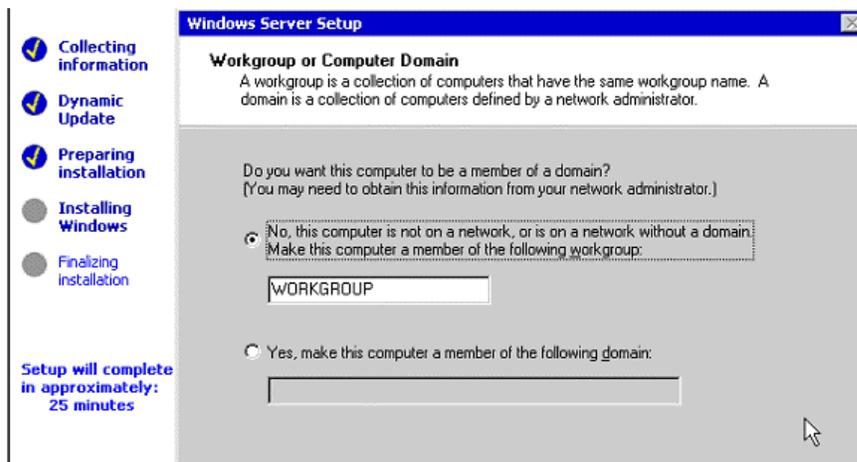
10. Date and Time Settings. Verify the date and time for your region, select the appropriate time zone, and then select whether to automatically adjust for daylight-savings time.



11. Networking Settings. Select custom settings for configuring a server, network clients, services, and protocols.



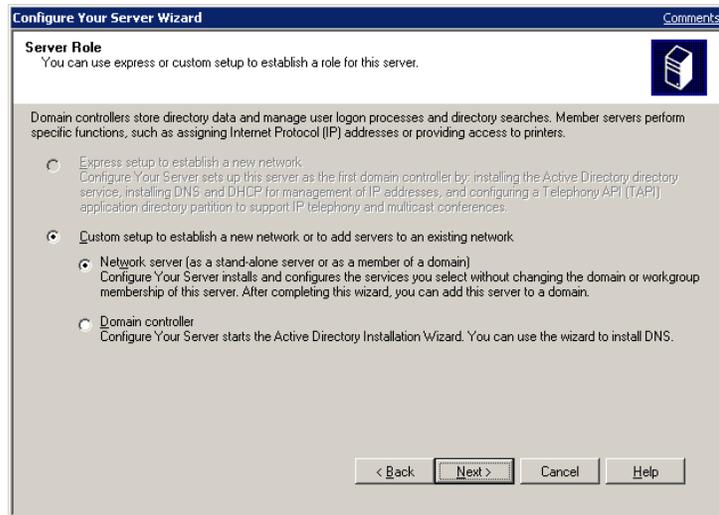
12. Workgroup or Computer Domain. During the setup process, join either a workgroup or a domain. If the system will not be working on a network, select the option to join a workgroup.



Once the GUI-mode setup is complete, the computer restarts automatically and Windows Advanced Server, Limited Edition is installed. You can log on with the administrator password provided during Setup.

Configuring the Server

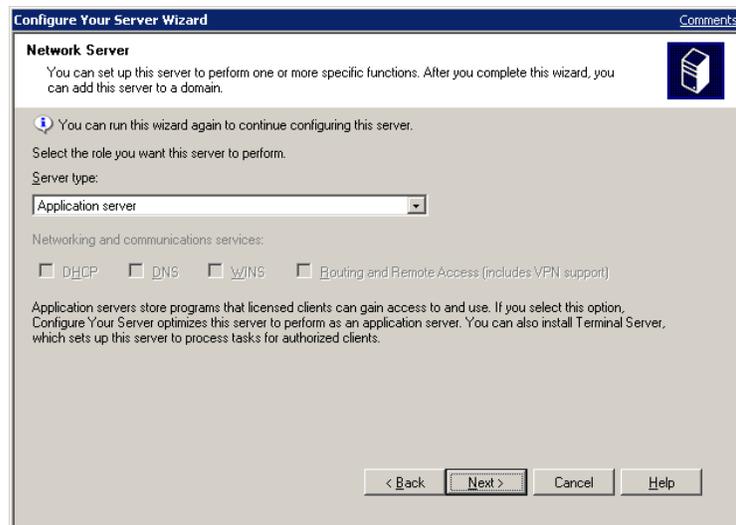
When Setup completes the installation, the computer restarts. The Configure Your Server Wizard appears when you log on as the Administrator. Register this copy of Windows Advanced Server, Limited Edition before using Configure Your Server.



To open Windows Help and Support Services, click Start, Help and Support. One of the features useful features in Windows Help and Support is New ways to do familiar tasks, available in the Help topics or by using Search in Help and Support Services.

Use the Configure Your Server Wizard to finish installing optional components that you chose during Setup and to configure domain controllers or member servers, including file servers, print servers, Web and streaming media servers, application servers, Microsoft SharePoint servers, and networking and communications servers.

To start the Configure Your Server Wizard, click Start, point to Programs, point to Administrative Tools, and click Configure Your Server. Other configuration tools are also available from Administrative Tools.



Note: This should complete your installation. For performance tuning and optimization, refer to the following section.



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Section 8 Performance Tuning and Optimization

Section Summary

■ Like Windows 2000, the 64 bit Editions of Windows are fundamentally self-tuning operating systems. At startup, it examines the hardware configuration and configures settings to appropriately balance performance. During operation, the operating system constantly monitors conditions and adjusts numerous parameters to meet those conditions.

Even with this built-in optimization, the operating system benefits from administrator intervention. Sometimes a balanced approach is not what's needed, but rather a tilting of the scales to favor one aspect of performance or another. If the system is being optimized for a memory intensive application, then tuning the system to favor memory use over disk performance is exactly what is needed. Microsoft sees the 64 bit Editions of Windows being used in scientific computing, large database, data warehousing, business intelligence, and large Web serving and caching environments. Each of these specific applications requires different optimizations.

Performance tuning and optimization are fundamentally about finding out where subsystems are running slow (also known as "bottlenecks") and adjusting the configuration to eliminate the slowness. This is a process of measuring, adjusting and then measuring again. Often, the elimination of one bottleneck will lead to finding the next bottleneck, which can then be tuned. The tuning for Windows XP

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is almost exactly the same as tuning Windows 2000. In this section, we examine quick tuning at a high level, then drill down into tweaking the specific subsystems, such as memory and disk.

Quick Tuning

This “quick tuning” section will help you identify performance problems quickly and find their sources. If the problem is caused by an issue that can be resolved easily, such as by the addition of memory, this section can help you get quick results. However, if the problem is more widespread or complex, this section will only help you get to the first step in solving it, but may not guide you to quick results. To help you resolve more pervasive and complicated problems, the rest of the section shows you how to carefully analyze the entire system and tune all components.

Cast a Wide Net

When evaluating the Windows XP 64 bit Edition, you might find that a particular application or the entire system is running slower than expected. Since the applications should run faster, there is probably a tuning problem in one of the subsystems. The quickest way to narrow down the problem is to “cast a wide net” and see what is caught.

The following counters cast a wide net over the performance of the system, covering all of the key subsystems of a workstation. Open a System Monitor session and add these counters:

Object \ Counter	What to Look For
Memory\Available Bytes	Check whether this value is low during slow periods.
Memory\Cache Bytes	Check whether this value is low during slow periods.
Memory\Pages/sec	Check whether this value is less than 60 for low-end systems and less than 200 for high-end systems.
LogicalDisk%\% Free Space	Ensure that there is at least 25 percent free space.
PhysicalDisk\Disk Reads/sec	Check whether this value is high during slow periods.
PhysicalDisk\Disk Writes/sec	Check whether this value is high during slow periods.
PhysicalDisk\Avg. Disk Queue Length	Check whether this value is 2 or greater.
Processor(All_Instances)\% Processor Time	Check whether the total or the value for any one processor is higher than 85 percent.
System\Processor Queue Length	Check whether this value is 2 or greater.

If any one or more of the wide-net counters show problem values, drill down on those to try to determine what the problem might be. After checking these counters, you should have a clear idea of where to take the next steps. Go to the appropriate section, Memory, Disk or Processor.

Look Deeper

In and of themselves, the counters do not indicate a problem in the subsystem. The values could be normal operating conditions for the workstation or could be problem conditions. Also, a high value in one subsystem may be the result of a constraint in another subsystem. For example, a high PhysicalDisk\ Ave Disk Queue Length may be the result of constrained system memory, resulting in excessive paging and high disk utilization.

The rest of this section goes into the details of performance tuning for each of the areas covered by the wide-net counters.

Processor and Processes

The Itanium™ processor benefits are inherent to the use of the Itanium™ processor. These include potentially higher clock speeds and the Explicitly Parallel Instruction Computing (EPIC) which allows the chip to process up to six instructions per cycle. The Itanium™ processor also provides very fast floating point support. However, these features do not require tuning.

While individual processors cannot be tuned, the overall system can be tuned with regard to processors. You can add processors or reduce processes if a system is processing constrained.

General Processor Malaise

The counters below can help you determine at a high level whether the processor is impacted. Processor utilization is the common measure of the amount of work that a system is doing, and a good rule of thumb is that a well-tuned system should have a sustained processor utilization value of below 85 to 90 percent.

Object/Counter	Description
Processor/% Processor Time	Shows the percentage of time the processor is busy during the sampling interval. This counter is equivalent to Task Manager's CPU Usage counter. For the total processor utilization rate system wide in multiprocessor systems, use the Processor _Total)\ % Processor Time counter.
System/Processor Queue Length	Performs an instantaneous count of threads that are in the processor queue.

The queue length counters, however, are better indicators of processor bottlenecks than the percentage utilization counters because in a high-throughput system, high utilization rates should be acceptable. Many systems are over-engineered, so that if the system approaches maximum utilization, there is a problem. In a well-engineered system, a high utilization rate simply means that the system is being used to its maximum potential.

In contrast, the processor queue length is a good indicator of bottlenecks. According to queuing theory, a queue length that is consistently over 2 very likely indicates a bottleneck. Although queues are most likely to grow when the system is very busy (that is, when the processor utilization rate is high), they can still grow when utilization is well below 85 percent. This can happen if requests arrive at irregular intervals, or if they take a long time to service.

Note: A queue is essentially a waiting line, similar to a line for a bank teller. Queuing theory is the mathematical theory of queues, or waiting lines. A. K. Erlang of the Copenhagen Telephone Company initially developed the theory for telephony purposes in the early 1900s. It has since been expanded to include computer science, manufacturing, air traffic control, and many other disciplines. There is quite a bit of math behind it and different models), but for the purposes of performance tuning, queuing theory can be distilled to a simple rule of thumb: on average, keep queue length to less than 2.

Processes

To quickly track down the application or process that is causing high processor utilization, follow these steps:

1. Launch Performance Tool.
2. Click Add to add a counter.
3. Select Process\% Processor Time and select the All Instances radio button.
4. Click the Add button.
5. Click the Close button.
6. Right-click the graph and select Properties.
7. Select the Histogram radio button in the View window.
8. Click the Close button.
9. Click the Highlight button (the light bulb icon on the menu).

With the Performance Monitor configured, the administrator can see a histogram of all running processes and their individual processor utilization values. There may be many processes, but scrolling through the legend at the bottom of the System Monitor will highlight the corresponding counter in the graph to make it easy to identify. The instance name in the legend identifies the application, such as explorer for Internet Explorer. The monitor also shows maximum, minimum, and average values for the counters, making performance counters easy to set up and monitor without having to watch the counters constantly.

Interrupts

High counts for interrupts, which can be checked using the counter below, can affect processor performance and may signal hardware problems. The Processor\ Interrupts/sec counter reports the number of interrupts that the processor is servicing from applications or hardware devices. Even in a completely idle state, expect interrupts to be higher than 100 per second for a system running Windows XP, even in an idle state. While a system is running a processor and I/O-intensive operations such as disk defragmentation, interrupts may average more than 250 per second with much higher peak values.

Object / Counter	Description
Processor\Interrupts/sec	Shows the average rate per second at which the processor handles interrupts from applications or hardware devices. High activity rates can indicate hardware problems.

The interrupt rate depends on the rate of disk I/O operations per second and network packets per second. The range varies from system to system, so a baseline should be established. If the interrupt counter values are out of range, the system may have hardware problems or older hardware such as 16-bit network adapters.

Context Switches

A context switch occurs when the kernel switches the processor from one thread to another—for example, when a thread with a higher priority than the running thread becomes ready. Context switching activity is important and can be measured using the counters in the table below. A typical rate of context switches per second for a Windows XP 64 bit Edition system is 300 or more when idling and 1,500 when several applications are running. While launching several applications simultaneously, you can expect peaks of 15,000 or more per second.

Object/Counter	Description
System\Context Switches/sec	Shows the average rate per second at which the context switches among threads on the computer. High activity rates can result from inefficient hardware or poorly designed applications. The counter reports system wide context switches.
Thread(_Total)\Context Switches/sec	Reports the total number of context switches generated per second by all threads.

Context switches can be a problem if the rate is either too high or too low, as compared to a baseline established prior to troubleshooting performance problems. An application that dominates the processor lowers the rate of context switches because it does not allow processor time for the other applications. A reasonable rate of context switching usually means that the processor is being shared equally. A high context-switch rate often indicates that too many threads are competing for the processors on the system, forcing the processor to juggle the threads.

An Itanium™ system with Windows XP 64 bit Edition can support a much higher context switch rate than would have been possible in a Pentium based system with Windows 2000.

Tuning Performance

Very little tuning can be done to the processor itself. It is hard-wired, encased in ceramic, and buried deep inside the computer system. That being the case, the two options for tuning are to reduce the load on the processor by slimming down, or to bulk up the processor by adding another one or replacing it with a bigger one. You can also reduce the graphics use of the interface and tune servers to optimize for either foreground or background applications. A final and rarely used method is to force the priority of an application.

Slim Down

If your system is experiencing performance problems, decrease the number of processes and threads that are running on the system by reducing the number of applications running on the system.

For systems in which a single process is causing a performance problem, consider not running the process. This may seem a simple-minded solution, but it is worth considering. If the application in question is a screen saver, the decision should be straightforward; the most obvious answer is sometimes the right answer.

In other cases, a line-of-business application may be consuming a large percentage of the resources but cannot be removed as it is critical to the business function of the system. However, you can still slim down the system by removing less-critical applications. For

example, consider eliminating personal Web servers, instant messaging applications, or fancy screen savers. While not reducing the load that the line-of-business application places on the system, this will reduce the overall load on the system and free up resources for the line-of-business application to use.

Bulk up

For systems with point source application performance problems, consider adding a second processor or upgrading the existing one to bulk up the capacity. Adding a processor is effective only if the application is multi-threaded, as adding a processor will then allow the application to run on multiple processors. A single-threaded application will not benefit from a second processor, as the system cannot distribute thread activity across processors. In that case, run the application on a faster processor or on a computer with extra processing capacity.

Measure the proportion of active threads to verify the likely benefit, even for applications purported to be multi-threaded. If the threads in a process are inactive most of the time, then simply adding a processor will not help performance. This can be the case if an application has been written to be multi-threaded but is not optimized to run on multiple processors. On the other hand, if there are a high proportion of active threads, the additional processor will likely translate to performance gains.

Under normal circumstances, using a faster processor will usually yield more performance improvement than installing additional processors. The additional management overhead required to juggle the processors takes away some of the benefits. This is an area where the Itanium processor really shines, as it provides a faster processor upgrade path.

Reduce GUI Use

Windows XP 64 bit Edition includes a quick setup option to adjust the performance of the graphical user interface (GUI). You can adjust the system to reduce the number of bells and whistles, which will enhance the performance for more productive processes.

1. On the desktop, right-click My Computer and select Properties.
2. Click the Advanced tab.
3. Click the Performance box, click on the Settings button.
4. Click on the Best Performance button to uncheck all the boxes.
5. Click OK, then OK to exit

This configures the system to not waste processor time generating cool graphic effects such as fading menus and animating windows when they are maximizing / minimizing.

Application Priority

Application priority can be tuned in general and for specific processes. General tuning is done by setting the foreground and background priority, which determines how Windows XP, 64 bit Edition balances process scheduling. If set to applications, then user applications (such as Word) will be given priority. If set to background, then services such as SQL server will be given priority. To set the processor scheduling:

1. On the desktop, right-click My Computer and select Properties.
2. Click the Advanced tab.
3. Click the Performance box, click on the Settings button.
4. Click on the Advanced tab
5. Select the appropriate radio button in the Processor scheduling frame.
6. Click OK, then OK to exit

Individual applications or processes can be given a specific priority to tune their performance. Use the START command to launch applications with specific priority. This command has

/low, /normal, /high, and /realtime switches to start programs with varying levels of priority. This command is the only means of externally influencing the priority of individual programs.

Memory

More, more! That has been the mantra of Windows 2000 administrators the world over. Now with the Itanium™ processor and the 64 bit Editions of Windows, they can finally make use of all the memory they want.

Memory has become the limiting component in most Windows-based systems. This is not necessarily a bad thing, as it is an easy performance problem to address. In fact, the common response to a performance problem is to throw handfuls of SIMM or DIMM chips at the system, because administrators have had this solution work so often. However, the 32 bit systems with Windows 2000 were architecturally limited in the maximum addressable memory, which 64 bit Itanium™ system and Windows XP 64 bit Edition increase by a factor of 4,000. The increase in addressable memory also allows the increase in a whole host of other memory related resources, which are listed in the table below.

Architectural Component	64 bit Windows 2000	32 bit Windows 2000
Virtual Memory	16 terabytes	4 GB
Paging file size	512 terabytes	16 terabytes
Hyperspace	8 GB	4 MB
Paged pool	128 GB	470 MB
Non-paged pool	128 GB	256 MB
System cache	1 terabytes	1 GB
System PTE	128 GB	660 MB

Even with all the potential memory space, the most economically feasible solution is not to just add memory to the system. This section takes a more analytical approach. Rather than waste resources by over-engineering the memory, this section shows you how to evaluate memory usage to understand what the operating system needs and how to function with less memory by reducing the demand—useful knowledge in times of belt tightening.

How Much Is Enough?

The normal response to a performance problem is to throw memory at it and hope that it sticks—that is, solves the problem. This is wasteful from a resource and time perspective, and over-engineering the memory may mask the real problem and delay finding it. There are much more effective methods for correctly sizing the memory in a system.

The first step is to verify the amount of memory in the system, which can be done in a variety of ways. The simplest is to look at the Performance tab of the Task Manager. Look at the Physical Memory box, in the Total row. As an added bonus, the available memory is also listed there, in the Available row.

Current usage

To give you a good feel for how memory is being used and whether there is a shortage, Windows XP 64 bit Edition provides a number of Performance Monitor counters. The counters in the table below are the most important to watch to identify memory shortages.

Object\Counter	Description
Memory\Available Bytes	Shows the amount of physical memory available to processes running on the computer, in bytes. This counter displays the last observed value only; it is not an average.
Process (All_processes)\Working Set	Shows the current number of bytes in the Working Set of this process. The Working Set is the set of memory pages touched recently by the threads in the process.
Memory\Pages/sec	Shows the number of pages read from or written to disk to resolve hard page faults. This counter displays the difference between the values observed in the last two samples divided by the duration of the sample interval.
Memory\Cache Bytes	Shows the sum of the System Cache Resident Bytes, System Driver Resident Bytes, System Code Resident Bytes, and Pool Paged Resident Bytes counters. This counter displays the last observed value only; it is not an average.

These counters can indicate current memory shortages. If these counters indicate memory shortage conditions, consider adding additional memory.

Controlling Swapping

Even with advances in memory technology and ever-increasing amounts of memory configured into systems, the operating system's memory use can still outrun the available physical memory. How does the operating system handle this?

Virtual memory

Although the operating system tries to keep everything in RAM, when everything does not fit, the operating system swaps the least recently used memory pages to the hard disk and stores them in the paging file. When a user needs the swapped pages, the operating system loads them back into RAM and swaps other pages to disk to make room for the pages that the user needs. This simulation of memory by mapping it to disk is called virtual memory.

To see how much virtual memory your Windows XP 64 bit Edition system uses or has used over time, start all of the applications that are normally in use and access the Task Manager to check the Peak Commit Charge value. This value appears in the Commit Charge (K) box on the Performance tab. The commit charge is the number of pages reserved for virtual memory that are backed by the paging file.

Impact on performance

Unfortunately, there is a performance cost to swapping. The disk speed is extremely slow in comparison to physical memory, so the system takes a performance hit by swapping memory to disk. The average computer memory chip today has an access time of 50

nanoseconds, or 5×10^{-8} seconds. Very fast disk access time today is about 6 milliseconds, or 6×10^{-3} seconds. Do a bit of quick math, and it turns out that physical memory is 120,000 times faster than memory swapped to disk. To put that in human terms, if it takes a minute to get a bit of information from physical memory, then it would take almost 12 weeks to get the same information from disk. Put another way, the decrease in speed is worse than the difference between sending e-mail to someone and shipping that person a package using Third-Class Book Rate through the U.S. Mail.

So, swapping can have a significant impact on performance, delaying the launch of applications and the switching between applications. In the case of large line-of-business applications with many dynamic link libraries and loadable modules, the application itself will run slowly as modules are forced to load and unload. Therefore, the placement of the paging file is important and can dramatically affect performance.

To monitor the impact of swapping on the performance of the system, load the counters listed below into System Monitor. These counters will give you a good picture of the rate of page faults, which are memory pages being swapped to disk.

Object \ Counter	Description
Memory\Pages/sec	Shows the number of pages read from or written to disk to resolve hard page faults. This counter displays the difference between the values observed in the last two samples divided by the duration of the sample interval.
Process (All_processes)\Working Set	Shows the current number of bytes in the working set of this process. The working set is the set of memory pages touched recently by the threads in the process. If free memory in the computer is above a threshold, pages are left in the working set of a process even though they are not in use. When free memory falls below a threshold, pages are trimmed from working sets. If these pages are needed, they will then be soft-faulted back into the working set before they leave main memory.
Memory\Pages Input/sec	Shows the number of pages read from disk to resolve hard page faults. This counter was designed as a primary indicator of the kinds of faults that cause system wide delays.
Memory\Pages Output/sec	Shows the number of pages written to disk to free up space in physical memory. Pages are written back to disk only if they are changed in physical memory, so they are likely to hold data, not code. A high rate of pages output may indicate a memory shortage.

For the Memory\Pages/sec counter, the value should be less than 60 per second for older computers and less than 200 per second for newer computers. The value really depends on the disk subsystem, because the page is being written to and read from the disk.

A simple response to a high rate of page faults is to add more physical memory. When this is not possible, try optimizing the pagefile.

Pagefile

The pagefile is the source of the most problematic interaction between hardware components. It creates a performance link between memory and disk that is a frequent source of performance problems. This section looks at how to size and place the pagefile for maximum benefit, as well as how to optimize the performance of the pagefile itself.

Sizing

The default size of the pagefile is 1.5 times the physical memory. Expanding the default size of the paging file can increase performance if applications are consuming virtual memory and the full capacity of the existing file is being used. The best way to determine how large the pagefile needs to be is to look at the system workload by monitoring the Process (_Total)\Page File Bytes Peak counter. This counter indicates, in bytes, the amount of the paging file used by processes.

Consider expanding the pagefile whenever this counter reaches 75 percent of the total size, in bytes, of the pagefile. This will ensure that the pagefile always has headroom. Rather than set a large maximum size, use the same initial and maximum sizes to avoid pagefile fragmentation.

Remember: in the case of the pagefile, bigger is better!

Placement

Because Windows XP 64 bit Edition puts the pagefile on the same drive as the operating system by default, the operating system's access to loadable modules and settings is in direct contention with the virtual memory system's use of the pagefile. The disk subsystem becomes a bottleneck during periods of high activity in both areas.

Moving the pagefile to a separate drive from the operating system is especially helpful in limited-memory systems, as these systems rely heavily on virtual memory and thus use the pagefile more. For a system with 256 of memory, the performance improvement can be as much as 30 percent.

Object\Counter	Description
Memory\Page Reads/sec	Shows the number of times that the disk was read to resolve hard page faults. This counter counts the number of read operations, without regard to the number of pages retrieved by each operation.
Physical Disk\Avg. Disk Bytes/Read	Shows the average number of bytes transferred from the disk during read operations.

Splitting

Putting the pagefile on two separate drives can increase performance in medium-memory profile systems. For example, splitting the pagefile for a low-memory configuration only increases the overhead the system has to manage, so the net benefit is less than when you use just one pagefile on a separate drive. In large-memory profile systems, swapping is minimal, and so any net benefits are minimal as well. Splitting the pagefile is very effective in medium-memory profile systems, where systems might see about a 15 percent improvement in performance over the use of just a single pagefile. Most Itanium

systems will have over a gigabyte of memory and some can have significantly more, so make sure that there is adequate disk space for the pagefile.

Remember that these benefits require that the drives be actual physically separate drives, not just logical partitions on the same physical drive.

Changing the pagefile

Changing the pagefile setting requires a reboot, as the system cannot modify its virtual memory profile while in operation.

To change the pagefile settings, follow these steps:

1. On the desktop, right-click My Computer and select Properties.
2. Click the Advanced tab.
3. Click the Performance box, click on the Settings button.
4. Click on the Advanced tab.
5. In the Virtual Memory box, click the Change button.
6. Modify the setting as appropriate.
7. Click Set to change the settings.
8. Click OK to exit.

Disk

After memory, disk performance is usually the workstation bottleneck. The operating system, all applications, and all data eventually reside on disk, so everything must go onto and eventually come off of the disk. This disk is also the safety valve for memory overflows, where the pagefile simulates memory. Compounding this memory overflow problem is the large performance ratio between the memory subsystem and the disk subsystem.

Fortunately, the disk is also a place where a lot of tuning, such as defragmenting a volume, can be done with great success. This section examines how to measure the performance of the disk subsystem and how to tweak it to make the disk perform better.

Throughput

Throughput is a measure of how fast a flow of information is passed through the system, rather than how fast a piece of information is passed through the system. Throughput is a better indicator of performance than just read and writes times, because it measures how much real work gets done.

Measuring throughput

Use the counters in the table below to measure the throughput of the disk subsystem. Use these counters in conjunction with other counters to determine the causes of low throughput.

Object \ Counter	Description
LogicalDisk\Disk Bytes/sec	Indicates the rate at which bytes are transferred and is the primary measure of disk throughput
PhysicalDisk\Disk Bytes/sec	
LogicalDisk\Avg. Disk Bytes/Transfer	Measures the size of I/O operations. The disk is efficient if it transfers large amounts of data relatively quickly. Watch this counter when measuring maximum throughput.
PhysicalDisk\Avg. Disk Bytes/Transfer	
LogicalDisk\Disk Transfers/sec	Indicates the number of read and write operations completed per second, regardless of how much data they involve. Measures disk utilization. If the value exceeds 50 (per physical disk in the case of a striped volume), then a bottleneck may be developing.
PhysicalDisk\Disk Transfers/sec	
LogicalDisk\Avg. Disk sec/Transfer	Indicates how quickly, in seconds, data is being moved. The counter measures the average time for each data transfer, regardless of the number of bytes read or written. A high value for this counter may mean that the system is retrying requests due to lengthy queuing or, less commonly, disk failures.
PhysicalDisk\Avg. Disk sec/Transfer	

As with the disk performance counters, the counters above give the total for both read and write operations. If you see high values, immediately begin monitoring the read and write versions of the counters to understand the nature of the high values at a finer level of detail.

Improving throughput

To improve throughput, limit the use of file compression and encryption. These features can consume quite a bit of overhead and will degrade throughput. Use them sparingly and only where specifically required.

Another way to improve throughput is to place multiple drives on separate I/O buses, particularly if a disk has an I/O-intensive workload. Many systems have dual PCI IDE buses, and systems with dual drives can place a separate drive on each one. Of course, there may be ramifications for systems that have other devices such as CD-ROM drives, so testing and a complete understanding of the effects are required.

Disk Performance and Memory Use

Memory tuning is key to ensuring that the disk subsystem performs at optimal capacity. Improper memory configurations can have disastrous effects on disk subsystem performance. For example, a system configured with memory that is insufficient to support applications and services relies heavily on the disk subsystem for virtual memory, placing an

added and unnecessary strain on the disk drives. The disks will constantly be accessed and used as backup for memory, limiting the disk subsystem's ability to perform its normal responsibilities.

Disk I/O vs. memory I/O

The symptoms of a memory shortage are similar to those of a disk bottleneck. When physical memory runs low, the system starts paging. The less memory the system has the more paging that occurs and the more the disk is used, resulting in a greater load on the disk system. Therefore, monitor memory counters along with disk counters when investigating a performance problem with your disk system, as it may be a memory problem in disguise.

Onboard disk cache

Several caching techniques are designed specifically to improve disk subsystem performance. More advanced drives, such as Seagate's Barracuda family of drives (<http://www.seagate.com>), incorporate caches on the drives themselves. Most drives available today ship with a minimum of 2MB and a maximum of 16MB of onboard disk cache. The goal of caching is to anticipate requests for code or data and retrieve the requested object before the system asks for it. When the disk drive has a caching mechanism of its own, the amount of processing the system needs to perform can be reduced significantly.

Is a bigger cache size better? The answer depends on how the cache is managed. Some advanced drives segment large caches and include enhanced caching algorithms to increase the cache hit rate and improve the effectiveness of the cache. Suppose, for example, that a drive with 1MB of its own cache space does not use any of these enhancements. It fills the entire cache with anticipated code or data. Then another request comes in, and it tries to anticipate future requests by reading in this data (because the anticipated requests are not currently allocated in the cache). However, it must find room in the cache to handle the additional requests. The only choice now is to purge the entire cache memory to service the new request. All of the work performed earlier is essentially wasted because it can no longer be used.

If this large amount of cache space is segmented, however, the drive will essentially have two or more caches at its disposal. Some drives, such as the ones from Seagate, can have as many as four cache segments to divide the cache load. When a cache segment becomes saturated, only that segment is purged. The other segments can still keep their contents and maintain a potentially high cache hit:miss ratio.

What happens when all of the cache segments are full? This is where the advanced caching algorithms make their mark. The drive must decide which cache to purge. It does not want to purge a segment that is about to be used; the drive purges the segment with the least amount of data likely to be used next.

It should be clear that disk read performance can be more efficient with an onboard disk cache. You should be sure to include this feature in your purchase if at all possible.

Turning on disk write caching

Some third-party programs require disk write caching to be enabled or disabled. In addition, enabling disk write caching may increase operating system performance.

To enable or disable disk write caching:

1. Right-click My Computer and then select Properties.
2. Select the Hardware tab.
3. Select Device Manager.
4. Click the plus sign next to Disk Drives to expand this item.

5. Right-click the drive on which you want to enable or disable disk write caching and then select Properties.
6. Select the Disk Properties tab.
7. Click to select or clear the Write Cache Enabled check box, as appropriate
8. Click OK.

Note: Enabling write caching generates the following warning: “By enabling write caching, file system corruption and/or data loss could occur if the machine experiences a power, device, or system failure and cannot be shut down properly.” This is normal, and you should disregard it.

Memory and Network Access

Network access also affects memory usage, as memory is allocated to caching the file system and network buffers. Different system uses need different allocation of resources to perform optimally. Windows XP 64 bit Edition allows you to balance the memory needs of application against the memory needs of the network through the Server Optimization settings.

Server optimization settings

The Server Optimization has four different settings to balance memory usage. These settings provide a convenient way to change the balance of memory, but are only available on the Windows Advanced Server, Limited Edition.

Setting	Description
Maximize memory used	Specifies that the server is optimized for a small number of clients.
Balance	Specifies that the server is optimized for a mixed usage of file and printer sharing, in addition to other services, such as serving as an interactive workstation.
Maximize data throughput for file sharing	Specifies that the server is optimized to dedicate as many resources as possible to file and print server resources.
Maximize data throughput for network applications	Specifies that server memory is optimized for distributed applications that perform their own memory caching, such as Microsoft SQL Server.

Setting server optimization

The settings are configured on the network interface. To set the values:

1. Click on Start\Settings\Network Connections
2. Right-click on Local Area Connection and select Properties
3. Select File and Printer Sharing for Microsoft Networks
4. Click on the Properties button
5. Select the appropriate Server Optimization
6. Click OK, then click OK to exit

This change does not require a reboot to take affect.

Defragmentation

Defragmentation is one of the most effective performance enhancing tweaks that you can perform. Defragmentation usually generates a significant performance increase that spans booting up, launching applications, and saving data, making it visible across a wide spectrum of activities.

File Fragmentation

If a file resides entirely in one location with no breaks on a disk, it is said to be contiguous. A fragmented file is separated into pieces that are stored in one or more places on the disk. File fragmentation is a normal process and affects files stored on both FAT and NTFS file systems. The operating system allows files to become fragmented as a trade-off for being able to write files to disk quickly wherever there is free space. Otherwise, the operating system would have to slow down writing while it moved files around to free up a contiguous stretch of disk space.

While fragmentation allows file to be written to disk quickly, over time it degrades performance. This is because the operating system has to move the disk head to all the different points on the disk to read the fragmented files. Fragmentation also gets worse over time, as more files are added and deleted. Large files stored on a workstation, such as a database file, can be fragmented into thousands and even tens of thousands of individual chunks on the disk. Eventually, fragmentation slows read and write operations to a fraction of their original performance. It also affects rebooting, as it takes longer to read files from disk. Fragmentation does not fix itself over time, but gets increasingly worse.

Identifying Fragmentation

Administrators can run the defragmentation utility to get a report on the state of disk fragmentation. This is a manual process and is somewhat intrusive. If you are monitoring on a continuous basis, using the performance counters is easier. Although there are no fragmentation-specific counters, the split I/O counters below can be used as indicators of fragmentation:

- LogicalDisk\Split IO/sec
- PhysicalDisk\Split IO/sec

These counters report the rate at which the operating system divides I/O requests to the disk into multiple requests. A split I/O request may occur if the program requests data in a size that is too large to fit into a single request, or if the disk is fragmented. Factors that influence the size of an I/O request can include application design, the file system, or drivers. A high rate of split I/O may not, in itself, represent a problem. However, on single-disk systems, a high rate for these counters tends to indicate disk fragmentation.

If the split I/O counters start reading high, the administrator can initiate defragmentation.

Defragmentation

Defragmentation is the process of making fragmented files and free space contiguous. Because both FAT and NTFS volumes can deteriorate and become badly fragmented over time, defragmentation is a vital system maintenance action. Defragmentation programs shuffle files around to consolidate the file fragments into contiguous files. This is similar to the tile puzzle game, in which there is a single open space to slide the tiles into, and the player has to move the tiles around to complete a pattern.

Windows XP 64 bit Edition includes a utility called Disk Defragmenter that will defragment the volumes. Prior to defragmenting, the tool allows administrators to generate an analysis of the disk to see if defragmentation is necessary. The analysis recommends whether the volume should be defragmented based on the fragmentation level. This saves unnecessary work if the drive will not benefit from defragmentation.

While defragmenting, the system will use between 30 and 50 percent of CPU time and about 50 to 80 percent of the disk I/O subsystem time. The disk I/O is mostly reads and few writes, as might be expected. Given the load that defragmentation places on the system, it is not usually recommended that it be run while the system is being used for productive work or during testing.

To effectively defragment a drive, the Disk Defragmenter needs free space in which to shuffle the files. In NTFS, the master file table (MFT) is an index file that maps everything stored on a volume. There is at least one entry in the MFT for every file on an NTFS volume. Each entry contains the size, time and date stamps, security attributes, and data location. Windows XP reserves 12 percent of the space on a volume for the exclusive use of the MFT. This area is known as the MFT zone and shows up as free space. The Windows XP Disk Defragmenter cannot use this reserved area, so it is normally recommended that at least 30 percent of the volume be free to perform defragmentation effectively. If it is not, the Disk Defragmenter may continue to report that defragmentation is needed even after a defragmentation pass. To eliminate this problem, free up disk space and rerun the defragmenter.

After defragmenting a disk, the Disk Defragmenter displays the results graphically and generates a report. It is important to note that the disk defragmentation rarely results in a completely defragmented disk. While there are still some file fragments, the majority of the volume will be contiguous, including free space.

When to Defragment

Given the high impact on performance of fragmentation, it is recommended that defragmentation be performed on a regular basis for all workstations to ensure that the hard disk is operating optimally; once a week is a good rule of thumb, though this schedule can be adjusted for systems with few local files. Also, after extensive disk testing in the lab, defragment to ensure that future testing is not affected.

New, upgraded, or systems with recently installed applications also benefit from defragmentation. Loading the operating system onto a brand new workstation, upgrading the operating system, or installing software can create both file and free-space fragmentation.

Pagefile Fragmentation

The Pagefile, like any other file, is subject to fragmentation. Normally, the file is created early in the life of the system and is created in contiguous space. However, if the file grows after that, it will likely add space from noncontiguous areas of the disk and become fragmented. If it is fragmented, performance can degrade severely due to increased disk I/O times. This is particularly bad for the paging file, as it compounds the already huge difference between memory and disk I/O times.

To see if the Pagefile is fragmented, run the Disk Defragmenter analysis and view the report. The section of the report with the heading "Pagefile Fragmentation" will list the total size of

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the Pagefile and the number of fragments. If this number is higher than 1, then the Pagefile is fragmented.

Unfortunately, the Windows XP 64 bit Edition Disk Defragmenter will not defragment the paging file. A workaround is to find a partition with enough space to hold the paging file, use the Disk Defragmenter to defragment the partition, and move the paging file to the defragmented partition. If necessary, the original partition can then be defragmented, and the Pagefile can be moved back to its original partition.



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Section 9 **Porting your Application to 64 bit Editions of Windows**

Section Summary

■ *Microsoft is committed to helping developers port existing applications from a Win32-based environment or build entirely new applications from the ground up. The 64 bit Editions of Windows development environment supports the same feature set as 32 bit Windows, making it easier for developers to port their applications to the 64 bit platform. Microsoft provides the Software Developers Toolkit (SDK) and Device Driver Toolkit (DDK) to ensure that applications conform to the 64 bit Editions of Windows model.*

64 bit Editions of Windows Environment

The 64 bit Editions of Windows development environment supports the same feature set as 32 bit Windows. This includes user interface and programming models, networking, security, graphics, multimedia, directory service, Plug and Play, and tools features. Many of the functions have been modified to reflect the computational precision of the platform on which an application is run.

The result is simplicity and a short learning curve for the developer. Writing code for the 64 bit Editions of Windows is just like writing code for 32 bit Windows. Developers can compile a single source base to run natively on either Win32- or Win64-based systems. This strategy reduces the cost of developing applications for the 64 bit architecture.

The 64 bit and 32 bit processes use their respective dynamic link libraries (dlls). However, the COM clients and remote procedure calls (RPCs) from both environments can communicate with each other.

General Porting Guidelines

Porting applications to the Windows XP 64 bit Edition will go smoothly with careful planning. Microsoft has provided some general guidelines below to help with the migration.

Planning

Determine the magnitude of the effort required for the port. Gauge how much work is involved by identifying the following items:

- Identify problem 32 bit code. Compile your 32 bit code with the 64 bit compiler and examine the extent of the errors and warnings.
- Identify shared components or dependencies. Determine which components in your application originate from other teams and whether those teams plan to develop 64 bit versions of their code.
- Identify legacy or assembly code. 16-bit Windows-based applications do not run on 64 bit Editions of Windows and must be rewritten. While x86 assembly code runs in emulation mode, you may want to rewrite this code to take advantage of the speed of the IA-64 architecture.
- Port the entire application, not just portions of it. Although it is possible to port pieces of an application or to limit code to 2G with /LARGEADDRESSAWARE:NO, this strategy trades short-term gain for long-term pain.
- Find substitutes for technologies that will not be ported. Some technologies, including Data Access Object (DAO) and the Jet Red database engine, will not be ported to 64 bit Editions of Windows.
- Treat the Windows XP 64 bit Edition as a separate product release. Even though the Windows 64 bit Edition may share the same code base as your 32 bit, it needs additional testing and may have other release considerations.

Development

- Start developing compliant code now. Developers can start writing compliant code by using the latest Platform SDK header files and the new data types with no negative effects on 32 bit product development. For more information, see [Getting Ready for 64 bit Editions of Windows](http://msdn.microsoft.com/library/psdk/buildapp/64bitwin_410z.htm) (http://msdn.microsoft.com/library/psdk/buildapp/64bitwin_410z.htm)
- Ensure that your code can be compiled for both 32- and the Windows XP 64 bit Edition. The new data model was designed to allow 32- and 64 bit applications to be built from a

single code base with few modifications. The SQL Server and Windows 2000 development teams are developing 32- and 64 bit versions of their products from the same code base.

- Use the compiler's new optimization features for best performance. Code optimization for IA-64 processors is more important than it was for the x86. The compiler assumes many of the optimization functions previously handled by the microprocessor. You can maximize the performance of a 64 bit application by using two new optimization features of the compiler:
 - Profile Guided Optimization involves a two-step compile process. During the first compile, the code is instrumented to capture the execution behavior. This information is used during the second compile to guide all optimization features.
 - Whole Program Optimization analyzes the code in all application files, not just one. This approach increases performance in several ways, including better inlining, as well as improved side-effect analysis and custom calling conventions.

Testing

- Determine whether you will test 64- or 32 bit code running in emulation. Some applications include both native 64 bit code and 32 bit code running in emulation. Investigate this closely while developing a test plan, and decide whether your test tools should be 64 bit, 32 bit, or a combination. You will often need to test both the 64- and 32 bit versions of your application on 64 bit Editions of Windows.
- Test frequently used 32 bit components. Recompile your code to 64 bit and test, fix problems, recompile in 32 bits, and retest. Finally, recompile to 64 bit and test.
- Test COM and RPC components. Verify that both 32- and 64 bit COM and RPC components communicate correctly. You may also have to test communications with 16-bit components over a network.
- Test your 32 bit version on Windows XP 64 bit Edition. Customers can continue to use 32 bit applications on 64 bit Editions of Windows where performance and memory issues are not major considerations.
- Test different memory configurations. Adding large amounts of memory on the server sometimes exposes previously unnoticed problems in either the application or the operating system.

The Windows 2000 SDK and DDK provide tools for the development of single source-code for Win32- and Win64-based applications. Developers working on Win64-based applications will find the environment virtually identical to the environment for Win32-based applications; the Win64 API is the same as the Win32 API.

For more information on how to write new 64 bit applications today, see [Getting Ready for 64 bit Editions of Windows](http://msdn.microsoft.com/library/default.asp?URL=/library/psdk/buildapp/64bitwin_410z.htm), (http://msdn.microsoft.com/library/default.asp?URL=/library/psdk/buildapp/64bitwin_410z.htm).

Platform Software Development Kit (SDK)

The key objectives of the Platform SDK are to simplify installation of your development environment by integrating formerly discrete SDKs, introduce you to the latest technologies, and

provide information about existing technologies. Visit the Microsoft Developer Network (MSDN®) Web site at <http://msdn.microsoft.com/> for the latest information on the Platform SDK and MSDN. The Platform SDK contains the following components:

- Headers, libraries, and type libraries needed to build your application.
- Tools to aid in the development and debugging of applications.
- Technology overviews, detailed interface references, and documentation for using the tools.
- Samples to demonstrate the various technologies available.
- Re-distributables to support application deployment.

System Requirements

The following are the system requirements for the Platform SDK:

- Windows XP 32 bit (Personal or Professional), Windows XP 64 bit Edition, Microsoft® Windows® Millennium Edition (Windows Me), Microsoft Windows® 2000 (Professional or Server), Microsoft Windows NT® version 4.0 (Professional or Server), or Windows 98.
- Microsoft Internet Explorer 4.02 or later.
- Microsoft Windows Installer version 1.2 runtime executables on Windows 98, Microsoft® Windows® Millennium Edition (Windows Me), and Microsoft Windows NT® version 4.0, and native version of Microsoft Windows Installer on other platforms.
- A C/C++ compiler (Microsoft Visual C++ 6.0 or later) to build C/C++ samples. A pre-release C/C++ compilation system is provided to target Windows 2000 64 bit Edition (pre-release). To gain access to the compilation system, during setup you must select Win64 Development Components (pre-release).
- Microsoft Visual Basic to build Visual Basic samples.
- Approximately 1150 MB of disk space on an NTFS partition is required for a full installation (more if compiling all the samples). Significantly more space is needed when installing to a FAT partition. Choose the Custom install option and select only the components you need to reduce disk space requirements.

To Obtain the Platform SDK

- Subscribe to MSDN at the Professional or Universal level. An MSDN subscription at either of these levels provides access to operating systems and beta releases and the Platform SDK on CD-ROM. For details about subscribing to MSDN, see <http://msdn.microsoft.com/subscriptions/default.asp>.
- Visit the Web site at <http://www.microsoft.com/msdownload/platformsdk/setuplauncher.htm> to download the Platform SDK.
- Order a CD-ROM of the Platform SDK from the Developer Store. The charge is for shipping and handling only.
- U.S. and Canadian customers go to:
http://developerstore.com/devstore/product.asp?productID=7594&store=TOOLBOX_NA&DisplayCode=HIDE.
- International customers go to:
http://developerstore.com/devstore/product.asp?productID=7596&store=TOOLBOX_INTL&DisplayCode=HIDE.

- To view the Platform SDK documentation only, visit the MSDN Library online at <http://www.msdn.microsoft.com/library/default.asp>.

Driver Development Kit (DDK)

The Microsoft® Windows® Driver Development Kit (DDK) for Windows Advanced Server, Limited Edition provides a development environment for the creation of Windows Advanced Server, Limited Edition drivers. The DDK provides additional driver-specific headers, libraries, sources, tools, and documentation that are used to develop drivers for Windows Advanced Server, Limited Edition.

System Requirements

The following are required to use the DDK on a driver-development machine:

- Microsoft® Windows Advanced Server, Limited Edition, Windows 2000, Windows® 98, Windows® 98 SE, or Windows® ME. If installing on Windows 98 Gold IE 5.x must be installed before the setup program can be run. Installation on Windows NT® 4.0 is not supported.
- CD-ROM drive or Internet access.
- At least 64MB RAM. 128MB of RAM or more
- Up to 400MB hard-disk space for a full installation. Up to 850MB may be required to compile all samples.

The following are required to use the DDK on a driver-testing machine:

- Microsoft Windows Advanced Server, Limited Edition.
- At least 128MB RAM if you are running a free or retail build of Windows Advanced Server, Limited Edition, 256MB RAM if running a checked build. In some cases, checked builds may require 128MB of RAM, depending on the particular drivers loaded on the machine.
- A second machine that is capable of running Windows 2000 or Windows Advanced Server, Limited Edition for kernel debugging of your under-development drivers. This machine can be your driver-development system if desired.

Resources

Additional information on developing the 64 bit Editions of Windows on the Itanium™ processor can be found at the following links.

- [Microsoft Press Release](http://www.microsoft.com/presspass/press/1999/Aug99/Intel64PR.asp)
(<http://www.microsoft.com/presspass/press/1999/Aug99/Intel64PR.asp>)
- [Intel's IA-64 Developer Information](http://developer.intel.com/design/ia64/devinfo.htm) (<http://developer.intel.com/design/ia64/devinfo.htm>)
- [Platform SDK: Getting Ready for 64 bit Editions of Windows](http://msdn.microsoft.com/library/default.asp?URL=/library/psdk/buildapp/64bitwin_410z.htm)
(http://msdn.microsoft.com/library/default.asp?URL=/library/psdk/buildapp/64bitwin_410z.htm)
- The Driver Development Kit Web Site: <http://www.microsoft.com/ddk>.
- The Hardware Development Web Site: <http://www.microsoft.com/hwdev>

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- MSDN® developer program: <http://msdn.microsoft.com>
- The DirectX® Web site: <http://www.microsoft.com/directx>
- [Platform SDK: Designing 64 bit-Compatible Interfaces](http://www.microsoft.com/isapi/gomsgdn.asp?TARGET=/library/default.asp?URL=/library/psdk/buildapp/mi-port64_9ius.htm)
(http://www.microsoft.com/isapi/gomsgdn.asp?TARGET=/library/default.asp?URL=/library/psdk/buildapp/mi-port64_9ius.htm)

Reference Materials

- Document – ReadMe.htm, Microsoft Platform SDK, February 2001
- Document – ReadMe.htm, Microsoft Platform DDK, February 2001
- White Paper - Microsoft® Windows® Advanced Server Limited Edition, Microsoft, May 2001
- Technical Document – MSDN Technical Online Library, General Porting Guidelines, (http://msdn.microsoft.com/library/default.asp?URL=/library/psdk/buildapp/64bitwin_410z.htm)
- Technical Article – 64 bit Editions of Windows portends enhanced enterprise computing, Robert Williams, Windows 2000 Advantage Web Magazine, 2001
- Product Overview – 64 bit Windows Overview, <http://www.microsoft.com/windows2000/future/64bit/64bit.asp>, August 2000



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Section 10 **Evaluating 64 bit Desktop Applications**

Section Summary

■ *This section provides an overview for evaluating specific 64 bit applications designed to run on the desktop; specifically, applications that can leverage the performance and features of Windows XP 64 bit Edition. These applications include Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), or Engineering and modeling programs. Graphic applications that are processing intensive (such as rendering and 3D-modeling) are also great candidates to capitalize on the benefits of the 64 bit platform.*

Computer Aided Design / Engineering / Manufacturing

A good example of an engineering desktop is a workstation set up for a CAD/CAE/CAM user. Design and simulation analysis applications require the ability to manage large and complex drawing and assembly models. Advanced manufacturing applications begin with mathematical models of physical parts, manufacturing tolerances, and characteristics of various materials. Then engineers simulate different physical effects on the models such as motion of moving parts, airflow and stress from impact, to determine how the models will behave in real world scenarios. This type of modeling and testing will benefit from Windows XP, 64 bit Edition, which provides high-end processing, memory bandwidth and support for large data sets.

This high-end workstation would be built on 64 bit hardware and Windows XP 64 bit Edition. All engineering applications installed on the workstation should be 64 bit as well to get the full benefit of the 64 bit platform. Because this workstation will need to handle complex drawings and diagrams, it should be built to include the following features:

- Large memory to hold content and reduce disk read/writes
- Fast bandwidth to move data in and out of subsystems
- Advanced processor features to quickly manipulate data and process calculations
- Cutting-edge graphics capability to visualize complex data sets

Evaluating the Engineering Desktop

When comparing the CAD/CAE/CAM applications on the 64 bit workstation with the 32 bit versions running on 32 bit hardware, the 64 bit platform should show a considerable increase in performance. Hardware components such as storage device, video adapter and amount of RAM should be identical on both 32 bit and 64-bit-platforms. Having a similar hardware foundation will show the true benefits of the multi-processing and memory handling capabilities of the Windows XP, 64 bit Edition on an Itanium™ processor system. Comparison tests should include the following:

- Application and file access speed
- Time required to process changes to drawing models
- Ability to handle multiple files simultaneously
- Run time for mathematical analysis on design models

Graphics Desktop

3D Animation and Rendering

A workstation configured to meet the needs of 3D Animators requires the ability to work with larger and more complex models and scenes that require faster rendering at high resolution. Applications in this category will benefit most from the 64 bit platform's increased addressable memory, floating point performance and memory bandwidth. Animators use applications that enable them to render images at full resolution and in real-time. They generally work with wire frame models due to lack of available addressable memory.

This high-end workstation would be built similar to the engineering workstation, based on 64 bit hardware and Windows XP 64 bit Edition. All 3D animation applications installed on the workstation should be 64 bit as well to get the full benefit of the 64 bit platform. Because this workstation will need to handle large files, it should be built to include the following features:

- Large memory to hold content and reduce disk read/writes
- Fast bandwidth through hardware components to move data in and out of subsystems
- Advanced processor features to quickly manipulate data and process calculations
- Cutting-edge graphics capability to visualize complex data sets

Evaluating the Graphics Desktop

When comparing the animation and rendering applications on the 64 bit workstation with the 32 bit versions running on 32 bit hardware, the 64 bit platform should show a considerable increase in performance. Hardware components such as storage device, video adapter and amount of RAM should be identical on both 32 bit and 64-bit-platforms. Having a similar hardware foundation will show the true benefits of the advanced floating-point processing and memory handling capabilities of Windows XP, 64 bit Edition on an Itanium™ processor system. Comparison tests should include the following:

- Application and file access speed
- Time required to process changes to 2D and 3D images
- Ability to handle multiple files simultaneously
- Rendering speed of 2D and 3D images
- Run time for processing full motion animation

Reference Materials

- Technical Article - Itanium-based workstations power data analysis and visualization, <http://developer.intel.com/eBusiness/products/momentum/ar1008.htm>
- White Paper – Itanium-Based Solutions in the Manufacturing Market, <http://developer.intel.com/eBusiness/products/ia64/overview/>, Analysts: Kara M. Yokley, Earl Joseph II, Ph.D. and Christopher G. Willard, Ph.D.
- White Paper – Itanium-Based Solutions in the Digital Content Creation Market, <http://developer.intel.com/eBusiness/products/ia64/overview/>, Analysts: Kara M. Yokley, Earl Joseph II, Ph.D. and Christopher G. Willard, Ph.D.

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Section 11 **Evaluating Internet Information Services 6.0**

Section Summary

■ *Many enhancements made to Internet Information Services 6.0 distinguish the newer version from its predecessor, IIS 5.0. IIS 6.0, a component of Windows Advanced Server, Limited Edition, contains many improved features, which are described in this section.*

The features are explained in how they improve reliability, scalability, performance, and interoperability. Emphasis is placed on how these features benefit an organization by leveraging the strengths of the new Windows Advanced Server, Limited Edition, and improving upon existing IIS functionality. This section also provides the steps for installing and configuring IIS 6.0. Suggestions for conducting an evaluation of IIS on the new 64 bit platform are also included.

Internet Information Services 6.0

Internet Information Services 6.0 (IIS 6.0), an integral component of Windows Advanced Server, Limited Edition, benefits an organization with its reliability, scalability, performance, and interoperability with IIS 5.0.

Reliability

IIS 6.0 introduces Dedicated Application Mode, which runs all application code in an isolated environment without the performance penalty of the previous versions of IIS. Dedicated application mode provides the capability to isolate anything from an individual Web application to multiple sites in their own self-contained Web service process. This prevents one application or site from stopping another.

Specifically IIS 6.0 **Dedicated Application Mode** improves upon its predecessors in the following areas:

- No reboots – The goal is to prevent having to reboot the server or shut down the entire HTTP service when performing common operations, such as upgrading content or components, debugging Web applications.
- Self-healing – Support for auto-restart of failed applications and periodic restart of leaky or unreliable applications with no interruption to service
- Debugging – Web application processes (worker processes) can be started under the debugger. This makes it easy to identify what is running in the process. It also supports the ability to dump a running worker process for troubleshooting.

Integral to IIS 6.0 is **Kernel-mode Queuing**. HTTP.SYS listens for requests and queues those requests on the appropriate request queue. Each request queue corresponds to one application pool. Because no third-party or user code runs in HTTP.SYS, it cannot be affected by crashes in user mode code that normally affect the status of the W3SVC.

If something causes the **Worker Process** serving the request queue to terminate, HTTP.SYS continues to accept and queue requests, provided the W3SVC is still up and running. Once the W3SVC notices the crashed worker process, it starts a new one.

Therefore, while there may be a temporary disruption in user mode request processing ability, an end user does not experience the failure because requests continue to be accepted and queued until there are no queues available, there is no space left on the queues, or the W3SVC has been shut down.

Web Administration Service (WAS) and HTTP.SYS make up the core portion of the W3SVC, where no third-party code is allowed to run. IIS 6.0 completely isolates third-party application code from the core Web server by keeping the main Web server functionality, such as configuration management and request queuing, in WAS and HTTP.SYS and allowing application code to run in dedicated mini-Web server processes called **worker processes**. IIS 6.0 kernel driver HTTP.SYS and the WAS portion of the W3SVC reside in a "sanctified" zone where critical IIS 6.0 services reside and third-part code is never loaded.

WAS configures HTTP.SYS and the various worker processes it starts, enforces many of the health detection features such as pinging, and manages the lifetime of the worker processes.

All user code is handled by Worker Processes in dedicated application mode, which is completely isolated from the core Web server. This improves upon IIS 5.0 in that Internet Server Application Programming Interface (ISAPI) is often hosted in-process to the core Web server. If an ISAPI load in-process in IIS 5.0 encounters an access violation, the Web server, iisadmin and any other services hosted by INETINFO are also taken down. In IIS 6.0

dedicated application mode, the only thing taken down is the worker process that hosts the ISAP. The W3SVC starts up a new worker process to replace the failed worker process.

Scalability

Asynchronous CGI is an integral part of IIS 6.0. The Common Gateway Interface (CGI) implementation in IIS 5.0 was synchronous (the thread that executed the CGI process was blocked until the CGI process returned). IIS 6.0 provides asynchronous CGI and the result is improved scalability.

The improved **Dedicated Application Mode** feature of IIS 6.0 supports scaling to ISP scenarios where there may be hundreds of thousands of sites on a server. Also, IIS 6.0 supports Web Gardens, where a set of equivalent processes on a computer each receives a share of the requests that are normally served by a single process. This provides better multi-processor scalability.

Performance

IIS 6.0 now uses the Windows Advanced Server, Limited Edition operating system to do **Bandwidth Throttling**. This allows IIS to throttle individual host-header sites and send responses for a given site in parallel when bandwidth throttling is on (IIS 5.0 serialized each response). As a result, an IT or Web administrator can have multiple host-header sites on a computer that share the same IP address and port. Each site can be set up for a certain amount of pre-assigned bandwidth, thus improving overall performance of the web server.

Interoperability

While dedicated application mode in IIS offers increased isolation, reliability, availability and performance, some applications may not work in this environment due to compatibility issues such as read-raw data filters and multi-instance issues. To address this, the default mode, **Standard Application Mode**, was created to ensure compatibility. Standard Application Mode is fully compatible with IIS 5.0 and takes advantage of the benefits offered by HTTP.SYS such as the kernel cache and kernel-mode request queuing.

Installation and Configuration

IIS 6.0 is installed by default with Windows Advanced Server, Limited Edition. If this component was deselected during the initial installation, the component can be added with these steps:

1. From Control Panel, choose Add or Remove Programs.
2. Click on Add/Remove Windows Components
3. Check the Internet Information Services (IIS) checkbox:

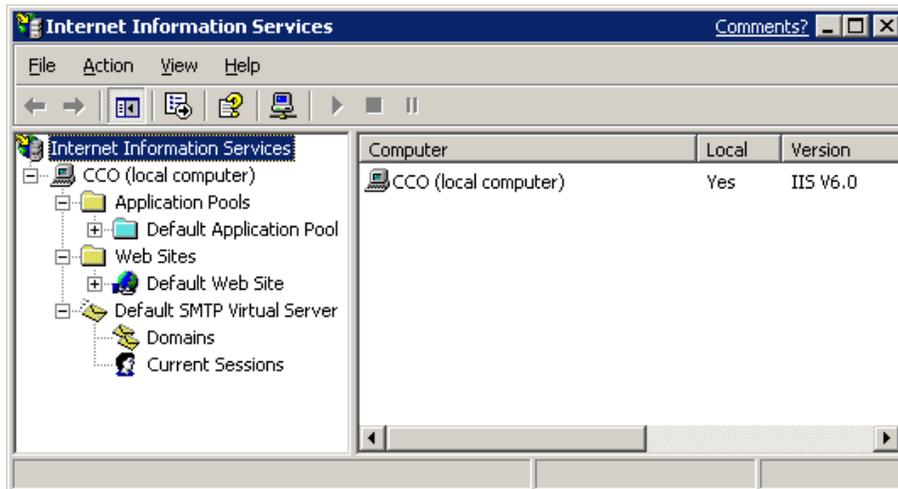
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If prompted for a CD, insert the Windows Advanced Server, Limited Edition installation CD. When the files are loaded, restart the computer.

To configure Internet Information Services, open the following:

1. Start – Programs – Administrative Tools – Internet Services Manager



IIS creates a default Web site and FTP site when Windows Advanced Server, Limited Edition is installed. The following steps describe how to publish information on those default sites.

To publish content on a web site:

1. Create a home page for the Web site. There are a variety of available tools used in Web site creation.
2. Name the home page file Default.htm or Default.asp.
3. Copy the home page into the default Web publishing directory for IIS. The default Web publishing directory is also called the home directory, and the location provided by Setup is \inetpub\wwwroot.

Note: If the network has a name resolution system (typically DNS), visitors can simply type the server computer name in the address bar of their browsers to reach the new site. If the network does not have a name resolution system, then visitors must type the numerical IP address of the server.

To publish content on an FTP site:

1. Copy or move files into the default FTP publishing directory. The default directory provided by Setup is \inetpub\Ftproot.

Note: If the network has a name resolution system (typically DNS), then visitors can type ftp:// followed by the computer name in the address bar of their browsers to reach this site. If not, then visitors must type ftp:// and the numerical IP address of the server.

Evaluating Internet Information Services

When comparing Internet Information Services on the 64 bit Server with the 32 bit version running on 32 bit hardware, the 64 bit platform should show a considerable increase in performance. Hardware components such as storage device, video adapter and amount of RAM should be identical on both 32 bit and 64-bit platforms. Having a similar hardware foundation will show the true benefits of the multi-processing and memory handling capabilities of Windows Advanced Server, Limited Edition on an Itanium™ processor system. Comparison tests should include:

- Number of synchronous HTTP connections.
- SSL transactions performed per second.
- Online transaction processing.

Reference Materials

- Document – Whistler Feature Guide for Beta 2. June 2001.

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Section 12 **Evaluating SQL Server 2000 (64 bit)**

Section Summary

■ *This section introduces Microsoft SQL Server 2000 (64 bit) for Windows Advanced Server, Limited Edition. The benefits of running SQL Server 2000 for 64 bit include increased memory support, increased scalability, an improved installation, and other enhancements. These benefits are detailed in this section. Also, this section provides the steps for installing and evaluating SQL Server 2000 (64 bit).*

Microsoft SQL Server 2000 (64 bit)

Microsoft SQL Server 2000 is the complete database and analysis solution for rapidly delivering the next generation of scalable Web applications. As a core component of the Microsoft® .NET Enterprise Servers, it dramatically reduces the time required to bring e-commerce, line-of-business, and data warehousing applications to market while offering the scalability needed for the most demanding environments. SQL Server 2000 includes rich support for XML and HTTP, performance and availability features to partition load and ensure uptime, and advanced management and tuning functionality to automate routine tasks and lower total cost of ownership.

In addition to providing the necessary enterprise “abilities” for data management and analysis, SQL Server 2000 helps deliver “agility”. Agility is a characteristic of organizations that can rapidly adapt to changing environments for competitive advantage. By going beyond simple data storage/retrieval and offering true business intelligence functionality, SQL Server 2000 allows business to understand and analyze their data.

Microsoft SQL Server 2000 (64 bit)

SQL Server 2000 (64 bit) provides full database services for Windows Advanced Server, Limited Edition running on Intel Itanium™ processors. Exploiting the 64 bit platform, SQL Server 2000 (64 bit) offers higher levels of single system scalability for the most memory intensive data applications, such as data warehousing and analytic applications.

Increase in Physical Memory

The 64 bit Editions of Windows installed on Intel Itanium™ systems support up to 4 terabytes of physical memory. The increased physical memory available to the Windows Advanced Server, Limited Edition includes the following benefits for database applications:

- Each application can support more users. All or part of each application must be replicated for each user, which requires additional memory.
- Each application has more memory for data storage and manipulation. Databases can store more of their data in the physical memory of the system. Data access is faster because there will be fewer disk reads and writes, reading from memory.

Increase in Scalability

The ability to install up to 16 SQL database engine instances on a single machine, coupled with Windows Advanced Server, Limited Edition, supports larger numbers of users and applications, and results in a lower cost of ownership. Businesses will require fewer servers to support the same number of users.

Improvements in SQL Installation

The installation process for SQL Server 2000 (64 bit) is a significant improvement over SQL Server 2000 32 bit. SQL Server 2000 (64 bit) Setup is based on the new Windows Installer technology, adding more reliability and flexibility to the installation process.

What used to be two distinct and separate setup procedures (one for the RDBMS and another for SQL Server 2000 Analysis Services) has been integrated into one simple procedure. A Windows Installer based setup keeps a master set of installation tables where every application resource (files, registry keys, and so on) is clearly tied to the component or feature it supports. If an application system file gets corrupted or accidentally deleted, the

application can be repaired. The installation data is checked and any missing or corrupt files are repaired or replaced as checked.

Integration with 32 bit Versions of SQL Server 2000

SQL Server 2000 (64 bit) ships with a 64 bit database server, a 64 bit server agent, and 64 bit analysis server (OLAP and data mining). These components of SQL Server 2000 (64 bit) are code compatible with the 32 bit version of SQL Server 2000, making it easy to integrate a 64 bit server with other SQL Server 2000 database servers, and providing compatibility for organizations that wish to maintain some of their 32 bit SQL Server deployments, while introducing new 64 bit technologies for larger, more demanding database applications.

Database management and administration, 32 bit clients and SQL Server tools such as Enterprise Manager, Query Analyzer, and so on, can be used to remotely manage a SQL Server 2000 (64 bit) database. Tools currently in use on administrators' workstations will not require upgrades to remotely manage the new 64 bit databases.

Other Enhancements in SQL Server 2000 (64 bit)

- Several key components that were traditionally a part of the SQL Server 2000 database installation are now a part of the 64 bit Editions of Windows. Examples of these components are the Microsoft Data Access Components or MDAC 2.7, Distributed Transaction Coordinator (DTC), HTML Help, and the Microsoft Management Console (MMC).
- Analysis Services now uses the SQL Server Desktop Engine 2000 (64 bit) also known as MSDE 2000, to host its repository.

Installing SQL Server 2000 (64 bit)

Details are not available at time of publication.

Evaluating SQL Server 2000 (64 bit)

When comparing SQL Server 2000 (64 bit), running on the new Itanium™ platform, with the 32 bit version running on 32 bit hardware, the 64 bit platform will show some performance improvement directly related to larger memory addressability. For example, the 64 bit platform may show I/O savings due to larger memory buffer pools. Database applications that require working data sets larger than 4GB to be loaded in memory will benefit from the higher memory addressability of the 64 bit platform, as memory sensitive workloads consume more memory.

For low-end implementations (4 processor servers), internal testing showed a 15% percent performance improvement on a 64 bit implementation over a 32 bit implementation using tests representative of typical OLTP workloads. Higher performance gains are expected for higher scale implementations (8 to 32 processor servers)

Reference Materials

- Document - SQL Server 2000 Product Guide. January, 2001.
- Document - Microsoft SQL Server 2000 (64 bit) Overview. May 2001.

About the Authors

Convergent Computing (CCO) is a 15 year old company, providing IT related Professional Services for companies in the Greater Bay Area. CCO is proud to be Microsoft's first "Gold Certified Partner" in the world, earning the respect of clients and vendors alike. CCO provides end-to-end, Enterprise solutions through "world class" consulting, proven Project Management, and a partnership approach.

Mark Bello serves as a Consulting Engineer for CCO and brings more than 16 years of IT related experience to every project. **Chris Amaris** serves as the Chief Technology Officer for CCO, providing leading edge technical expertise for many of their Fortune 1000 clients. Chris is the co-author of the just released publication, "Windows 2000 Performance Tuning and Optimization".

Gene Bondoc and **Eric Kovach** provide consulting and engineering for CCO, using their technical skills and experience to design and deploy IT related services.

Acknowledgements

- **Neil Kelly** and **Matt Zanner** from Hewlett Packard, for providing the RX4610 Itanium Server.
- **Umesh Shah** from Intel, for providing access to their Itanium lab.
- **Clyde Rodriguez** and **Kim Harrison** from Microsoft for their great assistance in identifying resources and providing much background information.
- **Velle Kolde** from Microsoft for being the driving force behind the creation of this Evaluation Guide.
- **Rand Morimoto** and **Scott Selverian** from Convergent Computing, for their technical and moral support throughout the project.

