TECHNICAL WHITE PAPER

Virtualize with Intel® Xeon® Processors and Windows Server® 2008 Hyper-V™

TABLE OF CONTENTS

Abstract

As virtualization technology plays an increasingly critical role in IT strategy, the nature of network management is changing. Intel and Microsoft bring advanced hardware and software technologies to bear on virtual and physical machine management. Intel® Xeon® processors form a leading hardware foundation for running and managing virtual servers by improving performance, increasing flexibility, providing higher reliability, and lowering total cost of ownership (TCO). Windows Server® 2008 Hyper-V™ virtualization technology and System Center Virtual Machine Manager 2008 offer an integrated set of robust management tools for creating and maintaining physical and virtual servers. Together, these technologies provide a powerful solution that helps businesses to properly integrate virtualization into the corporate network, be more agile in their IT deployments, and realize significant time and cost-savings benefits.

Introduction

Virtualization makes managing the IT infrastructure easier and more efficient by consolidating operating systems and applications onto fewer servers. Given that many IT departments spend as much as 80 percent of their budgets on resources such as power, space, cooling, and underutilized hardware just to keep the business running, virtualization technology is playing an increasingly critical role in IT strategy.

In the past, virtualization was primarily used to reduce the number of physical servers in a data center. However, more sophisticated hardware and software solutions are extending virtualization implementations beyond static server consolidation to business continuity scenarios including disaster recovery, high availability, and efficient resource allocation. These virtualization technology solutions offer a host of benefits, such as:

- **Increased asset utilization.** Depending on their workload requirements, servers running virtual machines can operate at 60 percent utilization, or higher.
- **Lower power, space, and cooling costs.** Server consolidation through virtualization technology results in more efficient data center operations with more applications running on fewer physical machines.
- **Faster response to business needs.** IT administrators can easily provision new virtual machines for development teams and business units, reducing delivery time from weeks or months to days or hours.

Moreover, integrated management of physical and virtual servers, with an emphasis on proactive maintenance and rapid response to business needs, is becoming a paramount requirement for IT organizations looking to implement virtualized infrastructures.

Intel® Xeon® processor-based servers form a solid foundation for supporting these IT needs. Intel Xeon processor-based servers augment virtual server implementation and management by improving performance, increasing flexibility, providing higher reliability, and lowering TCO. Combining Intel Xeon processors with the advanced features found in Hyper-V™ and Microsoft System Center Virtual Machine Manager 2008 creates a powerful management solution that brings advanced hardware and software technologies to bear on virtualization projects. This paper explores the power of a complementary hardware and software approach for virtualization implementations.

A Complementary Approach

Server virtualization at its best comes from a complementary approach that leverages hardware and software strengths. As key players in the field of virtualization, Intel and Microsoft have focused the power of their long-standing partnership to optimize the benefits that hardware assistance offers in virtual environments. The right combination of hardware and software provides businesses with robust management capabilities for their virtual and physical machines, resulting in the following time and cost-savings benefits:

- Optimized IT infrastructure
- Lower total cost of ownership
- Improved flexibility
- Higher reliability

Together, Intel and Microsoft offer built-in hardware and software virtualization technologies. Intel Xeon processors are designed to support virtual environments through Intel® Virtualization Technology† (Intel® VT). Intel VT provides hardware assistance to the virtual machine manager (VMM), reducing software overhead associated with translating processor requests. Thus, Intel VT forms a rock-solid hardware foundation for running and manag-ing virtual servers. Hyper-V delivers a robust hypervisor supported by advanced management tools found in System Center Virtual Machine Manager – both designed to capitalize on Intel VT. IT administrators can use these tools to deploy and manage multiple servers, both physical and virtual, as a single pool of resources, moving and balancing workloads among them without service interruption. Together, these advanced hardware and software tech-nologies create a powerful solution for virtual and physical machine management. IT infrastructures that leverage these complementary technologies help make organizations more agile and IT operations more robust and efficient.

Intel's Holistic Approach to Virtualization

As part of its commitment to providing robust virtualization solutions, Intel has adopted a holistic approach to virtualization. Intel Xeon processors deliver a hardware platform optimized for the best possible performance, reliability, and energy efficiency for virtualized environments.

Intel® Core™ Microarchitecture

Intel Core microarchitecture extends the Intel energy-efficient philosophy by providing more computing power and performance without increasing footprint and power demands. Now in its second generation, the Intel Core microarchitecture delivers hafnium-based 45nm processors that pack nearly twice the number of transistors into the same space as previous 65nm technology. For quad-core processors, that means more than 800 million transistors per processor, resulting in significant performance improvements, up to 50-percent larger L2 cache, and higher levels of energy efficiency.

The microarchitecture speeds up virtual machine entry and exit times by 25 to 75 percent – without any virtual machine software changes[1]. In terms of energy efficiency, the Intel Core microarchitecture reduces space and electricity burdens in the data center through processors that run at 130, 80, and 50 watts. It also reduces cooling challenges through performance-per-watt improvement, which enables denser data center deployments. The end result is increased responsiveness and productivity for multiple application types and user environments, as well as for data-demanding workloads.

Intel Virtualization Technology

At the core of the Intel virtualization strategy is Intel Virtualization Technology (Intel VT), which is embedded in Intel Xeon processors. Intel VT provides hardware assistance to virtualization software, reducing the size and complexity of the VMM and enabling less expensive, more efficient, and more powerful virtualization solutions. Specifically, Intel VT:

- Reduces the need for compute-intensive software translations between the guest and host operating systems in a virtual environment.
- Reduces overhead by allowing the guest operating system to directly access CPU cycles.
- Allows more virtual machines to run on a host server at near-native performance.
- Supports 32-bit and 64-bit applications as well as legacy operating systems running on the same physical server.
- Enhances overall server performance.

With Intel VT, you can achieve near-native performance of virtual workloads, optimize IT infrastructure, and improve server availability – all through the hardware level of a virtualization solution.

Energy Efficiency for Virtualized Environments

Of particular interest for virtualization solutions is Intel® Demand-Based Switching (DBS), an embedded feature of Intel SpeedStep® technology. DBS dynamically tailors power consumption to workloads by lowering processor power states when peak performance is not required. This technique substantially reduces average power consumption for servers operating at typical data center utilization rates. When combined with Windows Server® 2008 power management features, Intel DBS technology will deliver leading performance per watt, which translates into increased efficiency and a lower total cost of ownership (TCO) for Hyper-V virtualized environments.

Delivering "Near-Native" Performance

Intel Xeon processors take advantage of a balanced subsystem design to provide excellent server virtualization at near-native performance. While Intel VT reduces the need for compute-intensive software translations between the guest and host operating systems, several other subsystems contribute to increased performance for virtual solutions:

- **Dedicated High-Speed Interconnects (DHSI).** DHSI establishes an independent point-to-point interconnect between each of the four processors and the chipset. It creates fast, dedicated interconnects for higher throughput, resulting in increased on-chip

memory bandwidth – up to two times more than previous-generation platforms. The result is an increase in sheer processing power for physical and virtual machines.

- **Fully-Buffered DIMM Memory (FBDIMM).** FBDIMM memory in Intel Xeon processor-based servers minimizes bottlenecks within the memory subsystem. It replaces the shared memory bus with a serial point-to-point lane and a dedicated buffer for each memory module, allowing dramatically improved memory efficiency and performance. FBDIMM memory provides up to 21 GB/s, for three times more memory bandwidth than previous memory technology. This technology helps to extend the memory capacity while also creating enhanced reliability and greater availability for virtual and physical servers.
- **Intel® Input/Output Acceleration Technology (Intel® I/OAT).** Intel I/OAT enables more efficient network data movement, reducing system latency through accelerated I/O. It uses processors more efficiently to minimize performance-limiting bottlenecks. Intel I/OAT accelerates TCP/IP processing, facilitates more efficient data movement, and minimizes system overhead. The net result is significantly reduced CPU costs, which frees resources for more critical tasks.

Working in harmony, these subsystems produce near-native performance for virtual environments.

Reliability, Availability, and Serviceability (RAS)

The unique reliability, availability, and serviceability (RAS) features of servers with Intel Xeon processors reduce the cost and complexity of high-availability solutions based on virtualization technology, while improving recovery speed and reliability. Intel Xeon processor-based servers include support for Windows Hardware Error Architecture (WHEA), which reduces hardware error recovery times through standardized richer error reporting. And because it integrates with Windows Server 2008 Health Monitoring, WHEA also reduces system crashes related to hardware errors.

New memory controller features include an Error Correcting Code (ECC) system bus, new memory mirroring, and I/O hot-plug. When coupled with the Windows Server 2008 features of hot-pluggable component support and simplified clustering, this dual layer of virtualization technologies will offer organizations a more optimized IT infrastructure and improved server availability. It also fortifies disaster recovery strategies by doubling performance and redundancy features.

Interoperability

Intel Xeon processor-based servers deliver 64-bit quad-core computing, a key feature for virtualization solutions. This 64-bit architecture supports 32-bit applications and enables migration to 64-bit computing. It also allows more legacy applications and operating systems to run as virtual machines. The end result is increased flexibility to meet multiple virtualization scenarios.

Getting Ready for the Next-Generation Microarchitecture

The next-generation microprocessor, currently code-named Nehalem, and with it introduce the revolutionary Intel® QuickPath architecture. The Nehalem microarchitecture will build upon the success of Intel Core microarchitecture's ability to provide a robust platform for virtualization solutions by improving performance, increasing flexibility, and lowering TCO.

Improving performance. The Nehalem microarchitecture is optimized for scalable, multi-core operation with shared memory. The architecture will consist of low-latency Intel QuickPath memory controllers integrated into the microprocessor and stitched together with high-performance Intel QuickPath interconnects. Systems built with Nehalem processors will take full advantage of the interconnect technology to greatly increase the bandwidth and reduce the latency from processor to memory, processor to processor, and processor to chipset.

Increasing flexibility. Nehalem-based processors will support a scalable number of one to eight plus cores, and up to sixteen plus threads, with the Intel® Simultaneous Multi-threading Technology (SMT) across its product lifetime. The processor will support an on-die Intel QuickPath memory controller to increase the efficiency of local memory access. Using Intel QuickPath interconnects between the processors will enable the system to readily share cached and uncached memory data between processors.

Lowering TCO. As engineers at Intel designed the Nehalem microarchitecture, they used energy efficiency as the top criteria for choosing which features to include. If a proposed feature enhanced performance but did not increase energy efficiency, it was not included. The result is a feature-rich microarchitecture that reduces TCO while delivering energy-efficient performance.

The combination of Intel's new core microarchitecture and 45nm process technology provides greater energy efficiency and the multitasking performance necessary to maximize next-generation virtualization solutions using Hyper-V and System Center Virtual Machine Manager. Together, these technologies can provide a powerful management solution that allows businesses to be more agile in their IT deployments and realize significant time and cost-savings benefits.

Virtualization Software: Hyper-V

Virtualization has traditionally been a software-based solution. Windows Server 2008 includes Hyper-V as a role of the operating system. Hyper-V is the hypervisor-based virtualization technology from Microsoft and is a thin layer of software that sits between the hardware and the operating system. It allows multiple unmodified operating systems to run simultaneously on a host computer. It also enables simple partitioning, maintains strong isolation between partitions, and is inherently secure because it does not contain any third-party device drivers.

Hyper-V has been designed to run on servers with hardware-assisted virtualization technology, and it takes full advantage of Intel's virtualization features. Hyper-V is the perfect software complement for virtualization solutions and overcomes many of the challenges faced by previous software-based virtualization technologies, including:

- **Reduced complexity.** Hyper-V will support non-Microsoft and legacy virtual machines, including Windows®, Linux*, and Xen-enabled Linux, without modifying the operating systems.
- **Improved performance.** Virtual machines will be able to use larger amounts of physical resources, including up to 64 GB of memory per virtual machine. Hyper-V will also support pass-through disk access and will allow up to four processor cores to be assigned to each virtual machine. Further, Hyper-V will use page sharing to optimize memory use by maintaining a single copy of identical memory pages shared by multiple virtual machines, thus reducing resource utilization on the physical machine.
- **Increased functionality.** With Hyper-V, a single physical machine will be able to simultaneously run virtualized versions of 32-bit and 64-bit operating systems. In addition, Hyper-V will offer advanced networking capabilities for each virtual machine, including VLAN, network address translation, firewall, the ability to quarantine individual virtual machines, and the option to add or remove virtual NICs without downtime.
- **Improved reliability and protection.** Hyper-V leverages the clustering functionality in Windows Server 2008 to provide host and guest clustering for failover and load balancing across LANs and WANs. IT administrators can cluster multiple physical servers all running virtual machines to minimize the impact of one server failing, as well as migrate loads from one node to another in a cluster for easy maintenance and management.

These features alone provide a high degree of flexibility and power for virtualization. When coupled with the hardware assistance available in Intel Xeon processors, they present a powerful combination for complex virtualization strategies.

Manage Virtual and Physical Servers Side-by-Side

Until recently, virtual infrastructures required separate tools for managing the virtual machines they support. While physical hardware management burdens were eased, management of the virtual machines themselves required extra tools, processes, and effort. This challenge is being reduced with the newest releases of the Microsoft family of server products. Hyper-V is leading the way by providing a solid foundation for powering virtual machines, and Hyper-V is complemented by a robust set of tools for physical and virtual machine management. These tools are all components of Microsoft System Center:

- **Microsoft System Center Data Protection Manager 2007.** Provides live backup and virtual machine snapshots to support business continuity.
- **Microsoft System Center Operations Manager 2007.** Allows advanced monitoring and service reporting for consolidation, configuration, utilization, and growth projections.
- **Microsoft System Center Virtual Machine Manager 2008.** Enables centralized management of the virtual infrastructure.

Together with Hyper-V, these tools form a unified stack for virtual and physical machine operation and management. In particular, Virtual Machine Manager works seamlessly with Operations Manager to give IT administrators insight into physical and virtual machines. This ability to map the relationship of virtual and physical assets lets administrators effectively manage their entire infrastructure. The following sections discuss these Hyper-V management tools in greater detail.

System Center Data Protection Manager

Data Protection Manager supports virtualization solutions through Live Backup and VM Snapshots:

- **Live Backup.** Volume Shadow Copy Services enables backup of a complete virtual machine, including data and the virtual machine state, without downtime. This simplifies virtual machine management and provides an easier path to robust business continuity.
- **VM Snapshots.** This tool allows administrators to save the virtual machine's state, providing the ability to reset the machine to a previous "known good" state. Snapshots are commonly used before applying upgrades or patches, but can also be used to create a safeguard copy of the virtual machine before making any configuration changes.

Administrators do not have to change between virtual and physical nodes when using these tools, thus simplifying the management of virtualization solutions.

System Center Operations Manager

Operations Manager monitors virtual machines and helps automate event responses. It identifies important but non-urgent alerts and can apply filtering rules that trigger workflow processes (e.g., sending an e-mail, generating a support ticket, etc.), facilitating proactive management. Operations Manager also provides robust health monitoring, helping administrators identify virtual machines that need to be patched or upgraded to meet policy requirements, verify that applications are running correctly, check for memory leaks or conflicts, and monitor workloads, memory use, storage levels, and CPU utilization. It also provides service reporting for consolidation, configuration, utilization, and growth projections. Recently, the monitoring capabilities of Operations Manager 2007 was extended to HP-UX,* Sun Solaris,* Red Hat Enterprise Linux,* and SUSE Linux* Enterprise Server environments, providing the opportunity for cross-platform monitoring.

System Center Virtual Machine Manager

Virtual Machine Manager provides complete support for consolidating physical servers onto a virtual infrastructure. This centralized management console delivers many powerful tools to simplify virtual machine management, helping IT administrators rapidly provision, deploy, and migrate virtual machines in hours or days instead of weeks or months.

Physical (host) server management. IT administrators can use Virtual Machine Manager to manage virtual machine hosts, the physical servers running Hyper-V, and the Virtual Machine Manager agent software. These physical host

machines can be located anywhere, including on a perimeter network (e.g., a demilitarized zone or screened subnet) or in a remote server cluster.

Intelligent placement analysis. With intelligent placement analysis, Virtual Machine Manager analyzes the expected load of a virtual machine against available physical servers and recommends the best server for the load. Virtual Machine Manager conducts extensive data analysis using a number of factors before recommending which physical server should host a given virtual workload, including using historical data provided by System Center Operations Manager 2007. Administrators can adjust the analysis algorithms to change how recommendations are made (e.g., expected load, target algorithm, and importance variables).

Heterogeneous virtualization management. Virtual Machine Manager offers compatibility with VMware VI3* through Virtual Center integration. VMM supports WMotion, while also extending Virtual Machine Manager specific features such as Intelligent Placement to VMware-based servers. Another feature is the ability to convert a VMware-based virtual machine into a VHD file, through an intuitive Virtual-to-Virtual (V2V) transfer process.

Utilization counters. Virtual Machine Manager includes utilization counters to help administrators effectively monitor virtual machines and Hyper-V host server performance and to make informed decisions about virtual machine placement and usage levels.

Physical-to-Virtual and Virtual-to-Physical machine conversions. Virtual Machine Manager provides physical-to-virtual machine conversion technology that removes the need to halt the physical server. IT administrators can convert a running server to a virtual machine at disk speed, saving time and reducing complexity. Virtual-to-physical migration is also available, enabling administrators to easily roll out solutions constructed on virtual machines to physical machines.

Centralized library. Virtual Machine Manager features a centralized library that organizes and manages all the building blocks of a virtualized infrastructure, including stored virtual machines, virtual hard disks, CD/DVD software images, post-deployment customization scripts, hardware configurations, and templates. This library lets administrators respond rapidly to requests for new virtual servers and modifications.

Offline Virtual Hard Disk (VHD) manipulation. Offline Virtual Hard Disk manipulation lets administrators repair and change virtual machine files without launching the associated virtual machines. This creates the ability to securely access files within a virtual hard disk without having to instantiate a virtual machine, saving time and supporting rapid response to business requests.

Group policy integration. Virtual Machine Manager lets administrators push configuration changes to all Windows virtualization servers on a domain, as well as create custom host groups for centralized management.

Self-service provisioning. Designated users can access Virtual Machine Manager by way of a Web portal designed for user self-service. This portal enables test and development users to quickly provision new virtual machines for themselves, according to controls set by the administrator.

Integration with hardware-assisted virtualization. As part of the Intel and Microsoft commitment to complementary virtualization solutions, Virtual Machine Manager lets administrators select hardware-assisted virtualization for each virtual machine. This simple integration method enables businesses to immediately take advantage of the virtualization benefits built into Intel Xeon processor-based servers.

Hyper-V is the perfect software complement for virtualization solutions and overcomes many of the challenges faced by previous software-based virtualization technologies.

As a key component for complementary virtualization solutions, Hyper-V and its management tools provide centralized management of the virtualized infrastructure, resulting in increased physical server utilization, greater reliability and scalability, and decreased hardware and power costs.

Virtualization Scenarios

The following scenarios demonstrate how these advanced hardware and software technologies from Intel and Microsoft simplify virtualization solutions:

Server Consolidation

Virtualization technology plays a key role in the drive toward server consolidation. Consolidation entails converting physical servers to virtual machines and running the virtual machines on fewer, highly scalable, and reliable enterprise-class servers. By consolidating physical servers, organizations realize several significant business benefits:

- **Lower TCO.** Consolidation lowers hardware, facility, power, cooling, and management costs.
- **Optimized infrastructure.** Businesses gain significant advantages in asset utilization, reliability, and availability.
- **Improved flexibility.** IT administrators can freely integrate 32-bit and 64-bit workloads in the same environment, balance workloads, and rapidly respond to demands for more or different servers and applications.

Server consolidation can be done incrementally or as a coordinated project. In the incremental approach, new applications are added to the virtual infrastructure while old applications remain on their physical servers until the applications are retired. With a coordinated project, the IT group identifies existing candidate applications, virtualizes them, and migrates the workloads to appropriate physical resources. Intel Xeon processor-based servers and Hyper-V with System Center Virtual Machine Manager provide a robust set of features and tools for smoothly executing each step of a server consolidation project.

Identify candidates for virtualization. A fundamental part of server consolidation involves identifying physical workloads that can be converted into virtual servers. IT administrators can use Virtual Machine Manager to identify consolidation candidates by analyzing historical performance data stored in the Microsoft System Center Operations Manager database. Virtual Machine Manager creates a consolidation report that summarizes the long-term performance of an application, helping administrators identify trends such as seasonal spikes in demand.

As IT administrators determine candidates for virtualization, they are no longer bound by operating system limitations. Intel Xeon processors and Hyper-V both provide greater interoperability by supporting multiple virtual machines with different operating systems (Windows, Linux, Xen-based Linux) as well as 32-bit and 64-bit workloads on the same physical server. Administrators can also gain better consolidation ratios by running legacy applications as virtual machines.

Convert to a virtual machine. Physical-to-virtual conversion is the process of migrating a physical workload to a virtual machine. In the past, this process has been slow and risky as conversions can fail or disrupt mission-critical applications. Virtual Machine Manager mitigates these problems by providing integrated, time-saving tools, including a task-based wizard and the ability to create images of physical hard disks, prepare them for use in a virtual machine, and create the final virtual machine.

By using Volume Shadow Copy Service, Virtual Machine Manager lets IT administrators create virtual machines without interrupting the source physical server. And since the conversion process is completely scriptable, large-scale conversions can quickly and easily be done through the Windows PowerShell™ command-line. As a final note, Microsoft Virtual Server workloads can be easily converted to Hyper-V workloads.

Place virtual machine on a physical server. Placement is one of the most complicated aspects of virtualization. IT administrators must account for detailed information like processor and memory specifications as well as perfor-

mance trends for each physical server that will host virtualized workloads. Virtual Machine Manager uses a holistic approach called Intelligent Placement to help administrators select appropriate hosts. The approach is based on four factors:

- The virtual workload's resource consumption characteristics.
- Minimum processor, memory, storage, and network requirements.
- Performance data from physical servers.
- Business rules that include information about the workload's entire life cycle.

Virtual Machine Manager incorporates these considerations into algorithms that IT administrators can fine tune to identify the best physical server to host the virtual workload. Also, Virtual Machine Manager provides a thorough audit history that shows what changes were made, which user ID performed the action, and when the action took place.

Increased security. Finally, consolidating servers onto a virtual infrastructure increases security by isolating applications and functions on a virtual machine. Virtual machines running on the same physical server are isolated from each other because they run in separate partitions. This protects each virtual machine from faults or software attacks directed against any other virtual machine running on that physical server. In addition, administrators can create virtual machines that run a Windows Server 2008 Server Core installation and apply role-based security to that machine, further enhancing security and availability.

Business Continuity

Business continuity is a comprehensive process that includes disaster and business recovery as well as planning to minimize downtime, both scheduled (maintenance and backup) and unscheduled (unanticipated outages). Intel Xeon processors with Intel VT and Hyper-V include powerful business continuity features that:

- Reduce service interruptions.
- Provide scalable, high-availability solutions.
- Improve disaster and business recovery.
- Provide robust enterprise management.

The following sections describe how Intel and Microsoft provide outstanding management support for three key business continuity scenarios.

Disaster recovery. Natural disasters, malicious attacks, and even simple configuration problems like software conflicts can cripple services and applications until administrators resolve the problems and restore any backed up data. Virtualization technologies play a pivotal role in disaster planning. Because the virtualization layer abstracts the hardware out of the equation, IT administrators have greater flexibility in disaster recovery planning. For example, non-virtualized plans require identical equipment and configurations at a remote data center site in order to bring servers back up after a disaster. With virtualized disaster planning, businesses can architect warm standby solutions based on Windows Server 2008 clustering capabilities where virtual machines automatically fail over to any remote server running Hyper-V. The library in Virtual Machine Manager also gives administrators the flexibility to quickly and remotely manage new and existing virtual machines.

Another disaster recovery feature is the ability to run duplicate virtual machines on a single server. If one application instance fails, the second virtual machine can immediately pick up the workload, enabling increased business continuity on fewer platforms and for lower cost. Alternatively, administrators can create virtual machine high-availability by clustering physical servers and failing over cluster-aware applications across those servers.

Virtualization technology significantly reduces the administrative and cost burdens of development and testing.

System Center Operations Manager provides critical failure notifications, which helps administrators recognize and appropriately respond to failures. The RAS features found in Intel Xeon processors, such as support for WHEA, integrate with this high level of health monitoring to reduce recovery times and system crashes related to hardware errors. In addition, memory controller features including an Error Correcting Code (ECC) system bus, new memory mirroring, and I/O hot-plug fortify disaster recovery strategies by doubling performance and redundancy features at the hardware level. Virtualization promotes rapid and reliable disaster and business recovery to ensure minimal data loss and provides powerful management capabilities.

Load balancing. While often a goal of server consolidation projects, load balancing is also an important part of business continuity. IT administrators can design strategies to balance virtual workloads across physical hosts, maximizing consolidation ratios. As business and resource needs change over time, workloads can be easily redistributed to optimize server utilization. Virtual Machine Manager's Intelligent Placement tool includes a load-balancing algorithm to help administrators equally distribute workloads across a set number of servers. Also, because Hyper-V takes full advantage of the clustering abilities inherent in Windows Server 2008, businesses can implement clustering as a way to support business continuity goals.

Scheduled maintenance. Hyper-V supports Volume Shadow Copy Services through Data Protection Manager, providing hot, stateful virtual machine backup without downtime. Administrators can also take virtual machine snapshots to dynamically create "known good" checkpoints and revert to any previous checkpoint in the event of a failure or configuration error encountered during upgrades or other maintenance activities.

Quick Migration is another powerful business continuity feature that facilitates maintenance by letting administrators easily move virtual machines between physical servers. This approach uses Hyper-V and the server clustering abilities in Windows Server 2008 to consolidate virtual servers onto one physical host server without causing that host server to become a single point of failure.

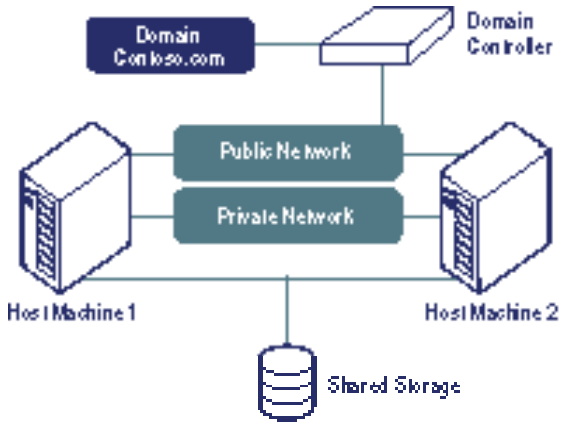

Figure 1. Quick Migration

For example, an IT administrator could convert the workloads from two physical servers into virtual machines and then consolidate them onto one of the physical servers. To maintain availability and flexibility of services, the administrator would configure both physical servers as nodes in a server cluster. This allows the second physical server to be ready to support the virtual machines in the event of scheduled or unscheduled downtime. When the need arises to shut down the first server, the workloads running on the first server can be easily migrated to the second server. After performing maintenance on the first server, the administrator can migrate the virtual machines back to it. Quick Migration provides the flexibility and reliability that organizations need for sustained business continuity.

Development and Testing

Virtualization technology significantly reduces the administrative and cost burdens of development and testing. Because test and development activities require constant provisioning and tear down of different environments, many organizations have moved to using virtual machines for their test and development needs. Hyper-V and its tools simplify the management of development and test environments, reduce costs, and increase the flexibility and utilization of physical resources.

Simplified virtual machine management. Virtual Machine Manager lets administrators maintain strict control over virtual assets. Unlike physical servers, which seldom go missing, it can be very easy to lose track of virtual servers. The Virtual Machine Manager library simplifies tracking, caching, and licensing of virtual machines by serving as a centrally managed repository for templates and other building-block resources. This library protects important virtual assets from being copied, misplaced, or deleted.

Rapid environment setup. Using virtual machines, IT personnel can quickly configure and save virtual test environments, creating the ability to bring any given environment back up as often as needed. Testers can also run multiple environments on a single workstation, providing greater flexibility and utilization from the same system. And because of the inherent security provided by Hyper-V and Intel VT, IT personnel are free to create and test a wide variety of scenarios in a safe, self-contained environment that accurately represents the production environment.

Simplified lifecycle management. Virtualized workstations enable developers to host successive iterations of a software stack – including the production version – in separate partitions on the same platform, improving hardware utilization and simplifying lifecycle management. They also allow concurrent development and software validation under different environments and even different versions of the same operating system.

Easy self-service provisioning. Virtual Machine Manager alleviates the management burden of constantly setting up test environments through a streamlined self-service Web portal. Authorized test and development staff can provision their own virtual machines based on rights granted to them by administrators. Authorized users work from templates and can manage only the virtual machines that they own. Additionally, administrators can set quotas on resources available to users. One major benefit of self-service provisioning is that it does not require a client on the host. In addition, large numbers of users can be given self-service provisioning privileges.

Lower TCO. Virtualization for development and test activities maximizes hardware utilization by consolidating workloads onto fewer physical servers. It also cuts power, cooling, and facility costs, in addition to reducing the time needed to migrate new applications from development to testing to production. Finally, new and upgraded versions of a product can be tested on the same production platform without disrupting the production environment, eliminating the need for costly duplicate environments. These savings all result in reduced TCO for development and test activities.

Selecting the Right Server for Virtualization

Choosing the right server depends on a number of variables, and in particular on the density (or number of servers to be virtualized) of the virtualization project. High-density virtualization projects generally include 20 or more virtual servers running on a single physical machine and require peak load application responsiveness. Low-density projects range from 8 to 16 virtual servers on one machine, are generally smaller in scale than high-density projects, and often require moving virtual machines across multiple physical machines (e.g., quick migration, clustering, and development and testing).

Table 1 presents server recommendations for three typical virtualization projects.

Scenario	High-Density Virtualization Project 4-Socket Server	Low-Density Virtualization Project 2-Socket Server
Server Consolidation	Intel® Xeon® processor 7000Δ sequence	Intel® Xeon® processor 5000Δ sequence (Consolidation of basic infrastructure applications)
Business Continuity	Intel® Xeon® processor 7000 sequence	Intel® Xeon® processor 5000 sequence
Development and Testing	N/A	Intel® Xeon® processor 5000 sequence

Table 1. Server Recommendations

Summary

Virtualization technology plays an increasingly critical role in IT strategy for all kinds and sizes of organizations. Intel Xeon processors combined with Hyper-V and System Center tools provide businesses with a powerful, complementary hardware and software solution for virtual and physical server deployments. Multi-core Intel Xeon processors with the Intel Core microarchitecture and Intel VT form a hardware foundation for running and managing virtual servers by improving performance, increasing flexibility, providing higher reliability, and lowering TCO. Hyper-V and System Center Virtual Machine Manager offer an integrated set of robust virtualization and management tools for creating and maintaining virtual servers. Together, these technologies provide a powerful virtualization solution that enables businesses to be more agile in their IT deployments and realize significant time and cost-savings benefits.

To experience Hyper-V on Intel Xeon processor-based servers, simply contact your Intel and Microsoft representatives.

Related Links

Intel Xeon Processors
www.intel.com/products/server/processors/index.htm?iid=process+5300

Intel Server Virtualization
www.intel.com/business/technologies/virtualization.htm?iid=servproc+rhc_virtualization

TechNet Webcast: Increase IT Flexibility and Responsiveness Through Hardware-Assisted Virtualization (Level 300)
go.microsoft.com/fwlink/?LinkId=109811

Next-Generation Intel Microarchitecture
www.intel.com/technology/architecture-silicon/next-gen/?iid=search

Hyper-V: A Key Feature of Windows Server 2008
www.microsoft.com/windowsserver2008/virtualization/default.mspx

Hyper-V: Frequently Asked Questions
www.microsoft.com/windowsserver2008/virtualization/faq.mspx

Windows System Center Virtual Machine Manager
www.microsoft.com/systemcenter/scvmm/default.mspx

TechNet Webcast: Managing Virtualization with System Center Virtual Machine Manager 2007 (Level 200)
go.microsoft.com/fwlink/?LinkId=109844

[1] Introducing the 45nm Next-Generation Intel® Core™ Microarchitecture. (www.intel.com/technology/architecture-silicon/intel64/45nm-core2_whitepaper.pdf).

[†] Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM) and, for some uses, certain platform software enabled for it. Functionality, performance or other benefits will vary depending on hardware and software configurations and may require a BIOS update. Software applications may not be compatible with all operating systems. Please check with your application vendor.

[Δ] Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See www.intel.com/products/processor_number for details.

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