Microsoft

Microsoft Virtual Server 2005 R2

AMD Smarter Choice

Virtual Server 2005 R2 SP1 and Next-Generation AMD Opteron™ Processors Increase the Business Value of Virtualization

White Paper

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For the latest information on Virtual Server, please see http://www.microsoft.com/virtualserver/.

For the latest information on AMD processors, please see http://www.amd.com/.

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Introduction

Virtualization is rapidly becoming a standard technology for use across the IT spectrum. A key enabling technology, virtualization allows customers to run multiple operating systems concurrently on the same physical computer by abstracting the physical hardware away from the operating systems. Each of these operating systems runs as a self-contained computer, or virtual machine, and is easily portable from one hardware platform to another. Virtualization scenarios include software development and test, server consolidation, re-hosting legacy environments, business continuity, and disaster planning and recovery.

Virtualization is popular because it provides so many direct business benefits. Virtualization allows for operating system portability and further allows for server consolidation which eliminates old, underutilized hardware resulting in saved time and money. Through server consolidation virtualization also helps eliminate the indirect costs associated with server sprawl, which is a growing problem in today's enterprise computing environments. Indirect costs include power, cooling, space in the datacenter, technical and support staffing, and management software, which can all be reduced with virtualization. Virtualization also enables new disaster recovery scenarios, which can make both planned and unplanned server downtime less painful by reducing or eliminating service interruptions.

Virtualization is made possible by virtual machine monitor (VMM) software (also known as the virtualization platform). Microsoft Virtual Server 2005 R2 with Service Pack 1 (SP1) is the Microsoft virtualization platform. Virtual Server 2005 R2 SP1 abstracts the hardware layer presenting the virtual machine a set of virtual hardware to interact with, rather than the actual physical hardware. This effectively decouples the virtual machine from the physical hardware allowing multiple operating systems to access hardware devices simultaneously. However, the overhead of emulating physical hardware introduces additional demands on system resources, such as CPU, memory, and hard disk, which can reduce the performance of virtual machines. Degraded performance can reduce the value of using a virtual machine as a replacement for a physical computer.

To help overcome this challenge, leading computer hardware manufacturers like AMD have brought products to market that remove some of the performance overhead of the virtual machine manager, by facilitating straightforward sharing of processor and other resources between the host operating system and any virtual machines running concurrently. Known as hardware-assisted virtualization, this approach is available in the Next-Generation AMD Opteron processor for servers and workstations, and in the recently introduced AMD Athlon™ 64 and AMD Turion™ processors, all part of the AMD64 family of processors. AMD's hardware virtualization assists are known as AMD-Virtualization™ (AMD-V™), and Service Pack 1 (SP1) for Microsoft Virtual Server 2005 R2 is built to take advantage of those assists. Leveraging AMD-V hardware-assisted virtualization, Virtual Server 2005 R2 SP1 delivers marked improvement in system performance of guest virtual machines.

Virtualization Benefits

IT organizations today are under incredible pressure to deliver more value to their business customers, typically with little or no increase in budget. Virtualization allows IT organizations to derive a range of benefits from the abstraction of the hardware layer, and the ability to run multiple virtual computers on each physical computer. The primary benefits of virtualization include:

- **Increased server utilization.** An optimized infrastructure is becoming imperative as servers sprawl and data centers reach their capacity for power and space. The problem is aggravated for companies whose servers run at very low utilization. Server utilization rates of 5 to 15 percent are not uncommon, while many customers' usage

rates fall into the 10-15 percent range. Many of these challenges can be addressed with the help of virtualization.

- **Improved service levels from IT organization.** Virtualization solutions enable organizations to rapidly deploy new servers and operating environments. Many of the problems associated with the traditional marriage of one server to one operating system are eliminated with virtualization, which allows IT staff to quickly deploy multiple operating systems and applications to fewer servers. IT staff can then focus on higher-value, strategic activities rather than procuring, racking and stacking hardware.
- **Extend useful life of legacy systems.** Virtualization technology can be used to consolidate multiple physical servers onto a single server. Virtualization can also be used to re-host legacy environments, especially as older generation hardware becomes more difficult and costly to maintain.
- **Streamlined manageability and security.** Virtualization enables IT organizations to enhance their administrative productivity and rapidly deploy new servers to address changing business needs. Easy integration into existing server management tools, such as Microsoft System Center Operations Manager and specialized management tools such as Microsoft System Center Virtual Machine Manager (SCVMM) facilitate integrated management of Windows-based virtual machines. The ability to consolidate workloads in a hardware agnostic environment and an integrated physical and virtual IT management framework enables administrators to lower operational costs and create more agile infrastructures.
- **Decreased hardware costs.** Virtualization allows organizations to reduce server count. Virtual machine isolation and resource management enable more workloads to coexist on fewer servers, which results in more efficient use of hardware resources and reduces demand overall. This can help save money on hardware, particularly in larger data center operations where a single application may require three or more servers – one for production, one for fail-over operation, and one for testing.
- **Reduced facility costs.** By reducing server count, virtualization solutions also provide the associated benefits of lowering fixed costs including reduced power consumption, reduced cooling costs, and reduced space requirements.

As a key part of any IT strategy, virtualization solutions increase hardware utilization and enable organizations to rapidly configure and deploy new servers improving administrative productivity.

Previous Hardware Limitations

Modern operating systems, like the Windows family of operating systems, require a tight interaction with hardware in order to provide processing power, memory, storage, and other resources to applications running on the operating system. Like physical computers, virtual machines need access to hardware resources. However, virtualization provides virtual machines with hardware that is not physical; rather, virtualization presents *emulated* hardware to the virtual machine. This emulated hardware is often referred to as *virtual hardware*, and this virtual hardware is presented to the virtual machine's operating system as if it were physical hardware. This frees operating systems from the exclusive interaction with the physical hardware. To achieve this, virtualization platforms, such as Virtual Server, translate requests into and out of the physical hardware via the VMM.

Software-based virtualization requires no modification to the physical hardware, the host operating system, or the virtual machine (or guest) operating system. The VMM does all the work, translating all calls to and from the physical hardware into and out of the virtual hardware. The challenge for software-based virtualization is that the translation between

physical hardware and virtual hardware results in system overhead. The net effect is diminished performance of the virtual machine and applications running on it.

Despite performance impact, the self evident benefits of virtualization are so compelling that an entire industry is growing around it. Initial implementations have used software-based virtualization, which allowed Microsoft and other companies to provide hardware independent virtualization platforms. However, as server virtualization has grown, hardware vendors have introduced extensions to processors that enable virtual machines to run more efficiently. Over time, software and hardware companies will continue to collaborate to improve the performance, security, and other capabilities of virtualized platforms.

Hardware-Assisted Virtualization

Virtualization has opened the door to run multiple heterogeneous workloads on a single physical computer. As a result, more organizations are seeing the benefits of consolidating workloads and increasing computer utilization. This shift in IT strategy is driving rapid growth in virtualization implementations, increasing demands on each server. The hardware must handle the virtualization platform, which, in turn handles multiple operating systems. Evidence of this shift can be seen in market demand for greater consolidation ratios (the number of virtual machines per physical server). As customers have increasingly called for hardware performance tailored to virtualization, hardware vendors are delivering.

The first examples of hardware-assisted virtualization are from processor vendors, such as AMD. AMD is providing a suite of hardware-assisted virtualization technologies, known collectively as AMD-V, in next-generation AMD processors. With AMD-V, processors are designed to directly support virtualization. This support, known as hardware-assisted virtualization, consists of hardware extensions to the x86 system architecture, which eliminate much of the processor overhead normally associated with software-only virtualization solutions. AMD-V simplifies the translation between physical hardware and virtual hardware. Specifically, AMD-V simplifies the processes within the VMM associated with trapping and emulating I/O operations and status instructions executed within the guest operating system. By decreasing, and in some cases eliminating, the virtualization overhead associated with processor operations, the result is improved performance.

Virtual Server 2005 R2 SP1

Overview

Microsoft Virtual Server 2005 R2 SP1 is a cost-effective server virtualization technology engineered for the Windows Server platform. It offers improved hardware efficiency by providing a great solution for isolation and resource management, which enable multiple workloads to coexist on fewer servers. Because it offers complete scripted control of a set of connected virtual machines that are easily administered with standard server management tools, Virtual Server 2005 R2 SP1 is easy to deploy, manage and use - resulting in increased administrator productivity. As a key part of any server consolidation strategy, Virtual Server increases hardware utilization and enables organizations to rapidly configure and deploy new servers.

As a part of the Dynamic Systems Initiative (DSI), Microsoft's industry-wide effort to dramatically simplify and automate how businesses design, deploy, and operate IT systems to enable self-managing dynamic systems, Microsoft is providing businesses with tools to help them more flexibly utilize their hardware resources. Virtual Server 2005 R2 SP1 is another example of how Microsoft is continuing to deliver technologies that result in improved server hardware utilization and provide for more flexible provisioning of data center resources.

Virtual Server increases hardware utilization and enables organizations to rapidly configure and deploy new servers with the following key benefits:

- **Efficient use of hardware resources**. Virtual Server 2005 R2 SP1 is ideal for server consolidation, allowing organizations to make more efficient utilization of their hardware resources. Virtual machine isolation and resource management enable multiple workloads to coexist on fewer servers, allowing organizations to make more efficient use of their hardware resources. Virtual Server 2005 R2 SP1 works with Windows Server 2003 R2 to provide the broadest interoperability with existing storage, network and security infrastructures. Furthermore, Virtual Server 2005 R2 SP1 provides high availability across your virtual machine environment both at the guest and host levels. Service Pack 1 for Virtual Server 2005 R2 offers new functionality, such as offline VHD mounting, support for hardware-assisted virtualization, and performance improvements.
- **Enhanced administrative productivity and responsiveness.** Virtual Server 2005 R2 SP1 enables IT organizations to enhance their administrative productivity and rapidly deploy new servers to address changing business needs. Features such as the comprehensive COM API in Virtual Server 2005 and network booting (PXE booting) for virtual machines enable automated deployment and configuration of connected virtual machines that are easily administered with standard server management tools. In addition, Service Pack 1 introduces Volume Shadow Copy Service (VSS) that will enable administrators to more easily perform backups, saving time and facilitating new disaster recovery strategies for virtual machines.
- **Well-supported server virtualization solution.** Virtual Server 2005 R2 SP1 is extensively tested and supported by Microsoft in conjunction with its server operating systems and applications. Virtual Server has an open COM API, and Microsoft has also opened the VHD image format specification allowing independent software vendors (ISVs) and partners to freely leverage Virtual Server to build solutions. Plus, Microsoft provides support for some Linux operating systems running in virtual machines on Virtual Server 2005 R2 SP1. Clearly, Virtual Server 2005 R2 SP1 is a well-supported virtualization solution both within Microsoft and across the broader ISV community.

New Features in Service Pack 1

Service Pack 1 for Virtual Server 2005 R2 adds time-saving functionality and new features that move Windows virtualization another step forward in delivering on the Windows Server® promise of doing more with less. Service Pack 1 adds new features that make it an even more compelling virtualization platform, including offline VHD mount capabilities, Volume Shadow Copy Services for virtual machines, improvements to take advantage of hardware assisted virtualization features, and other performance improvements.

- **Support for hardware-assisted virtualization.** This release includes support for both AMD Virtualization™ (AMD-V™) and Intel® Virtualization Technology (IVT). Processor hardware assistance eliminates the need for complex code to virtualize the processor in order to present expected privilege levels to virtual machine operating systems. By default, hardware-assisted virtualization is enabled if the feature is enabled on the physical server. This allows for more full utilization of available host hardware and can improve guest operating system performance.
- **VHD Mount.** VHD Mount is a Command Line Interface tool that provides the ability to mount a virtual hard disk file (.vhd file) as a virtual disk device on the host operating system. This enables offline activities and access to VHDs and eliminates the need to start up the VHD in a virtual machine in order to access files within it, saving administrators' time and increasing productivity.
- **Volume Shadow Copy Service.** This service allows you to back up Virtual Server and its running virtual machines without needing to install backup agents inside the guest operating system of the virtual machines. This means that the volume shadow copy service can take a point in time snapshot of a running virtual machine. This allows for increased productivity by eliminating extra steps previously required to backup VHDs, and it enables new disaster recovery scenarios by allowing rapid backup and restore of virtual machines.

Service Pack 1 also includes the following improvements:

- Scalability to greater than 64 virtual machines for 64-bit Virtual Server hosts
- Service connection points support
- Emulated SCSI bug fix for Linux guests
- Step-by-step guide to Virtual Server host clustering
- Larger default size for dynamically expanding virtual hard disks

The AMD Direct Connect Architecture and Hardware-Assisted Virtualization

Overview

AMD has long been known as a leading designer and producer of microprocessors. As the use of virtualization has grown, AMD established a commitment to enhance the performance of virtualization workloads with architectural changes. AMD64 processors, which include the AMD Opteron, AMD Athlon 64, and AMD Turion processor families, reflect this commitment by providing the underlying architecture that inherently aids virtualization, and additional virtualization-specific capabilities needed to efficiently run multiple operating systems.

Direct Connect Architecture

All AMD64 processors are built on Direct Connect Architecture. Direct Connect is an architecture that eliminates the bottlenecks inherent in 20-year old front-side bus architectures by directly connecting CPUs, memory and I/O for reduced latency and optimized memory performance. Components of Direct Connect Architecture include:

- **AMD 64 Core.** Offers 64-bit memory addressing, which provides virtualization software with the memory needed to efficiently handle multiple guest operating systems and applications.

  Compatible with 32-bit x86-based operating systems and applications, allowing legacy environments to be virtualized on newer, more power efficient servers

- **Multi-core.** Provides the processing resources needed to effectively drive multiple virtual machines, enabling multiple applications to be consolidated onto one server.

- **HyperTransport™ technology.** Reduces I/O bottlenecks and improves multiprocessor scalability, both of which aid in consolidating workloads.

- **Integrated memory controller.** Provides fast access to memory, better meeting the demands of inherently memory-intensive virtualized environments. Since memory is "owned" by the CPUs, advanced memory handling increases security of virtual machines.

Direct Connect Architecture offers a feature set that enhances any computing application – virtualized or not. Direct Connect Architecture provides inherent benefits to virtualization workloads since the reduced latency and performance improvements increase the number of virtual machines and/or loads in a virtual machine that can run on a server.

AMD-V Features

Supplementing the inherent benefits provided by Direct Connect Architecture, AMD also created processor improvements that specifically benefit virtualization. These improvements can be found in some members of the AMD64 family of processors and are collectively known as AMD Virtualization (AMD-V).

AMD-V is built on the Direct Connect Architecture foundation, and reduces overhead by allowing direct communication between guest virtual machines and the physical processor(s), and by providing enhanced memory handling.

Additional benefits that are derived from AMD-V are enhanced security and reduced complexity. By diminishing the reliance on the virtualization software platform, AMD-V also reduces the attack surface and eliminates points of failure.

- **Security.** Advanced memory handling capabilities offered by AMD Virtualization allows increased isolation of virtual machines and can exclude device access, both of which increase the overall security of virtualization. AMD's Enhanced Virus Protection (EVP)* technology, when run with a supporting OS, acts as a preventative measure against certain malicious viruses, worms, and Trojan horses. **Enhanced Virus Protection (EVP) is only enabled by certain operating systems. After properly installing the appropriate operating system release, users must enable the protection of their applications and associated files from buffer overrun attacks. AMD strongly recommends that users continue to use third party anti-virus software as part of their security strategy.
- **Reliability.** AMD-V and AMD's integrated memory controller enhance virtualization by providing efficient isolation of virtual machine memory. Virtualization software uses these hardware capabilities, so that errors that interfere with operations running in one virtual machine have no effect on other virtual machines on the same system.

Additional AMD-V capabilities include:

- Helps to address the pain points associated with virtualizing CPU and memory resources.
- Offers architectural enhancements to improve efficiency of switching between VMM and the guest operating systems
- Provides new instructions that can be used by virtualization software to reduce complexity and more efficiently run the host operating system or hypervisor and multiple guest operating systems simultaneously.
- Enables virtualization software to run guest operating systems unmodified, allowing legacy operating systems to run side by side with newer open source and proprietary operating systems.
- Selectively intercepts information destined for guest operating systems, which can reduce the overhead of virtualization software.
- Offers memory modes that improve efficiency as the processor(s) switches between VMM and the guest operating systems, which can reduce overhead and performance decreases that have traditionally been associated with virtualization.

The virtualization-specific improvements provided by AMD-V are now supported by Microsoft Virtual Server 2005 R2 SP1. Prior to Service Pack 1, hardware-assisted virtualization features of processors could not be used by Virtual Server. With the addition of Service Pack 1, computers equipped with AMD-V can take full advantage of the performance enhancements provided by hardware-assisted virtualization. If a server does not have hardware that provides hardware-assisted virtualization, or if this feature is not desired, hardware assistance can be easily disabled through Virtual Server.

Next-Generation AMD Opteron processor features

The Next-Generation AMD Opteron processors offer even more virtualization-specific features including energy-efficient DDR2 memory, which offers greater memory bandwidth, improved memory RAS, and cost savings.

Plus, Next-Generation AMD Opteron processors provide a seamless upgrade path to quad-core, using the same socket set, which provides even greater scalability for Virtual Server implementations and protects hardware investments by doubling processing power through a simple chip replacement in existing servers. The seamless hardware upgrade also dovetails

with the forward compatibility of VHDs to Windows Server Virtualization, which together provide a seamless upgrade path for virtual machines in the software layer.

Virtual Server and Next Generation AMD Opteron Processors: Increasing Business Value

To meet the increasing demands of their businesses while simultaneously controlling costs, organizations continually strive for ways to increase efficiencies through streamlined deployment processes, comprehensive consolidation strategies and optimized manageability. Virtualization has emerged as a leading technology enabling exactly those sorts of efficiencies.

Virtual Server 2005 R2 SP1 running on Windows Server 2003 R2, powered by AMD-V enabled Next Generation AMD Opteron processors provides a compelling virtualization platform for use in the following scenarios:

Server Consolidation

As the costs of x86-based servers dropped over the past decade, they became the standard in organizations everywhere. This was accompanied by a “one application, one server” philosophy, which often became three or more servers per application – one for production, one for fail-over redundancy, and at least one for development and test. Datacenters have become filled with racks of servers operating at capacities that average 15% - 20%, primarily to isolate application stacks.

By de-coupling the operating systems and applications from the physical hardware, virtualization meets the isolation requirements of applications through the use of virtual machines. Since multiple virtual machines can run on one physical machine, utilization rates can increase to more desirable target utilization levels of 70% or more.

The success of any consolidation strategy requires the use of the most robust and efficiently architected platforms available. Virtual Server 2005 R2 SP1 is an ideal virtualization platform, offering a comprehensive feature set to enable optimal consolidation. However, software-based virtualization is inherently memory intensive. Achieving high performance requires a hardware architecture that can access main memory faster and more efficiently. AMD-based platforms, with Direct Connect Architecture and AMD-V technology, provide this efficiency and are ideal for virtualizing x86-based servers through increased platform utilization and scalability. Reducing complexity at the software layer by using AMD-V improves memory utilization and performance. By using Virtual Server 2005 R2 SP1 with AMD64 processors equipped with AMD-V, businesses can realize the processing power needed to increase consolidation ratios.

Disaster Planning and Recovery

Virtualization is also opening up new options for disaster planning and recovery. By allowing the virtual machine to run independently of the physical hardware, virtualization makes virtual machines highly portable. Virtual machines can be moved from one physical computer to another with no impact on the virtual machine configuration; the virtual machine moved from one physical computer is available for immediate use on another physical computer, thus minimizing downtime.

By combining this inherent property of virtualization with disaster planning methods, such as real-time incremental streaming of a virtual machine onto fail-over hardware, virtualization is allowing organizations to achieve superior business continuity with minimal cost and complexity.

Virtual Server 2005 R2 SP1 can be used as part of a disaster recovery plan that requires application portability and flexibility across hardware platforms. Consolidating physical servers

onto fewer physical machines running virtual machines decreases the number of physical assets that must be available in a disaster recovery location. In the event of recovery, virtual machines can be hosted anywhere, on host machines other than those affected by a disaster, speeding up recovery times and maximizing organization flexibility.

New features in SP1 for Virtual Server 2005 R2 make Virtual Server Volume Shadow Copy Service (VSS) aware, which simplifies and accelerates the backup and restore process for virtual machines running on Virtual Server. This enables new virtual machine disaster recovery scenarios, which can streamline disaster recovery processes. These new approaches can reduce the overall cost to implement and operate disaster recovery solutions and can simultaneously help reduce the administrative effort required to manage the solution. When used in conjunction with AMD processors, Virtual Server and its associated management systems enable new levels of reliability in disaster planning and recovery.

IT Infrastructure Management

Today, multiple hardware platforms, operating systems and programming environments lead to a jumble of systems and resources. The proliferation of single–application servers - and resulting data silos - can wreak havoc on data accessibility and network performance. It is not unusual for an organization to overuse some equipment while other devices remain vastly underutilized. The resulting imbalance and cascading inefficiencies typically lead to higher costs, reduced response time and more complex provisioning. By de-coupling the operating system from the physical hardware, and allowing multiple operating systems to run on one physical computer, virtualization mitigates the proliferation and utilization imbalance.

Virtualization will also play an ever-increasing role in creating more secure and robust client environments. For example, a bank call center could provide workers with remote access to a client virtual machine hosted on a server. The virtual machine provides isolation and a unique operating environment for each user, while the remote hosting and management can help to vastly improve security.

The cost of managing the IT infrastructure can also be reduced using virtualization. By reducing the total server count, you eliminate hardware that has to be supported and managed. You also eliminate the power consumption and cooling required by each of those servers, as well as the cabinet space consumed by each server.

Virtual Server 2005 R2 SP1, as part of the comprehensive family of Windows Server products, provides superior, integrated management of virtualized environments. Administration is easy with standard server management tools like Microsoft Operations Manager and Systems Management Server and a simple Web-based interface for Virtual Server management. With integration into Microsoft's System Center toolset, deploying and administering Virtual Server and virtual machines has never been easier. Additionally, administrators and developers can customize and automate control of Virtual Server with scripts written through a robust COM API, which enables automated deployment, configuration of connected virtual machines and more.

AMD processors, via Direct Connect Architecture and AMD-V, also contribute to simplified management. AMD hardware helps improve all aspects of business continuity, from daily management of the computing infrastructure to reductions in downtime to achieving faster and more reliable disaster recovery. By enabling more secure virtual machines, AMD is advancing a new mechanism for securing the IT infrastructure - monitoring operating systems and applications at the virtual machine level through direct mapping of devices and memory to virtual machines.

Together, Virtual Server 2005 R2 SP1 and AMD processors provide a platform and functionality well-suited to leverage the IT infrastructure management advantages inherent in virtualization implementations.

Roadmap: Windows Server Virtualization with AMD-V

The future of virtualization relies on providers at all level of the technology ecosystem to work together. Software developers like Microsoft will continue to evolve their virtualization platforms to improve virtualization features and performance, and so will hardware vendors like AMD and their partners.

Microsoft's Virtualization Roadmap

Microsoft's virtualization roadmap reflects their commitment to advance self-managing dynamic systems. This roadmap combines:

- A long-term vision for how customers can drastically reduce complexity of IT infrastructure as a part of the overall Dynamic Systems Initiative
- Valuable near-term solutions that are part of a solid product roadmap, enabling customers to take a series of practical steps in line with the long-term vision

Virtualization is a key technology in this vision, and as such is being integrated into Microsoft products across platforms, operating systems, applications, and management layers.

Windows Server Virtualization

Windows Server virtualization takes a big step forward in realizing advanced capabilities of virtualization and providing customers with a scalable, secure, and highly available virtualization platform. Windows Server virtualization is a hypervisor-based technology that is a part of the next generation Windows Server codename "Longhorn". Windows hypervisor is a thin layer of software running directly on the hardware which combines an optimized instance of Windows Server "Longhorn" and the VMM. It leverages the powerful enhancements provided by hardware vendors, and provides customers with a scalable, reliable, secure and highly available virtualization platform.

There are several new features in Windows Server virtualization that help deliver a more robust virtualization platform as a part of Windows Server "Longhorn". The following are some of the key components and features of Windows Server virtualization.

- **Windows hypervisor:** A very thin layer of software that leverages the Windows Server driver support and hardware assisted virtualization technology. The minimal code base with no third party code or drivers helps create a more secure and robust base for virtualization solutions.
- **Dynamic resource management:** Windows Server virtualization provides the capability to hot add resources such as CPU, memory, networks and storage to the virtual machines with no downtime. Combined with the hot add features of Windows Server "Longhorn", this enables administrators to manage their hardware resources without impacting their SLA commitments.
- **64-bit guest support:** A key new feature of the Windows Server virtualization platform is the ability to support 64-bit guests. This enables organizations to be able to virtualize more applications that are memory intensive and benefit from the increased memory pool accessible in a 64-bit environment.
- **Multi-processor guest support:** Windows Server virtualization now provides the capability to allocate multiple CPU resources to a single virtual machine and enables virtualization of multi-threaded applications. This capability combined with the 64-bit guest support makes Windows Server virtualization a scalable platform for virtualization.

- **Live migration of virtual machines:** Windows Server virtualization will provide the ability to move a virtual machine from one physical machine to another with minimal downtime. This capability combined with host clustering of physical machines provides high availability and flexibility to achieve an agile and dynamic datacenter.
- **New device virtualization architecture:** Windows Server virtualization provides a new virtualized I/O architecture. This provides customers with the highest possible performance with the lowest possible overhead.
- **Offline VHD manipulation:** Windows Server virtualization provides the administrators the ability to securely access files within a virtual hard disk without having to instantiate a virtual machine. This provides the administrators granular access to VHDs and be able to perform some management tasks offline.

System Center Virtual Machine Manager

As a part of the System Center family of management products, Virtual Machine Manager facilitates management of Windows virtual machines. Virtual Machine Manager enables increased physical server utilization by allowing for simple and fast consolidation on virtual infrastructure with integrated consolidation candidate identification, fast physical-to-virtual (P2V) migration and intelligent workload placement based on performance knowledge and user defined business policies. Virtual Machine Manager enables rapid provisioning of new virtual machines by the administrator and end users using a self-service provisioning tool. Virtual Machine Manager is a tightly integrated member of the System Center product family of management products.

System Center Virtual Machine Manager focuses on unique requirements of virtual machines and is designed to enable increased physical server utilization, centralized management of virtual machine infrastructure and rapid provisioning of new virtual machines. The following are some of the key features in Virtual Machine Manager.

- **Consolidation candidate identification:** The first step in migrating from a physical data center with a one-workload per server model is to identify the appropriate physical workloads for consolidation onto virtual hardware. The decision factors for determining the appropriate candidates are based on several factors such as historical performance, peak load characteristics, access patterns, etc. Virtual Machine Manager leverages the existing historical performance data in the System Center Operations Manager database to list the consolidation candidates in rank order.
- **Intelligent placement:** The act of assigning and activating a given virtual workload onto a physical virtual host server is referred to as placement. Placement is at the crux of maximizing the utilization of physical assets. Virtual Machine Manager brings a deep and holistic approach to placement and combines the knowledge from historical performance data of the virtual workload and the intelligence about the virtual host system. Business rules and associated models are also leveraged by Virtual Machine Manager to determine the placement options.
- **Host provisioning:** Virtual Machine Manager will identify the physical virtual hosts in the enterprise through integrated discovery with Active Directory. This helps organizations to easily scale the management of virtual machines and hosts across the datacenter and branch offices.
- **Central library:** Virtual Machine Manager provides a central repository for all the building blocks for a virtual machine such as VHDs, offline virtual machines, templates, and even conventional disk images. Each item in the library has models or rich metadata that enable more controlled management of the objects. A template is a new object that enables an administrator to create approved virtual machine configurations that serve as a gold standard for subsequent virtual machine deployments.

- **Self-service provisioning:** Virtual infrastructure is commonly used in test and development environments where there is consistent provisioning and teardown of virtual machines for testing purposes. With Virtual Machine Manager, administrators can selectively extend self-provisioning capabilities to user groups and be able to define quotas. The automated provisioning tool will manage the virtual machines through their lifecycles including teardowns.

AMD's Virtualization Roadmap

AMD will continue to build on its virtualization-specific innovations. AMD has added hardware virtualization capabilities to the Next Generation AMD Opteron™, AMD Athlon™ 64, and AMD Athlon 64 X2 Dual-Core processors, as well as AMD Turion™ 64 X2 mobile technology. CPU extensions in today's AMD-V solve only part of the hardware barriers to virtualization; a complete solution requires the virtual mapping of I/O devices, which in turn requires changes to the chipsets and I/O bridges that link system processors to I/O buses (such as PCI Express).

To this end, early in 2006, AMD published the AMD IO Virtualization (IOMMU) Specification for chipset extensions consistent with AMD's Direct Connect Architecture. AMD is working with chipset partners to incorporate AMD IO Virtualization features.

AMD is not stopping there. Its quad-core processor architecture plans include features that extend the capabilities of AMD-V and improve its performance. AMD plans to demonstrate once again how its Direct Connect Architecture enables AMD processor-based systems to outperform those based on legacy front-side bus based approaches. Organizations won't have to wait too long to try these processors - AMD plans to start shipping quad-core processors in 2007. Because of AMD's commitment to platform stability, its OEM system partners will be able to drop these quad-core processors into the DDR2-based platforms they started shipping in 2006.

Summary

Virtualization technology is the latest in a long line of technical advancements that have increased the level of system abstraction and enabled IT users to harness ever-increasing levels of computer performance. Virtualization essentially de-couples users and applications from the specific hardware characteristics of the systems they use to perform computational tasks. This change is ushering in a new wave of hardware and software innovation. Virtualization will simplify system upgrades (and in some cases may eliminate the need for such upgrades), by capturing the state of a virtual machine, and transporting that state in its entirety from the old to new host system. Virtualization will enable a generation of more energy-efficient computing. Processor, memory, and storage resources that today must be delivered in fixed amounts determined by real hardware system configurations will be delivered with finer granularity via dynamically tuned virtual machines in the future.

Microsoft Virtual Server 2005 R2 SP1 is the most cost-effective server virtualization technology engineered for the Windows Server platform. As a key part of any server consolidation strategy, Virtual Server increases hardware utilization and enables organizations to rapidly configure and deploy new servers. Virtual Server can be used to improve operational efficiency in consolidating infrastructure, applications, and branch office server workloads, consolidating and re-hosting legacy applications, automating and consolidating software test and development environments, and reducing disaster impact. It offers improved hardware efficiency by providing a great solution for isolation and resource management, which enable multiple workloads to coexist on fewer servers. Because it offers complete scripted control of a set of connected virtual machines that are easily administered with standard server management tools, Virtual Server 2005 R2 SP1 is easy to deploy, manage and use - resulting in increased administrator productivity. Furthermore, it is another key deliverable on Microsoft's Dynamic Systems Initiative (DSI) roadmap, in line with Microsoft's continued investment in delivering technology that provides more flexible provisioning and utilization of server hardware resources. In addition, Service Pack 1 adds new features including offline VHD mount capabilities, Volume Shadow Copy Services for virtual machines, improvements to take advantage of hardware-assisted virtualization features, and other performance improvements.

AMD provides benefits inherent to virtualization in its Direct Connect Architecture, found in AMD64 processors. Direct Connect Architecture allows CPUs and memory to connect directly, thus reducing latency and optimizing performance. On top of that, AMD has engineered improvements specific to virtualization in AMD Virtualization Technology, or AMD-V, which simplifies the translation between physical hardware and virtual hardware. AMD is actively striving to provide further hardware-assisted virtualization benefits, by working with its chipset partners to extend these virtualization-specific benefits beyond the processor.

The combination of Microsoft Virtual Server 2005 R2 SP1 and powerful AMD processors with Direct Connect Architecture and AMD-V technology allows users to deploy computing resources in more agile, efficient, and cost-effective ways.

Related Links

- For information about Virtual Server 2005 R2 SP1 and to download Virtual Server visit the Virtual Server home page located at: http://www.microsoft.com/virtualserver
- For more information about Windows Server 2003 R2 Enterprise Edition visit the Microsoft Web site at: http://www.microsoft.com/windowsserver2003/enterprise/
- For more information about AMD, AMD Direct Connect Architecture, and AMD Virtualization Technology: http://enterprise.amd.com/us-en/AMD-Business/Business-Solutions/Consolidation/Virtualization.aspx

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