Optimizing your Infrastructure with Highly-Scalable Virtualization

vmware® IBM® intel®

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Table of Contents

Scalability and high availability maximize your return on investment....3

IBM System x3850 M2 and x3950 M2: Industry-leading hardware hosts....3

The case for four-socket systems....4

Beyond four-socket systems: Realizing the full potential of virtualization....4

Unique features maximize service availability and performance....5

Lower cost per virtual machine....6

VMware vSphere 4: An optimized software foundation for virtualized infrastructures....6

Scalability....6

CPU, memory, storage, and networking....7

Resource management....7

Performance management....7

Seeding the clouds: How IBM and VMware enable cloud computing....8

Summary....9

Scalability and high availability maximize your return on investment

Organizations today face challenges that require a new approach to how IT is conceived and implemented. They need a dynamic infrastructure that reduces costs and generates more business value while managing risk to the company's information. Virtualization is an important part of this, unchaining logical resources from physical elements and redelivering them in a fluid fashion—whenever and wherever the organization requires them. Many high-value business benefits follow: higher hardware utilization, higher uptime, lower energy costs, and faster IT response to business units.

Companies of all sizes are employing VMware virtualization technology as a way to reduce costs and improve services to deliver a more dynamic infrastructure. Maximizing the cost savings—and the ROI—on larger virtualization deployments requires high consolidation ratios. Toward that end, IBM® System x® enterprise servers, featuring fourth-generation custom IBM eX4 chipset and Intel® Xeon® processors, with built-in hardware assists for virtualization and running VMware vSphere™ 4, represent a best-of-breed virtualization platform.

VMware vSphere 4 on IBM's highly-scalable eX4 server platforms allows the highest possible consolidation ratio onto x86 systems. The IBM System x3950 M2 is the reference platform for the scale-up capabilities of VMware's vSphere 4 software suite and is an ideal platform for consolidating many virtual machines as well as large databases and mission-critical workloads onto a single server, saving customers cost, improving service, and reducing risk.

A scalable virtualization environment is important for more reasons than just near-term benefits to business operations and the bottom line. The IT services industry is moving toward cloud computing. Companies can take steps now toward managing their IT environment as an "internal cloud," so that in the future they can take advantage of external cloud computing resources from service providers if they choose to do so.

> ***"We used the IBM x3950 M2 as the current reference platform for developing and testing single-system scale-up of VMware vSphere 4 due to its tremendous scalability and reliability," said Bogomil Balkansky, vice president of product marketing, Server Business Unit, VMware. "Working together, VMware and IBM are addressing our customers' needs for a virtualization platform that can support large memory and mission-critical applications."***

To fulfill all of these goals, IBM System x3850 M2 and x3950 M2 platforms, Intel Xeon processors, and VMware vSphere 4 provide an optimized computing environment. Together, thanks to many compelling innovations and optimizations, they form an exceptional virtualization platform characterized by high performance, high availability, and flexibility for enterprise workloads.

And for the highest possible levels of scalability, the IBM System x3950 M2 represents an ideal platform for VMware vSphere 4 deployments—well suited for even the most demanding virtualized applications and services.

IBM System x3850 M2 and x3950 M2: Industry-leading hardware hosts

For any organization looking for an x86 platform to drive virtualization strategies, IBM's System x is a leading choice. The System x architecture, boasts many unique features, unavailable on x86 platforms from other OEMs, that maximize both performance and availability while minimizing costs.

IBM System x3850 and x3950 incorporate 4- or 6-core Intel Xeon processor 7400 Series (up to 24 cores per chassis), up to 1TB of memory, up to 1GB of L3 cache, the largest snoop filter in its class, virtualization hardware assists, support for up to 28 high-performance PCIe slots (including 8 hot-plug slots), enterprise-class scalability, reliability, availability, flexibility, and record-setting performance.

x3850 M2

The case for four-socket systems

Some may wonder, given recent developments in processor architectures, whether the business case for four-socket systems is really as strong for virtualization as it has been in the recent past. The answer is clearly yes.

Part of the explanation lies in the memory-hungry nature of virtualized infrastructures. Undoubtedly, when many virtual servers are simultaneously running in parallel on one physical host, that host must be able to supply sufficient memory to meet all of their needs at any given time. Such hosts will have unusually high memory requirements. Memory costs, therefore, represent a major consideration in evaluating the price/performance ratio of any given host.

For four-socket systems, and especially the IBM System x3850 M2 and x3950 M2, memory costs can be substantially lower than for competing two-socket alternatives with large memory configurations. This is because they are capable of utilizing less-expensive 4 GB DIMMs, rather than the more-expensive 8 GB DIMMs required by other platforms with fewer DIMM slots. When you multiply the costs per DIMM by the number of DIMMs needed, the cost savings become substantial—up to six thousand dollars for a physical host with 128 GB RAM, for instance. Furthermore, for systems that require the highest memory installations, only a four-socket system will suffice. Dual-processor systems support at most 144 GB of RAM—many of them far less—limiting system flexibility and scalability. By comparison, the x3850 M2 and x3950 M2 support up to 256GB per chassis.

Another key factor to consider: I/O capacity. Just as a high-end virtual infrastructure has exceptional memory requirements, so too are its I/O requirements. Here, the business case for the IBM offerings is clear. A four-socket system typically supports more I/O slots than a two-socket server, which better facilitates mapping of I/O ports on a one-to-one basis with virtual machines as required. The ability to map I/O ports to each virtual machine provides access control, the bandwidth required for that application, and security for that virtual machine.

With greater memory capacity, greater I/O capacity, and greater system flexibility come more configuration options for each system, and better hardware utilization for every virtual machine hosted on the system. Thus, IBM System x hosts a virtual infrastructure that generates superior business value—particularly when you consider memory costs.

Beyond four-socket systems: Realizing the full potential of virtualization

Also key to the IBM value proposition is the fact that IBM's eX4-based servers can be configured with more than four processors if necessary. The IBM platform is easily scalable to suit the needs of the organization; customers can add more processors to increase performance for demanding applications.

The System x3950 M2's revolutionary 'pay-as-you-grow' scalability allows you to start simply and later expand—as your needs dictate—far beyond the limits of a conventional 4-socket server. By connecting a second x3950 M2 chassis to the first, you not only double the processors (to 8) and memory (to 32 slots/512GB), you also double the number of I/O slots (from 7 to 14), and the internal hard disk drives (from 4 to 8). Adding two more chassis doubles all of these resources again. Using the 6-core Intel Xeon processor 7400 series, this translates into an astonishing 16 processors, 96 cores, 1TB of RAM, 28 PCIe slots, and 16 HDDs per IBM host—an industry-leading powerhouse suitable for mass consolidation of IT workloads, their management, and the physical infrastructure needed to support them. This provides you with tremendous flexibility and bandwidth. And, for your most critical I/O needs, 2 of those slots per chassis (8 in all) are hot-plug slots, meaning that you can add, remove, or swap out adapters without shutting down the server, thus minimizing downtime.

Such a system is also an ideal platform to drive VMware vSphere 4. Why is this so? The answer is that it allows the maximum processing power and memory to be assigned to any single instance of an application within a virtual machine on demand.

VMware vSphere's new workload expansion capabilities now support up to 64 cores, 1 full terabyte of memory, and 320 virtual machines. The IBM System x3950 M2 can support those maximum limits in every respect. Meanwhile, offerings from other vendors leave vSphere expansion potential untapped.

The System x3950 M2 has the industry's leading VMware 48-core VMmark benchmark. What does that mean for you the customer? VMmark is the industry's first standard virtualization benchmark. It quantifies and measures the performance of virtualized environments, measures the scalability of consolidated workloads in "tiles," and provides an indication of application performance. With a VMmark score of 33.5@24 Tiles, the x3950 M2 has the highest peforming 48 core benchmark[1] running 144 typical workloads simultaneously. This is proof that the x3950 M2 is a powerful consolidation and virtualization platform for a broad range of workloads.

Unique features maximize service availability and performance

Central to the business case for the IBM System x3850 M2 and x3950 M2 are key features included with the IBM eX4 technology and not available on any competing systems. Together, these features help to enable virtual machines hosted by the system to be highly available and deliver exceptional service levels.

For example, IBM Memory ProteXion® helps avoid possible data loss in DIMMs by detecting and working around double-chip errors. IBM Chipkill™ protection helps recover from double-*bit* errors, offering up to 16 times the reliability of conventional ECC memory. Memory Mirroring, with hot-swap support, allows simultaneous read/write operations from independent memory cards. Memory scrubbing tests each memory chip on boot-up, and disables any that fail *before* they have the chance to fail during use. Collectively, these features mean that memory-resident data is protected, better preserving system stability and application functionality.

Another distinction of IBM System x eX4-based hosts is support for Predictive Failure Analysis on more critical components than on other server vendors' systems. This technology boosts availability and uptime of all virtual machines, and the services they support, by proactively detecting future hardware failure and notifying IT staff by generating an alert. Once notified, IT can then

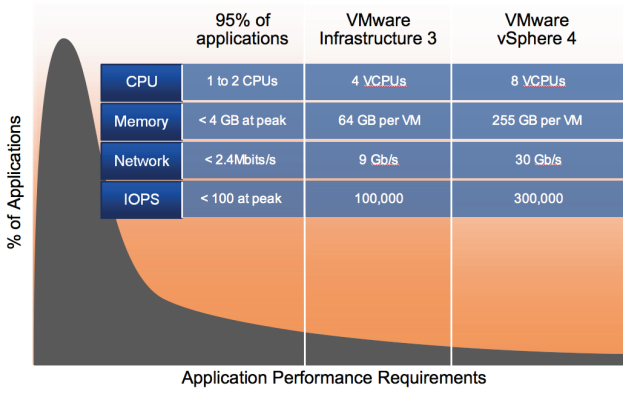
take prompt action to mitigate or even preclude any business impact of the anticipated failure. Virtually all physical elements of these systems are supported by Predictive Failure Analysis, including memory, processors, power supplies, fans, hard drives, voltage regulator modules, and L3 cache. IBM light path diagnostics then helps a technician save servicing time by lighting an LED next to the failing component, so the technician doesn't have to figure out which of 16 DIMMs needs to be replaced.

Lower cost per virtual machine

One particularly compelling benefit of processor-rich IBM System x hosts: lower cost per virtual machine.

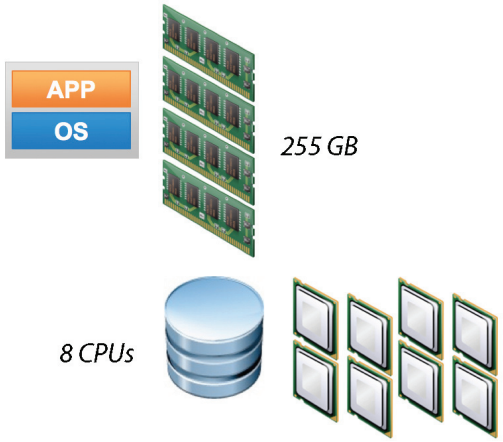
Because of their exceptional computational power, IBM System x servers allow for similarly exceptional consolidation ratios; quite literally, organizations can accomplish more, yet use far fewer systems. This consolidation, in turn, translates into less money required for each virtual server those systems support.

The IBM System x3850 M2, for instance, can be used to consolidate the workloads of up to twelve conventional 2-processor systems for typical virtualization deployments—three times the consolidation ratio of competing offerings. As a result, the cost per virtual machine can drop by more than thirty-five percent.



VMware vSphere 4: An optimized software foundation for virtualized infrastructures

Just as the IBM System x3850 M2 and 3950 M2 represent a best-of-class hardware basis for virtualized infrastructures, so too does VMware vSphere 4 represent a best-of-class software basis. VMware is the recognized world leader in virtualization, and vSphere 4—the company's latest offering—has been designed to spur virtual infrastructures to new heights, maximizing the business value they generate while driving down their associated costs.



Scalability

For virtual infrastructures to capitalize fully on their potential, they must be able to scale to meet dynamic workloads on demand. vSphere 4 represents a quantum leap in scalability over its predecessor as measured by several different metrics.

Virtual machine CPU count, for instance, has doubled from four to eight. Host CPU core maximum has similarly doubled from thirty-two to sixty-four. Maximum host memory has quadrupled, from 256 GB to a full terabyte; the amount of memory that can be allocated to any single virtual machine has also quadrupled, from 64 GB to 255 GB. Perhaps most impressively, vSphere now

supports up to 320 virtual machines and 512 vCPUs.

Are you interested in consolidating large workloads and mission-critical workloads to a single virtualized server, but have found memory and processing limitations are impeding? The increased processing power of more cores and additional memory capacity allow a customer to virtualize larger business critical workloads without impacting application performance. The more applications that can be supported in a virtualized environment, the greater the reduction in cost, risk, and downtime. The capabilities of the IBM System x3950 M2, and VMware vSphere 4.0 have made virtualizing more of your mission critical applications a reality.

In short, vSphere 4 delivers more scalability than ever before—and therefore is exceptionally well suited to the resource-rich IBM System x3850 M2 and x3950 M2, which similarly scale to extraordinary levels when required and can take full advantage of the new scalability features of VMware vSphere 4. For these reasons, the System x3850 M2 and System x3950 M2 and vSphere combine for a very powerful virtualized solution.

CPU, memory, storage, and networking

Superior utilization of host CPUs is now made possible via enhancements to the VMware ESX 4 scheduler. The scheduler now boasts, among other improvements, fine-tuned co-scheduling of virtual CPUs; finer-grained locking to reduce scheduling overheads; and an awareness of processor cache topology.

New storage enhancements are available as well. Included with vSphere 4 is a new virtual storage adapter, Paravirtualized SCSI, designed for exceptionally I/O intensive applications, as well as support improvements for iSCSI that significantly spur both performance and overall functionality.

Not to be forgotten in the list of vSphere 4 optimizations is the networking subsystem, now updated with a third-generation virtual network interface card adapter, as well as many optimizations to the network stack. The upshot: even links of up to 10 Gb/s can now be saturated for both transmit and receive network I/O operations.

Resource management

VMotion—VMware's innovative mechanism to deliver transparent migration of live virtual machines across hosts—has been further enhanced. Virtual machines can now be migrated far more quickly, up to 75 percent faster.

Intel Xeon processors have built-in virtualization capability called FlexMigration, which allows VMware's VMotion to migrate workloads between multiple generations of Intel processors. Future and backward compatibility helps to assure that IT managers can pool IBM servers containing Intel processors of different generations together without breaking the data center architecture every time a new server is purchased. This increases IT financial protection.

Furthermore, Storage VMotion, previously an experimental technology, is now fully supported. Thanks to a new technology called Changed Block Tracking, Storage VMotion now minimizes both CPU and memory resource time on the ESX host.

Performance management

For organizations with large-scale virtualized infrastructures, new improvements in performance management of vSphere 4 will be very welcome indeed.

vCenter Server can now manage up to 300 hosts and 3000 virtual machines. Furthermore, through vCenter

Server Linked Mode, many vCenter Servers can be integrated logically, allowing the management of as many as 10,000 virtual machines from a single pane of glass.

Thanks to new charting and reporting features, keeping track of those virtual machines and the business impact of their services is easier than ever. Performance charts now provide a single view of all performance metrics, including CPU, memory, disk, and network. Aggregated charts reflect high-level status, and yet in the event of technical problems, administrators can drill down to any necessary level of detail to isolate and resolve those problems.

Seeding the clouds: How IBM and VMware enable cloud computing

The powerful combination of IBM System x® hosts and VMware vSphere 4 software implies a range of exciting opportunities for IT—a chance not just to accomplish current tasks more effectively and cost-effectively, but also to create new business value, in new ways.

One particularly compelling possibility, given a virtual infrastructure powered by IBM, Intel, and VMware, is cloud computing. Cloud architectures represent a new model (considered as both a management scheme and a technology platform) to create and deliver IT services with unprecedented speed and flexibility. In this sense, cloud computing can be seen as a means to achieve the dynamic infrastructure end: organizations looking for the most dynamic responsiveness from IT will find it appropriate to take steps now towards a cloud architecture that meets both their near-term and longer-term needs.

To understand why, consider how IT services have conventionally been deployed. Initially, requests for new services are submitted to IT; staff members are then chartered with creating a suitable infrastructure for those services. This will usually involve lengthy stages of procuring necessary resources such as hardware or software, or manually creating virtual servers if a virtual infrastructure is in place. These servers, in turn, must be provisioned with the appropriate operating system, middleware, applications, data, and other elements as needed to support the service. Finally, all necessary requirements pertaining to security, regulation compliance, and other strategic and operational goals have to be addressed. In sum, service creation can typically involve multiple weeks from initial request to final rollout. Cloud computing represents a dramatic acceleration of every stage of this process. Given an initial cloud infrastructure—typically a high-end computational platform in combination with virtual server management and system monitoring and provisioning tools—the time required to create new services can fall from multiple weeks to less than a single business day.

How? Users request new services, and intelligent automation handles the service creation process. The internal cloud—or federated internal and external clouds—will have been implemented with strategic goals in mind, such as SOA methodology or end-to-end security. Attributes such as performance, SLA, redundancy, and security are known for the application, and are met regardless of the location where the application is running or the details of the physical host on which it's running. And when cloud services reach the end of their lifecycles, the resources they use can automatically be returned to the general pool, where they can then be reallocated in new ways, to generate new business value.

As compelling as cloud architectures can be, however, they require a best-of-breed virtual infrastructure if their potential is to be fully realized. Here, too, IBM and VMware represent the ideal combination of hardware and

software elements in the pursuit of such an infrastructure.

IBM eX4-based hosts deliver industry-leading uptime, availability, performance, and scalability—all mission-critical metrics for cloud architectures, which by their nature will be required to support unpredictable workloads at unpredictable levels.

And VMware vSphere, the first operating system specifically designed for cloud deployments, helps enable virtual machines running in the cloud to obtain the best possible utilization of the IBM hardware through a comprehensive array of new features and enhancements addressing scalability, resource management, and performance management.

Summary

Virtualization has transformed enterprise-class IT, such that the infrastructure can more effectively, and cost-effectively, change in parallel with new priorities in business requirements, strategies, and workloads.

For this reason, organizations today, confronted by a difficult economy and threatened revenues, will often find that virtualization can play a key role in helping them obtain the best business outcome from IT. Virtualization helps by reducing costs, spurring service levels, and mitigating business risks of many types.

While virtualization can help to optimize IT, virtualized infrastructures require best-in-class platforms to deliver on their full promise. Toward this end, IBM System x3850 M2 and 3950 M2 hosts, when deployed with VMware's powerful new vSphere 4 offering, are ideal.

Thanks to compelling innovations and unique optimizations on both the hardware and software sides, these offerings boast a compelling total value proposition for even the most demanding, mission-critical tasks, such as enterprise resource planning, core database hosting, and more.

Organizations that deploy the IBM/VMware combination today will find themselves exceptionally well positioned to capitalize on emerging technologies and architectures that pair well with their requirements, such as cloud computing, to render IT services with exceptional speed and consistency.

In short, by selecting the IBM System x3950 M2 and x3850 M2 based on Intel Xeon processors, and running VMware vSphere 4, organizations can create a more dynamic, resilient, and cost-effective virtualized infrastructure, serving IT and business needs today and tomorrow.

For more information:

- www.vmware.com/go/ibm
- www.ibm.com/virtualization/vmware

References

1 VMmark is a free tool that hardware vendors, virtualization software vendors, and other organizations can use to measure the performance and scalability of applications running in virtualized environments. VMware developed VMmark as a standard methodology for comparing virtualized systems. Result referenced is current as of June 16, 2009. The x3950 M2 VMmark disclosure report is available at: http://vmware.com/products/vmmark/results.html

VMware, Inc. 3401 Hillview Ave Palo Alto CA 94304 USA
Tel 877-486-9273 Fax 650-427-5001 www.vmware.com