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**Windows Server 2008 Hyper-V Technical Overview**

Microsoft Corporation

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# Introduction

Today’s data center is a complex ecosystem where different kinds of servers, operating systems, and applications interact with a wide variety of desktop computers and mobile client computers. IT departments are under increasing pressure to manage and support this assortment of mission-critical technologies, while controlling costs and maintaining reliability and security. Deploying server virtualization technology—moving disparate servers to virtual machines (VMs) in a centrally managed environment—is an increasingly popular option for facing these challenges.

With its built-in server and presentation virtualization technologies, Microsoft® Windows Server® 2008 enables you to reduce costs and increase hardware utilization, as well as accelerate and extend application deployment and access, while improving server and application availability.

Windows Server 2008 includes Hyper-V ™, a powerful virtualization technology that enables businesses to take advantage of virtualization’s benefits Hyper-V reduces costs, increases hardware utilization, optimizes business infrastructure, and improves server availability. Microsoft Hyper-V™ Server offers Hyper-V functionality in a standalone package for dedicated virtualization hosts.

This white paper introduces Hyper-V as an important component of the Microsoft desktop-to-data-center virtualization strategy and the Dynamic Systems Initiative (DSI), moving network and service management toward self-managing, self-healing systems. New and enhanced features in Hyper-V help relieve enterprise customer pain points in common scenarios: server consolidation, business continuity/disaster recovery management, testing and development, and the dynamic data center.

# Hyper-V Overview

Virtualization is a widely adopted solution. Around 75 percent of organizations are using or evaluating virtualization and seeing its advantages for server consolidation, centralized management, and cost-reduction due to reduced hardware, power and cooling requirements. . As these benefits drive profit, companies want to virtualize more demanding workloads. They want more powerful and flexible virtualization solutions that are better integrated with their management tools. Wide adoption of 64-bit, multi-processor, multi-core servers spurs demand for virtual machines that are better able to take advantage of more scalable server hardware.

In light of these developments, Microsoft created Hyper-V, a next-generation, hypervisor-based virtualization technology that provides a reliable virtualization platform and and integrated management that enable customers to virtualize their infrastructure and reduce costs.

## Key Benefits

Windows Server 2008 Hyper-V technology simplifies the interaction between hardware, operating systems, and virtual machines, while simultaneously strengthening the core virtualization components.

### Reliability

Hyper-V provides better reliability and greater scalability that allows you to virtualize your infrastructure. It has a thin micro-kernelized hypervisor architecture with minimal attack surface. This hypervisor does not include any third party device drivers. It leverages the vast majority of device drivers that have already been built for Windows. Hyper-V is also available as a Server Core role.

### Strong Isolation

Server virtualization enables potentially resource- and control-intensive applications to coexist on the same server. Virtual servers must be able to do their work with as much flexibility as possible, leveraging as much hardware capacity as they need, without conflicting with other virtual servers.

Hyper-V works with virtualization-aware hardware to tightly control the resources available to each virtual machine. For example, virtual machines are isolated in a way that gives them very limited exposure to other VMs on the network or on the same computer.

### Security

Security is a central challenge in every server solution. Virtual servers are at least as exposed as their stand-alone counterparts and, in many ways, more exposed. For example, multiple server functions on one computer can mean more administrators have access to that computer. Third-party software and drivers can present security risks as well, so it’s important to make sure that, if a virtual machine is compromised, it has limited exposure to other virtual machines on the same physical server.

Virtualization provides an opportunity to increase security for all server platforms. Features that
Hyper-V uses to enhance security include:

* Enabling VMs to take advantage of hardware-level security features, such as execute disable bit (preventing execution of the most prevalent viruses and worms), available in newer server hardware.
* Providing strong role-based security to prevent exposure of secure VMs through shared servers.
* Integrating network security features that enable automatic Network Address Translation (NAT), firewall, and Network Access Policy protection (quarantine).
* Reducing the attack surface through a streamlined, lightweight architecture.

### Performance

Performance advances and integration with virtualization-aware hardware enable Hyper-V to virtualize much more demanding workloads than previous virtualization solutions and to give them more resources for greater scalability.

Performance advancements include:

* Speed enhancements through lightweight, low-overhead virtualization hypervisor architecture.
* Multi-core support, giving each VM access to as many as four logical processors.
* Enhanced 64-bit support, enabling VMs to run 64-bit operating systems and to access very large amounts of memory (up to 64 GB per VM), enabling more resource-intensive workloads and helping avoid slowdowns due to paging.
* Microkernelized hypervisor architecture, enabling VMs to cut out layers of emulation and drivers, working more closely with virtualization-aware hardware.
* A high-performance, hardware-sharing architecture that optimizes data transfer between physical hardware and virtual machines.

## New Microkernelized Hypervisor Architecture

Hyper-V uses 64-bit hypervisor-based technology to give VMs running Windows Server 2008, Windows Server 2003, specific Linux distributions, or Xen-enabled Linux the ability to work as closely with CPUs and memory as possible in a shared environment, vastly increasing performance.

Hypervisor-based virtualization is the latest stage in virtualization technology’s evolution, from emulated environments, which began more than 30 years ago, to today’s hardware-enhanced, close-to-bare-metal virtualization.

Basic virtualization (*Type 2* virtual machine) places a thick, relatively slow layer of abstraction between hardware and guest operating systems. This approach is called *hosted virtualization*. The virtual machine monitor (VMM) runs as an application on an operating system, and each VM runs on top of the VMM. As a simplified example of the overhead involved in this type of virtualization, a hardware call from a guest operating system’s device drivers:

1. Goes first to emulated virtual hardware managed by the VMM.
2. The VMM routes it to the operating system.
3. The operating system routes it to the hardware’s device driver.
4. The hardware’s device driver routes it to the hardware.

The process happens in reverse for any responses from the hardware.

Newer, *Hybrid* virtualization architectures, including that used in Virtual Server, run side by side with server operating systems.

*In Type 1 virtual machine monitors,* the hypervisor sits at the level closest to the hardware, sometimes called the *bare-metal* level.

There are two kinds of hypervisor architectures – monolithic hypervisors and micro-kernelized hypervisors (see graphic below). The monolithic hypervisor model still places large amounts of code between hardware resources and virtual machines, because the virtual machine monitor emulates hardware for its VMs. When a guest operating system makes a hardware call through its device drivers:

1. The VMM’s emulated hardware intercepts the call.
2. The VMM routes it to the device drivers, necessitating numerous expensive context switches.
3. The device drivers route it to the physical hardware.

This approach, called a *monolithic* *hypervisor*, includes hardware drivers in the hypervisor. Examples of monolithic hypervisors include VMware’s ESX Server.

Windows Server 2008 Hyper-V uses a micro-kernelized hypervisor model. In a micro-kernelized hypervisor, the only layer between a guest operating system and the hardware is a streamlined hypervisor with simple partitioning functionality. The hypervisor has no third-party device drivers. In addition to improved performance, it has an inherently more secure architecture with a minimal attack surface. The drivers required for hardware sharing reside in the host operating system, which provides access to the rich set of drivers already built for Windows.



Figure . Approaches to Hypervisors: Monolithic Hypervisor’s contain its’ own driver stack as a part of the hypervisor; Microkernelized Hypervisor’s has a minimal hypervisor layer and leverages the parent partition and provides an inherently more secure architecture with minimal attack surface

### Leveraging Virtualization-Aware Hardware

The new generation of 64-bit server hardware includes virtualization-aware processors.
Intel® Virtualization Technology and AMD Virtualization (AMD-V) are able to manage some memory- and hardware-sharing functions that would otherwise be left to the server’s virtualization management software.

Hyper-V *requires* a processor with hardware-assisted virtualization functionality, enabling a much more compact virtualization codebase and associated performance improvements.

With the availability of these new processors and a new, hypervisor-based virtualization architecture, Hyper-V is able to put virtualized applications as close to bare metal as possible. This enables virtualized applications to take advantage of features like multi-core processing that would be available on a standalone, physical server but haven’t up to this point been available inside a virtual machine.

Benefits of the new approach include previous solutions’ single-processor/single-core VM being supplanted by support of up to four cores per VM with Hyper-V.

Table

|  |  |
| --- | --- |
| Virtual Server | Hyper-V |
| Processor Support1 processor/core per VM | Processor SupportUp to 4 logical processors per VMUp to 16 processing cores in the physical machine. |
| Type of Virtual Machines Supported32-bit VMs | Types of Virtual Machines Supported32-bit VMs64-bit VMs32-bit and 64-bit VMs running simultaneously |
| Maximum Memory per Virtual Machine3.6 GB | Maximum Memory per Virtual MachineUp to 64 GB |

## Simplified Management with Familiar Tools

Microsoft has added functions to Hyper-V that enhance management capabilities:

* Simplifying management by replacing product-specific tools (browser interface) with industry-standard tools (Microsoft Management Console [MMC] interface)
* Automating tasks and event response to minimize human interaction wherever possible
* Performing extensive monitoring to keep administrators aware of issues before the issues become problems

From a network management standpoint, virtual machines should be easier to manage than physical computers. To this end, Hyper-V includes many management features designed to make managing virtual machines simple and familiar, while enabling easy access to powerful VM-specific management functions.

Hyper-V can be managed in three ways:

1. MMC interface
2. Microsoft System Center
3. Third party management tools

### MMC Interface

Hyper-V moves from the browser-based remote management used in Virtual Server to a standard
MMC 3.0 interface. With Windows Server 2008 Hyper-V, VMs and servers are configured through a familiar and widely used management interface. Benefits of this standardized approach include:

* Broad industry support, reducing the learning curve experienced when moving from managing physical computers to managing VMs.
* Enabling VM management with enhancements from third-party management console plug-ins.
* Ability to enhance the MMC with user-created Windows® PowerShell™ commandlets.

### Microsoft System Center

Microsoft System Center, a suite of system and server management tools, manages all of the Microsoft virtualization offerings as well as networks’ physical resources. System Center provides a single set of integrated tools to manage both physical and virtual environments. System Center is designed to help businesses create self-managing dynamic systems, where the management and monitoring tools are able to diagnose and address problems with as little human interaction as possible.

System Center includes a virtualization-specific management tool, System Center Virtual Machine Manager, as well as virtualization functions in its other tools.

### System Center Virtual Machine Manager

System Center Virtual Machine Manager (SCVMM) provides centralized and powerful management, monitoring, and self-service provisioning for virtual machines.

SCVMM host groups are a way to apply policies and to check for problems across several VMs at once. Groups can be organized by owner, operating system, or by custom names (such as “Development” or “Production”).

In the SCVMM interface, selecting a virtualization host server results in a displayed list of its VMs. Select a specific VM to show its CPU and memory usage, as well as a live-updating thumbnail. The interface also incorporates Remote Desktop Protocol (RDP); double-click a VM to bring up the console for that VM—live and accessible from the management console.

### System Center Virtual Machine Manager Main Features

|  |  |
| --- | --- |
| **Feature** | **Description** |
| **Host configuration** | Host setup and configuration can be automated, including global settings, such as storage, like Virtual Hard Disk (VHD) paths and VM Additions. |
| **Virtual machine creation** | A wizard-based user interface creates VMs, enabling rapid VM creation, including physical-to-virtual conversion (P2V) and templates. The virtual-to-virtual (V2V) conversion in SCVMM can convert VMware ESX VMs (VMDK format) to Hyper-V VMs (VHD format).SCVMM includes the ability to save VM definitions as templates for rapid deployment. |
| **Library management** | SCVMM can store and manage offline VMs, templates, and ISO images, enabling rapid VM deployment. It can create, update, delete, and store objects in the library without launching the associated VMs. |
| **Virtual machine placement and deployment** | SCVMM can provide recommendations for where to place VMs, based on host capacity and utilization, facilitating movement (including Quick Migration) of VM files over a local area network (LAN) or storage area network (SAN). |
| **Monitoring and reporting** | SCVMM provides a centralized view of all VMs in the environment and their status. The view can be customized by host and VM groupings, scalable to thousands of VMs.Integrated tools provide for complete reporting and health monitoring, including VMs and physical machines. Standard reports include consolidation candidates, utilization trending, and optimization opportunities. |
| **Rapid recovery** | VM snapshots and live backup help departments quickly recover from outages. |
| **Self-service provisioning user interface** | Instead of requiring an administrator to create and configure VMs, the SCVMM self-service interface enables users to create and delete VMs themselves. Administrators set the rules, boundaries, and permissions for self-service provisioning. |
| **Automation** | SCVMM contains a completely scriptable user model based on Windows PowerShell and includes the ability to view the Windows PowerShell script for each action—enabling administrators to develop scripts for complex actions. |

### Microsoft System Center Operations Manager

Microsoft System Center Operations Manager (SCOM) 2007 monitors the health and performance of physical and virtual workloads. Administrators have powerful tools, such as at-a-glance status, highly customizable alerts, and integrated configuration management, to respond to issues immediately and can enable automated response without administrator involvement. For example, when a virtual machine shows network saturation, SCOM might respond with a script to add a network adapter and restart the VM with more available bandwidth. A virtual machine overloading its processor or paging excessively could get additional logical processors or memory.

### Third party management solutions

In addition to the above options, Hyper-V provides APIs that can be used by third party management solutions. This enables customers to use third party management solutions to manage Hyper-V.

## Integrated Virtualization

Microsoft offers customers a complete set of virtualization products, from the data center to the desktop. As discussed, all assets – both virtual and physical – can be managed with our System Center management platform.

Hyper-V is a key component of Microsoft’scomplete virtualization solution suite.Virtualization is a key pillar to the Microsoft Dynamic Systems Initiative (DSI), embedding operational knowledge in the management tools, and enabling the system to manage and even heal itself. (See “Microsoft System Center Integration and the Dynamic Systems Initiative,” below.)



Figure . The Microsoft end-to-end virtualization strategy enables centralized management for virtual and physical assets through Microsoft System Center.

Presentation virtualization through Microsoft Terminal Services enables remote users to access applications and operating systems hosted from remote locations. A common usage model is accessing the corporate data from home or while traveling, giving the remote user the ability to manipulate files, log in to applications that require hardware locks on the desktop PC, and use other resources that wouldn’t otherwise be available. Presentation virtualization has the added benefit of enabling resource-intensive applications to be used through lower-power portable computers or other computers that would otherwise be incompatible, even those running different operating systems.

Application virtualization with Microsoft SoftGrid® insulates applications running on the same operating system, helping to eliminate potential conflicts and enabling rapid provisioning. An application that would normally update the registry, for example, updates a virtual registry, so the system is able to meet the application’s requirements without impinging on other applications. Applications are not “installed” in the traditional sense, so they can be set up and removed more quickly than through typical setup and uninstall procedures, including custom options that would otherwise have to be configured manually.

Desktop virtualization with Microsoft Virtual PC enables users to run guest operating systems. It is commonly used for vertical applications that require different operating systems and testing.

## System Requirements

### Host Operating Systems

Hyper-V is an available feature of Windows Server 2008 Standard x64, Windows Server 2008 Enterprise x64, or Windows Server 2008 Datacenter x64 editions. The Server Core installation option for these editions of Windows Server 2008 can also install the Hyper-V role.

Clustering features, including Quick Migration, require Windows Server 2008 Enterprise or
Windows Server 2008 Datacenter x64 editions in the parent partition.

### Guest Operating Systems

Hyper-V supports Windows Server 2008, Windows Server 2003 and specific Linux distributions running as guest operatring systems. For a complete list and configurations of supported guest operating systems running Hyper-V please refer to the datasheet.

### Processors

Hyper-V requires processors with hardware-assists from AMD and Intel.: AMD-V or Intel VT processors.

Hardware Data Execution Protection (DEP) must be enabled. Hyper-V requires that hardware data protection is enabled: Intel XD bit (execute disable bit) or AMD NX bit (no execute bit).

### Shared Storage for Quick Migration

Quick Migration requires shared storage in the form of either a SAN (Internet Small Computer System Interface [iSCSI] or Fibre Channel) or Serial Attached SCSI. Windows Server 2008 clustering is no longer supported by means of parallel SCSI.

# Usage Scenarios

There are four key usage scenarios for Hyper-V. They are:

Server consolidation

Dev/Test environments

Business Continuity

Dynamic Datacenter

# Scenario: Consolidate Infrastructure, Application, and Remote Site Server Workloads

The biggest driver for adopting virtualization technology is server consolidation. Businesses are under pressure to automate management and reducecosts, while retaining and enhancing competitive advantages, such as reliability, scalability, and security.

Hyper-V is ideal for server consolidation in both the data center and remote sites, enabling organizations to make more efficient use of their hardware resources. It also enables IT organizations to enhance their administrative productivity and to rapidly deploy new servers to address changing business needs.

##

## Key Consolidation Features

Table

|  |  |
| --- | --- |
| Feature  | Description  |
| **Broad guest operating system support** | Guest operating systems supported include Windows, specific Linux distributions, and Xen-enabled Linux. In addition to supporting the operating systems above with synthetic hardware, VMs in Hyper-V can run many other operating systems with hardware emulation, including all versions of DOS, Windows, and Windows Server. |
| **Hardware virtualization and older-version hardware emulation** | VMs based on specific virtualization-aware operating systems (Windows Server 2008, Windows Server 2003, and specific Xen-enabled Linux distributions) interact with high-performance synthetic devices that have no physical counterpart (for example, “Windows Display Adapter”). Other operating systems interact with emulated hardware that acts like specific devices (for example, S3 Trio64 SVGA adapter).  |
| **P2V: Physical-to-virtual conversion (SCVMM)** | P2V enables running physical servers to be converted to virtual machines, with minimal downtime. |
| **V2V: Virtual-to-virtual conversion (SCVMM)** | The virtual-to-virtual conversion in Hyper-V can convert VMware ESX VMs (VMDK format) to Hyper-V VMs (VHD format). |
| **Quick Migration (SCVMM)** | The Quick Migration feature in SCVMM enables running virtual machines to be moved from one server to another, with minimal downtime. |
| **CPU resource allocation** | CPU resource allocationsupports both weighting and constraint methods for fine-grained control.* Multithreaded for highly scalable performance.
* Number of cores in a VM:
* Each virtual machine can use up to 100 percent of a single host processor (up to 16 total processing cores per system).
* On hyper-threaded systems, the single host processor is a logical processor.
* Multiple virtual machines can execute concurrently to make use of multiple host processors.
* The number of virtual machines that can be hosted on any server depends on the:
	+ Combined processor, memory, and I/O load the virtual machines put on the host.
	+ Processor, memory, and I/O capacity available on the host system.
* Virtual processor resources can be changed using industry-standard tools, the Hyper-V MMC management interface, or WMI scripting (processor change requires restarting the VM).
* Hyper-V supports both weight-based and constraint-based CPU resource allocation for balanced workload management.
* The relative weight given to the resource needs of this virtual machine is based on comparisons with the needs for all other virtual machines. A virtual machine with a higher relative weight is dynamically allocated additional resources as needed from other virtual machines that have lower relative weights. By default, all virtual machines have a relative weight of 100, so that their resource requirements are equal, and none is given preference.
* Capacity and weight algorithms operate concurrently:
	+ Contention can occur for the maximum system capacities.
	+ Relative weights indicate how to allocate resources during contention.
 |
| **Memory resource allocation** | Hyper-V enables flexible memory configuration on a per-virtual machine basis. * Support is included for non-uniform memory access-aware (NUMA-aware) scheduling and memory allocation, reducing memory bus contention on multi-processor systems.
* On non-NUMA systems, Hyper-V relies on the host operating system scheduler.
 |
| PXE Boot  | Virtual network cards in Hyper-V support Pre-Boot Execution Environment (PXE). This network boot allows customers to provision their virtual machines in the same ways that they do their physical servers.**Note:** To take advantage of this feature, the PXE infrastructure needs to be installed on the host network. |
| Active Directory integration | Active Directory® directory service allows the same directory management features to be used for virtual machines as are used for physical machines, by providing a centralized repository for hierarchical information about users and computers on the network. Active Directory incorporates significant improvements in management and performance in Windows Server 2008, which can be leveraged through virtual machines hosted by Hyper-V.Integration with Active Directory enables delegated administration and authenticated guest access. Hyper-V enables fine-grained administrative control over virtual machines with per-virtual machine Access Control Lists (ACLs) that can be managed from within the Active Directory Group Policy Management Console. Event logs are integrated with Active Directory and Microsoft Management Consoles. |
| Windows Server Core option | Hyper-V is available as a Windows Server 2008 Server Core role, facilitating higher uptime due to fewer mandatory reboots for OS patches. Hyper-V can also achieve higher VM density when consolidating core infrastructure workloads by using Windows Server Core as a guest OS. The reduced disk and memory footprint of Server Core can help achieve higher VM densities on consolidated servers. |

# Scenario: Automate and Consolidate Software Test and Development Environments

Hyper-V enables businesses to consolidate their test and development servers and to automate the provisioning of virtual machines.

Customers across all business segments are looking for ways to decrease their costs and to accelerate application and infrastructure installations and upgrades, while delivering comprehensive quality assurance. To achieve testing coverage goals prior to going into production, multiple challenges must be overcome:

* **Network operations:** A test network that is incorrectly configured could endanger production networks.
* **Developer productivity:** Developer productivity should not be wasted on time-consuming administrative tasks, such as configuring test environments and installing operating systems.
* **Server operational and capital costs:** High-quality application test coverage requires replicating production computing environments, which in turn need costly hardware and human resources. This extra resource demand can pose risks to budgets and schedules

Virtual machine technology was developed more than 30 years ago to address some of the challenges first encountered during the mainframe era, enabling side-by-side testing and production partitions on the same system. Now, Hyper-V enables better test coverage, developer productivity, and user experience. The memory and processor scalability inherent in Hyper-V 64-bit architecture supports enterprise test scenarios.

Developers can also leverage Hyper-V as an efficient tool to simulate distributed applications on a single physical server. Deploying and testing distributed server applications typically requires quantities of available hardware resources and a great deal of time to configure the hardware and software systems in a lab environment, to simulate a desired scenario.

Hyper-V is a powerful time- and resource-saving solution that optimizes hardware and human resource utilization in distributed server application development scenarios. Hyper-V enables individual developers to easily deploy and test a distributed server application using multiple virtual machines on one physical server. Combining the robust features in Hyper-V, such as disk hierarchy and virtual networking, with the value of machine consolidation gives developers a powerful and efficient way to simulate complex network environments. The result is a development environment solution that is very time and cost effective because less hardware, less real estate, and less time are required for build-out.

##

## Key Software Testing and Development Features

Table

|  |  |
| --- | --- |
| Feature  | Description  |
| **Broad guest operating system support** | Guest operating systems supported include Windows Server 2008, Windows Server 2003, and specific Xen-enabled Linux distributions. In addition to supporting the operating systems above with synthetic hardware, VMs in Hyper-V can run many other operating systems with hardware emulation, including all versions of DOS, Windows, and Windows Server. |
| **Self-service portals** | System Center Virtual Machine Manager enables developers and testers to create and destroy VMs from a configuration library instead of requiring administrator intervention. |
| **Flexible resource control** | VMs can also take advantage of flexible resource control, enabling testers to assign memory and processor resources that best fit the test or development scenario.  |
| **VM Snapshots** | With the Snapshot feature of Hyper-V, a VM can be reset to a previous state. |

# Scenario: Business Continuity and Disaster Recovery

Hyper-V can be part of a disaster recovery plan that requires application portability and flexibility across hardware platforms. Consolidating physical servers onto fewer physical computers running virtual machines decreases the number of physical assets that can be damaged or compromised in event of a disaster. During 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.

## Key Business Continuity and Disaster Recovery Features

Table

|  |  |
| --- | --- |
| Feature  | Description  |
| **High availability through host and guest clustering** | Hyper-V enables clustering of guest operating systems and host computers, enabling a variety of high-availability scenarios. Clustering host computers offers a cost-effective means of increasing server availability, enabling failover of virtual machines among the Hyper-V hosts in the cluster. Using Hyper-V, organizations can create a high-availability virtual machine environment that can effectively accommodate both planned and unplanned downtime scenarios, without requiring the purchase of additional software tools.For example, IT administrators can effectively anticipate host server restarts if required by system updates. With a properly configured Hyper-V host cluster, running virtual machines can be migrated to another host in the cluster with minimal downtime. In unplanned downtime scenarios, such as hardware failure, the virtual machines running on the host can be automatically migrated to the next available Hyper-V host.Guest clustering allows cluster-aware applications to be clustered within virtual machines across Hyper-V host computers. |
| **Live backup** | Hyper-V virtual machines and their data can be automatically backed up without experiencing downtime (if the guest OS supports Volume Shadow Copy Service). If a server stops responding, its VMs can be restored and started on any other host server, minimizing service interruptions.Tape backup processes take advantage of virtual tape drive functionality in Hyper-V. For example, if a server incorporates a script to automatically back up its data to a tape drive, that process can still be used when the server is converted to a virtual machine. |
| **Health monitoring** | Hyper-V leverages comprehensive integration with monitoring tools, like Microsoft System Center Operations Manager (SCOM), to spot and respond to issues before they become larger problems. |
| **Quick Migration** | Quick Migration enables VMs to be moved to other servers, automatically or manually, with minimal downtime. Note: Quick Migration is available only in the Enterprise and Datacenter editions of Windows Server 2008.When monitoring tools like SCOM identify important but non-urgent problems with servers—a system reaching its maximum capacity, for example—integrated management tools can automatically move that server to another physical computer, even at another location. |
| **Windows Server Core option** | Hyper-V is available as a Windows Server 2008 Server Core role. Windows Server Core as a guest OS helps facilitate high availability for core infrastructure roles. The reduced disk and memory footprint of Windows Server Core will facilitate faster Quick Migrations and faster cluster failovers of VMs based on Windows Server Core. |

# Scenario: Enabling the Dynamic Data Center

Data centers face increased pressure to optimize hardware and facilities utilization, while increasing performance and leveraging business intelligence. Hyper-V gives data centers the agility to respond to changing needs, and the power and flexibility to design for the future.

Core features, such as dynamic hardware management, Quick Migration of running VMs with minimal downtime, and 64-bit, multi-processor support, enable data centers to rely on virtual machines for even the most resource-intensive workloads.

Hyper-V helps realize the dynamic data center vision of providing self-managing dynamic systems and operational agility. Combining business processes with System Center Virtual Machine Manager enables a data center to rapidly provision new applications and dynamically load balance virtual workloads across different physical machines in their infrastructure and to progress toward self-managing dynamic systems.

## Microsoft System Center Integration and the Dynamic Systems Initiative

Hyper-V integrates with Microsoft System Center (MSC), a new generation of dynamic management tools designed to support the Dynamic Systems Initiative (DSI). MSC provides IT Professionals with the tools and knowledge to help manage their IT infrastructure, embedding operational knowledge in the management tools, and enabling the system to manage and even heal itself.

The essence of Microsoft DSI strategy is to develop and deliver technologies that enable businesses and people be more productive, and to better adapt to dynamic business demands. There are three architectural elements of the dynamic systems technology strategy:

1. Design for Operations to capture the diverse knowledge of people, such as business architects, application developers, IT Professionals, and industry partners, by embedding it within the IT infrastructure itself, using system models.
2. Knowledge-Driven Management enables systems to capture desired states of configuration and health in models, and to use this inherent knowledge to provide a level of self-management to systems.
3. Virtualized Infrastructure helps achieve greater agility and leverage existing infrastructure by consolidating system resources into a virtual service pool. Virtualized infrastructure makes it easier for a system to quickly add, subtract, move, or change the resources it draws upon to do its work, based on business priorities and demands.

These three elements are the foundation for building dynamic systems. Virtualized Infrastructure mobilizes the resources of the infrastructure, Knowledge-Driven Management is the mechanism for putting those resources to work to meet dynamic business demands, and Design for Operations ensures that systems are built with operational excellence in mind.

For more information about DSI, see: [www.microsoft.com/dsi](http://www.microsoft.com/dsi).

## Key Dynamic Data Center Features

Table

|  |  |
| --- | --- |
| Feature  | Description  |
| **Broad guest operating system support** | Guest operating systems supported include Windows Server 2008, Windows Server 2003, and specific Xen-enabled Linux distributions.In addition to supporting the operating systems above with synthetic hardware, VMs in Hyper-V can run many other operating systems with hardware emulation, including all versions of DOS, Windows, and Windows Server. |
| **Automated VM reconfiguration** | The VM configuration capabilities in Hyper-V enable advanced management tools to reconfigure VMs with additional storage, memory, processor cores, and networking (minimal downtime required to restart the VM). A dynamic data center uses this technology not only to respond to problems, but also to anticipate increased demands. The dynamic data center can give a Web server additional processing power in anticipation of a Web-based promotion, for example. If the payroll system always slows down during the last few days of the month, the system can automatically add capacity for that period and free up those resources for other VMs after payroll processing is done.  |
| **Quick Migration** | The Hyper-V Quick Migration feature enables running VMs to be moved to other servers, with minimal downtime. Dynamic data centers leverage Quick Migration to move workloads to servers with applicable capabilities for their current needs. A server providing application updates, for example, could migrate to a more powerful server in anticipation of a company-wide software update. |
| **Utilization counters** | Hyper-V utilization counters provide server administrators with detailed server load and performance information to facilitate planning and analysis, as well as charge-back metrics. |

# Conclusion

Hyper-V is a reliable and cost-effective server virtualization technology for the Windows Server 2008 platform.

The move by Microsoft to hypervisor-based, hardware-assisted virtualization vastly improves reliability and scalability for virtual servers, enabling even the most demanding workloads to be run in dynamic virtual machines.

The industry-standard management tools in Hyper-V enable system administrators to manage virtual servers and physical servers in the same familiar, widely supported interface.

IT departments use Hyper-V to:

* **Consolidate infrastructure, application, and remote site server workloads.** Hyper-V is ideal for server consolidation in both the data center and remote sites, allowing organizations to make more efficient use of their hardware resources. It also helps IT organizations to enhance their administrative productivity and to rapidly deploy new servers to address changing business needs.
* **Automate and consolidate software test and development environments.** Hyper-V enables businesses to consolidate their test and development server farm and to automate the provisioning of virtual machines.
* **Provide for business continuity and disaster recovery.** Hyper-V can be used as part of a disaster recovery plan that requires application portability and flexibility across hardware platforms.
* **Support the drive to create dynamic, self-managing systems.** Hyper-V gives data centers the agility to respond to changing needs and the power and flexibility to design for the future.