



Server Virtualization Solution

Industry

Cross Industry

Business Challenge

Reducing costs and inefficiencies by consolidating distributed server resources

Technology Solution

IBM®/VMware™ solution from IBM® and VMware™

Enterprise Hardware Platform

IBM® **@server** xSeries™ servers featuring scalable Intel® Architecture

SOLUTION ARCHITECTS



MEETING NEW MARKET DEMANDS

There is a dramatic shift underway in which proprietary platforms and applications are giving way to more modular, standards-based solutions. This is driven by some of today's most urgent business demands and priorities, such as the need to reduce costs and inefficiencies, to increase return on investment (ROI), and to ensure business continuity and security. Advancements in Intel® Architecture-based platform capabilities are also accelerating this shift, by providing more and better resources for consolidating distributed server resources.

As computing needs rose dramatically in the mid to late 1990s, many businesses and organizations found themselves deploying excessive numbers of single- and dual-processor servers to quickly address emerging business needs. The latest generation of Intel® Xeon™ processor-based platforms offers an affordable, standards-based strategy for consolidating these systems. Information technology (IT) organizations can decrease server numbers, improve management efficiency, and reduce their overall operational costs—while continuing to take advantage of the tremendous modularity and price/performance of Intel® Architecture-based solutions.

Data centers within large enterprises faced with increasing workloads often employ an expensive and complex mix of servers and operating systems to support daily operations—making it difficult to quickly launch new applications or provide ongoing server management. Consolidating workloads onto fewer, larger platforms using virtual machine technology can help IT organizations reduce costs, increase resource utilization, and integrate support services. The IBM®/VMware™ solution, based on a powerful, adaptable Intel® Xeon™ processor MP-based platform, enables businesses to consolidate workloads from multiple, smaller servers onto an IBM® @server xSeries™ 440 system with logical partitioning provided by VMware™ ESX Server. This quick-to-deploy, cost-effective solution unifies multiple system instances—operating systems and applications—onto a single physical system that is tuned for rapid expansion, simplified management, reliable operation, minimal disaster recovery downtime, and reduced operation costs.

The IBM® xSeries™ 440 platform, powered by the Intel® Xeon™ processor MP, satisfies the rigorous requirements of corporate data center customers—offering the high performance, reliability, and scalability to handle demanding workloads in a virtual machine environment. Within enterprise server consolidation projects, 20 virtual machines per IBM® x440 is the most common. However, as many as 64 virtual machines can run on a single IBM® x440 system, contributing to significant savings in the total cost of ownership (TCO) and simplified software lifecycle management.

THE BUSINESS CHALLENGE

To maintain the cost effectiveness of data centers and meet maintenance requirements affordably, IT departments in large enterprises must find ways to simplify complex operations, enhance resource utilization, and manage dynamic workloads that are distributed through a disparate collection of servers and operating systems.

To respond to these challenges, enterprises typically seek:

- Increased system maintenance efficiency
- Capabilities for rapidly deploying new systems to address business needs
- Technologies to reduce the associated capital, personnel, and operational costs

IT departments that are expanding capacity or embarking on new projects often find themselves in a position where they must acquire new systems—adding to the overall

Solution Blueprint:
Server Virtualization Solution

Solution Provider:
VMware™ and IBM®

management and maintenance complexities within their operations. This often requires additional personnel with expertise in managing similar, yet separate hardware and software environments.

This approach to data center operations often results in a proliferation of single- and dual-processor commodity servers. In this type of environment, a multitude of individual servers handle file and print server operations, directory infrastructure, Web applications, Lotus Notes* messaging, and Citrix* MetaFrame*, or other terminal service solutions. Other applications that require individual servers because of development considerations, security factors, or other issues compound the problem of maintaining a large collection of small systems.

Consolidating operations on a single platform offers the potential for meeting this challenge, but the capability of isolating, or logically partitioning, operating system and application installations on a shared hardware platform is not supported in most solutions. Without this capability, running multiple applications and larger total workloads on a single multi-processor-based system instance raises software compatibility risks, emphasizes single point-of-failure concerns, and increases individual system maintenance requirements. Another challenge is that applications that are built for single- and dual-processing platforms often do not scale well to larger, multi-processor servers.

THE SOLUTION OVERVIEW

The IBM®/VMware™ solution consolidates under-utilized commodity servers with the VMware™ ESX Server on an IBM® x440 platform—supporting virtual machine functions for a wide variety of platforms. This server-consolidation solution supports installation of multiple server instances on a single physical system that is logically partitioned to protect and control resource usage between each of the virtual server instances. The IT organization gains control and flexibility by consolidating applications and services that normally run on dedicated, single- and dual-processor servers. This approach also provides significant cost benefits and the agility to rapidly respond to changing business requirements.

By consolidating physical systems onto IBM® x440 servers with VMware's ESX Server and data center, enterprises experience:

- **Reduction of hardware acquisition and maintenance costs**—through a 20:1 consolidation of physical systems onto multiple virtual servers running on a single, fully configured multi-processor-based platform.
- **Consolidation of idle system resources**—freeing up usage for new projects across multiple virtual systems.
- **Increased operational efficiency**—with a unified server management interface and browser-based remote console ability.
- **Cost-effective and consistent production environment**—with a repeatable testing and development environment.

The quad-based, building-block design architecture of the IBM® x440 series servers supports incremental increases in processing capacity—ranging from 4-way to 16-way—scaling fluidly to adapt to changing requirements in data center operations. The Intel® Xeon™ processor MP delivers the exceptional platform performance required to capably handle virtual machine operations—while providing sufficient headroom to accommodate steadily increasing server workloads.

TECHNOLOGY

The IBM®/VMware™ solution runs on a platform that combines the manageability and feature-rich capabilities of the IBM® x440 server with the industry-leading computing power and dependability of the Intel® Xeon™ processor MP. The solution focuses on consolidating applications that don't scale well or are under-utilized—such as file and print services, Web applications, messaging, terminal services, and directory infrastructure systems—onto a powerful virtual machine infrastructure based on VMware™ virtual machine software. These applications typically run under a combination of the Microsoft* Windows* Server operating systems or the Linux* operating system. With a logical partition created within the VMware™ ESX Server environment, the same operating system and application currently loaded on different physical systems can be virtualized and run on a single IBM® x440 server.

One IBM® x440 system, powered by an 8-way Intel® Xeon™ processor MP with VMware™ ESX Server 1.5 installed, provides a 20:1 ratio of virtual servers to physical systems. The IBM® x440 system includes a number of features that make it particularly well equipped for enterprise use, such as remote I/O expansion capabilities, an Enterprise X-Architecture™ chipset for extending the availability and scalability of the open-standards design, memory mirroring to compensate for loss of system memory during operation, and Predictive Failure Analysis®. The Intel® Xeon™ processor family offers features such as Intel® NetBurst™ Microarchitecture—leading to increased response times, transaction rates, and headroom for growth—and Hyper-Threading Technology to increase the number of tasks that can be performed simultaneously.

HARDWARE

- IBM® x440 servers powered by Intel® Xeon™ processors MP

SOFTWARE

- VMware™ ESX Server virtual machine software

OPERATING SYSTEM SUPPORT

- Microsoft* Windows*
- Linux*

WHO THE SOLUTION WILL BENEFIT

The IBM®/VMware™ solution benefits business data centers that may currently have hundreds of Microsoft* Windows* or Linux* servers performing specific operations, such as file and print services, terminal services, messaging, or providing Web server functionality. IT departments managing these data centers can benefit from the ability to consolidate physical systems onto fewer, logically partitioned servers. Many data centers and businesses share the common goal of consolidating under-utilized systems and lowering acquisition and maintenance costs. The IBM®/VMware™ solution can help organizations realize these benefits.

Specific benefits to individuals and groups within organizations include:

Chief Financial Officer—Less capital expenditure is required for infrastructure and IT resources because consolidated systems provide faster ROI.

Chief Information Officer—Flexibility is increased with the growth and maintenance of systems in relation to support for new projects. Increased utilization of existing system resources can be experienced with a decrease of physical system count.

Information Technology—Companies can deliver services more affordably because of the flexibility and management control provided through the browser interface and the logical partitioning of systems. System downtimes can be reduced with the migration of virtual systems to other physical server platforms. New services and systems for business-user projects are brought online faster, thus decreasing response times for new system needs.

CASE STUDY/PROOF POINTS

Case studies based on enterprise deployments of the IBM®/VMware™ solution demonstrate how companies are able to simplify their infrastructure and reduce costs through virtual machine technology. Refer to the following case studies and examples for additional details:

- To read how a 135 2-way server environment was consolidated to 5 8-way servers and capable of supporting 2,000 users, refer to the following link:
<http://www.vmware.com/solutions/stories/conseco.html>
- To see how a department store retailer consolidated 30 to 40 servers onto a single IBM® x440 system with a VMware™ ESX Server, refer to the following link:
http://cin.earthweb.com/article/1,3555,10493_1438111,00.html
- “...VMware™ ESX Server 1.5...holds the most promise as the software virtualization technology to enable both applications and data-centric server consolidation projects...”
- “VMware’s ESX Server virtualization capabilities can help in all Intel® processor environments where servers are underutilized and where the workloads are predictable. It is an infrastructure tool that can wring more use out of existing IT assets and potentially reduce the cost of managing a larger number of servers.”²
- To learn more about the high availability, scalability on demand, and expansion flexibility features of the IBM® x440 platform, refer to the following link:
<http://www.pc.ibm.com/us/eserver/xseries/x440.html>
- Using a basic Gartner Group Server TCO model³, VMware™ analysis demonstrates the following cost reductions:
 - Hardware cost reductions ranging from 28% to 53%
 - Operations cost reductions ranging from 72% to 79%
 - Overall cost reductions ranging from 29% to 64%More information can be obtained from:
https://www.vmware.com/vmwarestore/newstore/tco_login.jsp
- IBM® provides support for the hardware and software environments within server consolidation solutions using the VMware™ ESX Server.
<http://www.pc.ibm.com/ww/eserver/xseries/vmware.html>

¹ “VMware’s ESX Server: Virtual Machines Benefit Intel Server Consolidations” Giga (6/4/02)

² “The Problem of Application Sprawl—VMware ESX Server is a Solution” The Clipper Group (5/22/02)

³ *Gartner Group Strategic Analysis Report R-09-9332*, M. Silver, December 16, 1999

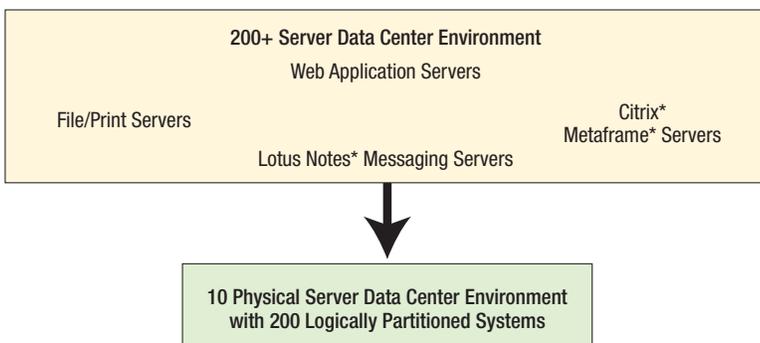
SOLUTION BENEFITS

The IBM®/VMware™ solution, through consolidation of physical systems onto IBM® x440 servers with VMware's ESX Server and data center, offers significant cost reductions and other benefits to companies. Solution benefits include:

- **Simplified computing infrastructure**—Delivers enterprise services at a greatly reduced cost. Reduces hardware acquisition and maintenance costs by consolidating physical systems to virtual systems at a ratio of 20:1.
- **More efficient use of system resources**—Idle system resources can be consolidated—freeing up resources for new projects or extending multiple virtual systems.
- **Accelerated software development and testing**—With support for multiple machine environments, applications can be developed and tested under VMware™ virtual machine software in reduced time, with a minimum of computer hardware.
- **Increased operational efficiency**—A well-designed, unified server management interface and browser-based remote console ability simplify management tasks and remote system configurations.
- **High availability and integrated disaster recovery**—The stable, reliable platform protects mission-critical data and includes numerous features for disaster recovery. Secure, isolated virtual machines make it possible to deliver new services quickly and efficiently.

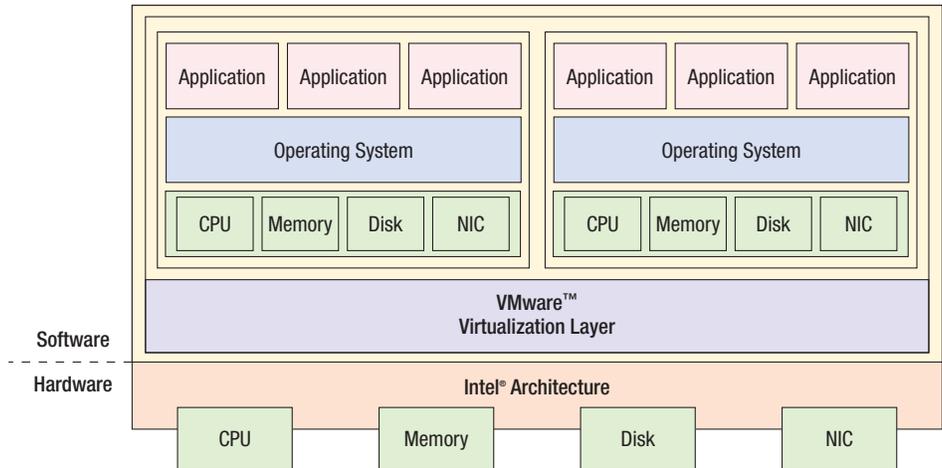
FUNCTIONAL BUSINESS CONCEPT

Targeted for low-utilization servers, this solution can dramatically reduce the number of physical systems required within an environment. Server operations such as file and print services, Citrix* and other terminal services, Lotus Notes* messaging, and some Web application services can be handled efficiently using consolidation and a virtual machine infrastructure. The machine infrastructure enables homogeneous and heterogeneous logical partitions to coexist on the same physical system.



VMware's ESX Server handles the physical resource interaction and management operations—thus abstracting the view of physical resources for each logical partition. Each virtual system environment uses standard operating systems and application software for individual tasks.

The VMware™ virtualization layer, located between the hardware and software on a system, allows the creation of virtual machines equivalent to standard Intel® x86 Architecture. The virtualization layer allows for multiplexing of virtual machines on a single physical system with low overhead impact to system performance. Each virtual machine utilizes the virtual CPU, virtual memory, and virtual I/O devices provided by the virtualization layer.

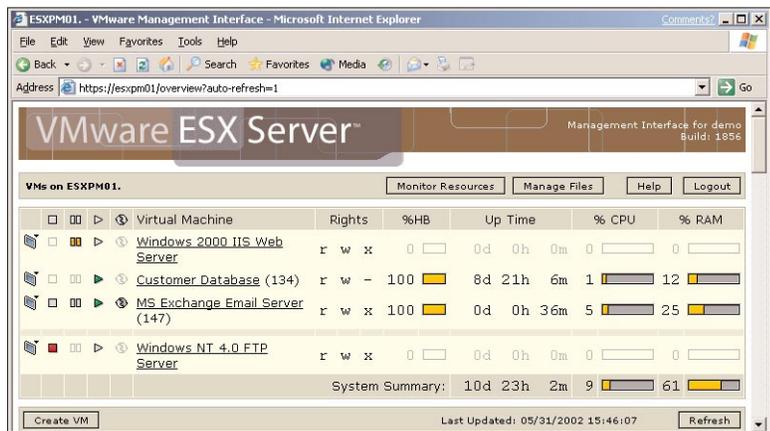


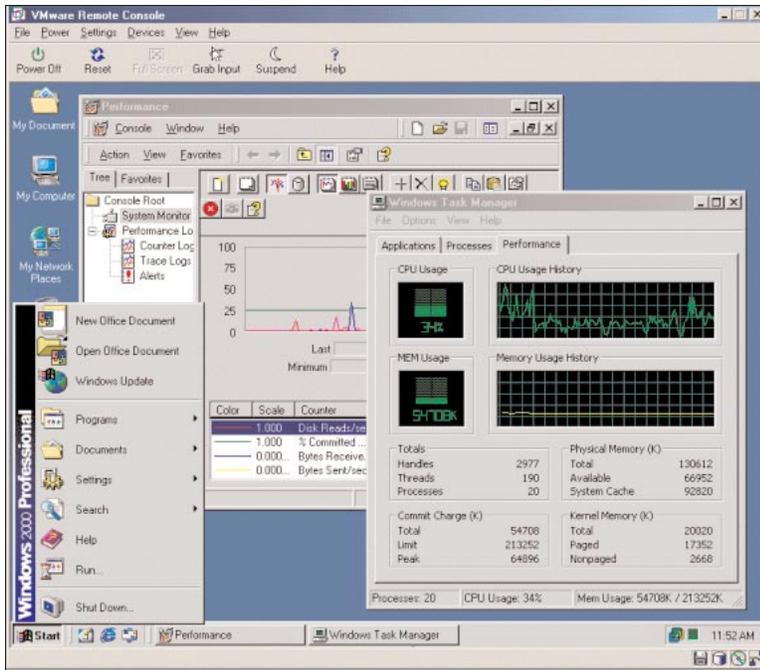
USER EXPERIENCE

Management of virtual systems is performed through a browser interface. This lets administrators perform dynamic updates and gain real-time access to individual system partitions. The following figure shows a summary of four virtual servers running on the ESXPM01 system. Based on the credentials of an administrator, the designated access rights to each system are provided.

Administrators can manage the state of each server (stop, pause, and start), ensure servers are operational (%HB for heart beat), determine how long the server has been operational, and view a summary of processor and memory resource utilizations. The interface also supports the creation of new virtual systems, greater details pertaining to individual system configurations, and other essential management tasks.

Virtual Server Summary
The activities of each of the virtual servers in use can be viewed through the management interface.





Desktop Access

A summary view of systems may require direct access to the desktop and interface of an individual system. Selecting the individual system can access the console of each virtual server within the VMware™ Management Interface.

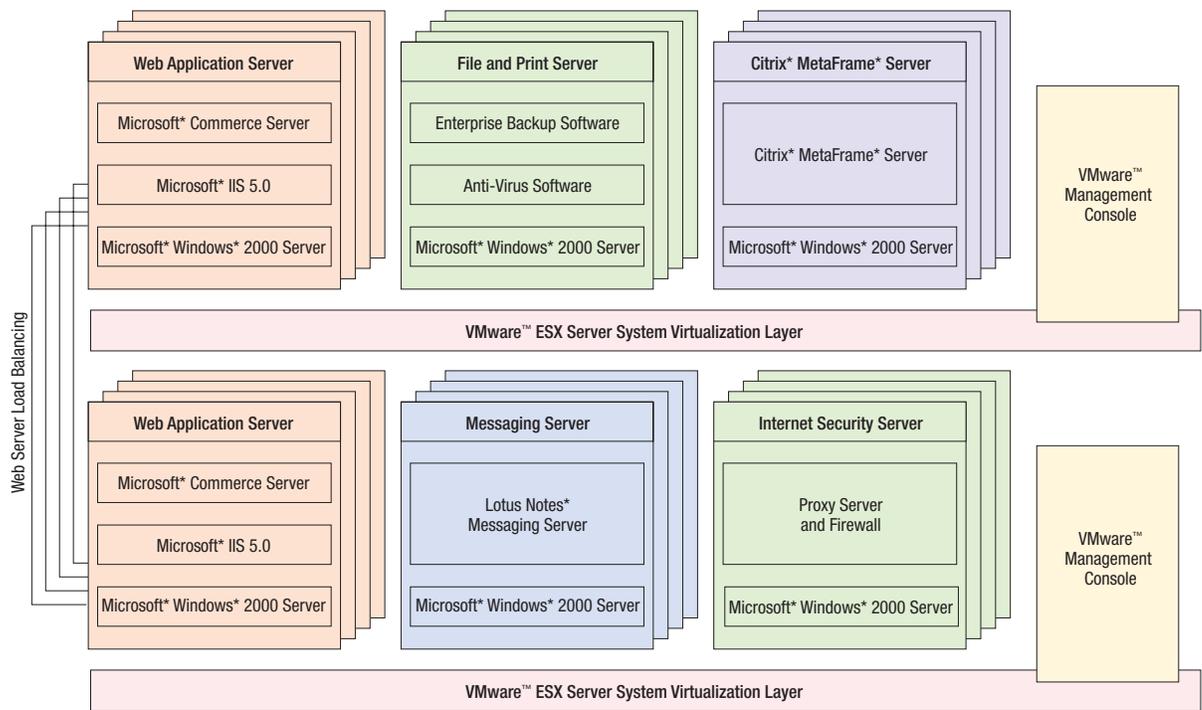
SOFTWARE ARCHITECTURE

The virtualization of system resources allows multiple systems' images (both homogeneous and heterogeneous) to exist on the same physical server. The operating system and applications of the system have the same version and installation level as the stand-alone, independent systems that were consolidated. The example shown in the figure depicts a series of servers handling Web applications, file/print tasks, Citrix* MetaFrame* (terminal services), Lotus Notes* messaging, and Internet security coexisting on two physical systems.

The heart of the system virtualization is the VMware™ ESX Server system virtualization layer, in combination with the management console. These two components control allocation of server resources and keep virtual server instances separated from each other. The management console allows user interaction into the creation and maintenance of virtual servers supported by each virtualization layer.

The VMware™ ESX Server resource manager maps the physical system resources to specific virtual machines. Appropriate mechanisms and policies implemented by the resource manager (also known as the virtualization layer) allocate processor, memory, I/O, and other system resources in a fair-share approach. Each virtual machine is guaranteed a minimum resource allocation through the management interface.

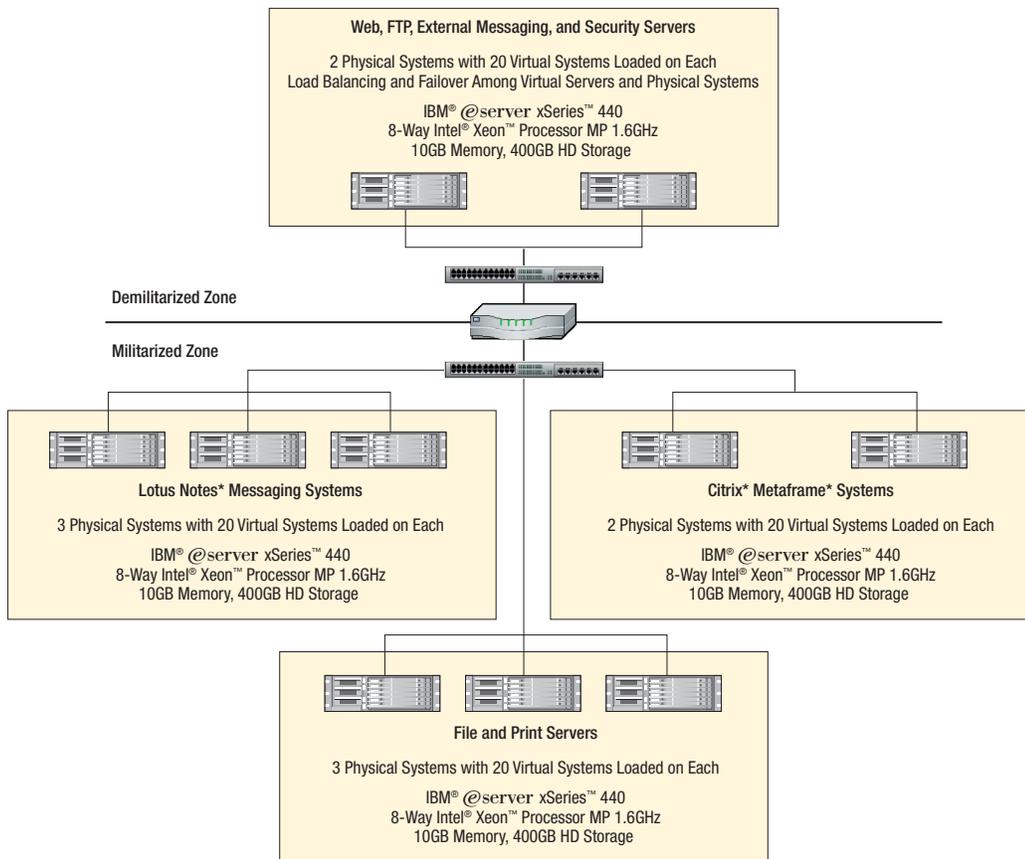
With each system acting independently of other systems—as is typical the case with multiple stand-alone systems—standard redundancy and fault-tolerant functionality, such as network load balancing can be added to the solution. In addition, the configuration, settings, and data of each system can be packaged within a file and transferred to a different physical server. This feature supports migration of virtual systems whenever hardware maintenance or other tasks make it necessary.



SYSTEMS ARCHITECTURE

The following figure illustrates how a 200-server data center environment—including Web, FTP, file/print, Lotus Notes*, Citrix* MetaFrame*, and other low-processor utilization systems—is consolidated into 10 IBM® x440 systems. A 20:1 consolidation of systems onto a single 8-processor unit containing 500MB of memory per system instance helps reduce maintenance costs in an organization and reduce the need for additional hardware.

The IBM® x440 system, designed to support up to 16-way scalability, features the Intel® Xeon™ processor MP with Hyper-Threading Technology—providing the processing power to support intensive multitasking operations within server consolidation environments. Incorporating a design architecture that capitalizes on the best-of-breed hardware advances, the IBM® x440 was the first product in a server line to bring remote I/O to market, and features the only bus-to-bus interconnect. In addition, the IBM® x440 is the only server to offer both physical and logical partitioning on industry-standard hardware in 2002.



SUMMARY

The IBM®/VMware™ solution delivers the benefits of virtual machine technology to enterprises looking to reduce the complexity and cost of their data center operations. Through a model that relies on the IBM® x440 powered by the Intel® Xeon™ processor MP, this solution makes it easy to develop and launch new applications designed for different machines and operating systems. Through increased resource utilization, integrated support services, centralized Web-based management, and industry-proven components from IBM® and Intel—the IBM®/VMware™ solution provides a cost-effective means to reduce the complexity and maintenance requirements of data center operations.

LEARN MORE ABOUT THIS INNOVATIVE SOLUTION

For general information about the products described in this solution blueprint, visit:

www.vmware.com www.pc.ibm.com/ww/eserver/xseries/vmware.html
www.intel.com/go/solutionblueprints

If you have a specific question about implementing this solution within your organization, contact your Intel representative or e-mail us at: solutionblueprints@intel.com

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