# **Microsoft**

# MICROSOFT VIRTUALIZATION

from Data Center to Desktop

A comprehensive guide for customers to Microsoft Virtualization and its role in enabling Dynamic IT and a people-ready business.



Introduction	1
The People-Ready Business	2
Virtualization and Dynamic IT	5
Integrated Virtualization— from Data Center to Desktop	6
Data Center Challenges and Associated Virtualization Benefits	7
The Dynamic Data Center	8
Virtualization Scenarios	10
Using Microsoft Virtualization Solutions for a Diverse Employee Base	18
Enabling Microsoft Virtualization Products and Technologies	21
Interoperability	24
Why Microsoft for Virtualization	25
Tools to Get Started	27
Conclusion	29
Appendix A: Virtualization Licensing	30
Appendix B: Windows Vista Enterprise Centralized Desktop Licensing for VDI	40
Appendix C: New Microsoft Licensing and Support Eases Path to Virtualization	44

# Published: September 2008



For the latest information, please visit http://www.microsoft.com/virtualization

# Introduction

This guide examines strategies for moving an organization toward a dynamic information technology (IT) environment using data center virtualization technologies. As companies approach Dynamic IT, their data centers evolve through a series of stages from manual and reactionary to automated and proactive—from being perceived as cost centers to becoming strategic assets for the company. This guide shows how virtualization can help organizations improve their data centers, control costs, increase security and availability, and enable their business to be more agile.

This guide also highlights scenarios that show how virtualization can enable server consolidation, business continuity, and an optimized desktop environment, among others, while examining the Microsoft<sup>®</sup> technologies that support those solutions. It also explains some of Microsoft's technology partnership investments that support heterogeneous virtualization environments.

Lastly, the appendices in this guide provide information on Microsoft licensing for virtualization.



# The People-Ready Business

Businesses don't garner insights or make decisions. Businesses don't close deals, invent new products, or find new efficiencies. People do.

Companies excel when they empower their people to drive the business forward. Strategies, organization, motivation, and leadership all set the stage for business success. But to see results, you also have to give your people the right tools, information, and opportunities. Microsoft refers to a business that fosters a winning environment as a People-Ready Business.

Software is instrumental to the people-ready business. Software is increasingly how organizations harness information, which is the lifeblood of business today. Software enables people to turn data into insight, transform ideas into action, and turn change into opportunity.

# Making the People-Ready Business Real—Optimization Models

How does a business become People Ready? How can you successfully build the necessary platform and infrastructure for a People-Ready Business?

IT Infrastructure is a strategic asset and the critical foundation upon which software can deliver services and user applications that a business needs in order to create a People-Ready Business. However, for many organizations, growth and rapid developments in new technologies have resulted in data center and desktop infrastructures that are overly complex, inflexible, and difficult to manage with built-in costs that are high and relatively fixed regardless of changing business requirements.

The Microsoft Optimization models are designed to help organizations like yours address these challenges and guide you as you mature your IT infrastructure. As you mature your infrastructure, your IT can become a strategic asset that enables your people by providing them the tools, insight, information, and connection to partners and customers that they need to drive business success.

Microsoft is helping businesses break out of reactive IT cycles and move toward automated, dynamic systems and applications. To enable organizations like yours along this path, Microsoft has created Optimization models, including the Core Infrastructure Optimization model, the Business Productivity Infrastructure Optimization model, and the Application Platform Optimization model. Each of these models includes related capabilities. For the Core Infrastructure

Optimization model, capabilities include Identity and Access; Desktop, Device, and Server Management; Security and Networking; Data Protection and Recovery; and IT and Security Process.

The Optimization models are based on Gartner's Infrastructure Maturity Model and MIT's Architecture Maturity Model, then have been refined using industry best practices and Microsoft's own experiences with its enterprise customers. A key goal for Microsoft in creating the Optimization models was to develop a simple way to use a maturity framework that is flexible and can be used as the benchmark for technical capability and business value.



# Maturity Levels

The Optimization models identify four levels of infrastructure maturity for each capability, including Basic, Standardized, Rationalized, and Dynamic.

- Basic: "IT fights fires"—Uncoordinated desktop, manual infrastructure, high cost of management and maintenance.
- **Standardized**: "IT is gaining control"—Managed IT infrastructure with some automation.
- Rationalized: "IT enables business success"—Managed and consolidated IT infrastructure.
- Dynamic: "IT is a strategic asset"—Fully automated management, dynamic resource usage.

Currently, most organizations are at the Basic stage, where IT is seen as a cost center. As organizations adopt standard technologies and practices, IT can become an *efficient* cost center, but most organizations really want to move beyond seeing IT as a cost center, regardless of how efficient it is; they want to rationalize IT so it becomes a business enabler.

Eventually, organizations want IT to be Dynamic—a strategic asset that provides a competitive advantage. Dynamic IT is characterized by the following:

- Aligned. IT becomes thoroughly connected with business requirements, aligning the new goals that the business generates and proposing the appropriate IT implementations. Organizations with Dynamic IT have an expanded point of view and a willingness to embrace new roles like business architects or analysts in the IT life cycle.
- **Adaptable**. Industry trends and new technologies generate significant interest, and IT must be able to evaluate new technologies with business needs in mind, then rapidly incorporate new technology as part of strategic initiatives. IT needs to balance innovation with the ability to support prior investments that are already in place and are providing critical functionality.
- Efficient. While investments should be expected as processes evolve from being reactive and manual to proactive and automated, these investments need to be made with key success criteria and the return on investment calculated from the outset. As IT moves from being viewed as simply "infrastructure" to being seen as a "business asset" that provides information for decision makers, it becomes a key component in new business initiatives. At this stage, IT can garner additional budget because IT is seen as enabling profit rather than simply maintaining existing systems
- **Empowering People.** Helping to make the enterprise People Ready means allowing employees access to the information they need. It means making sure that IT services become literally like a dial tone: computing on demand, wherever people need it.



As you move through the stages of maturity in the Optimization models, you should find it easier to control and even lower IT costs. Furthermore, you should be able to increase the availability, security, and agility of your business systems, shortening the time from idea to implementation.

Microsoft has developed a self-assessment tool that you can use to determine your current level of optimization. It's recommended that you assess your organization before selecting or implementing virtualization solutions. This will help you and your organization identify virtualization initiatives that will provide the most value at each stage of maturity.

While Microsoft provides technologies and solutions to help you improve your infrastructure, the Optimization models are product agnostic. Using the guidance provided by the models, you can achieve a more agile infrastructure regardless of the products or solutions you use.

# **Optimization Benefits**

The Optimization models may help you realize cost savings for your IT infrastructure by moving from an unmanaged environment toward a Dynamic IT infrastructure. Security may improve from highly vulnerable in a Basic infrastructure to dynamically proactive in a more mature infrastructure. IT infrastructure management may change from highly manual and reactive to highly automated and proactive.



Virtualization and Core Infrastructure Optimization Models

Microsoft and partners can provide the technologies, processes, and procedures to help you move through the infrastructure optimization journey. Processes move from fragmented or nonexistent to optimized and repeatable. Your ability to use technology to improve your business agility and deliver business value can increase as you move from a Basic level of maturity toward a Dynamic state, empowering your information workers and managers and supporting new business opportunities. By working with Microsoft and using the models as a framework, you can quickly understand the strategic value and business benefits of optimizing your infrastructure.

# **Virtualization and Dynamic IT**

Virtualization technology can be a key factor in helping your organization optimize your IT. If you are at a Basic level of Optimization, you should be able to realize power savings and substantially improve resource utilization. Virtualization can help you in application testing, staging, and moving workloads into production. While your IT may still be viewed as a cost center, virtualization can help your IT department become much more efficient.

Virtualization is also crucial when it comes to simplified backup and disaster recovery because it can help you reduce downtime caused by catastrophic events from days to hours or even minutes. Virtualization can help ensure that your applications remain available, independent of hardware servicing. Virtualization can also simplify your efforts to increase the resources that are available to applications.

In more advanced organizations, business units can acquire their own infrastructure through self-service provisioning of virtual machines. In fact, dynamic provisioning can enable business units to automatically bring new resources online (or take services offline) as workload demands require. Migration of workloads can also happen automatically and without interrupting users, and problems can be detected and mitigated with minimal manual effort.

With these sorts of capabilities, your IT department can become an empowering agent that enables business goals and increases agility.

# Integrated Virtualization— From Data Center to Desktop

A truly dynamic data center utilizes a variety of technologies and best practices to optimize operations. Offerings from Microsoft extend beyond hardware or server virtualization, providing the technologies that organizations need to address a wider range of technology issues and needs. Individually, technologies provide critical functionality; together, they provide the functionality needed for dynamic operations.

Virtualization from the data center to the desktop is an extension of the trend that began with server virtualization. With integrated virtualization, the concept of virtualization is extended to the desktop, graphics and input/output resources, individual applications, and even the provisioning of a centralized management environment. Elements of integrated, data center to desktop virtualization include server virtualization, desktop virtualization, application virtualization.

# **Server Virtualization**

Server virtualization creates a separate operating system environment that is logically detached from the host server. This enables organizations to increase server utilization rates, allow applications to leverage a greater density of computing resources, and facilitate benefits such as high availability and disaster recovery.



# **Desktop Virtualization**

Desktop virtualization allows companies to host desktops in virtual machines in the data center, enabling each end user to obtain access via a remote graphics protocol. Alternatively, desktop virtualization can also enable you to create a separate operating system environment on the user's desktop, enabling several operating systems and their corresponding applications to run on simultaneously on the user's desktop.

# **Application Virtualization**

Application virtualization separates the application layer from the operating system on a desktop. This reduces application conflicts and enables centralized, simplified patch management and updates.

# **Presentation Virtualization**

Presentation virtualization isolates computing processes from the graphics and input/output functions, making it possible to run an application in one location (say on a server in the data center) but have it be viewed and controlled in another location (say on a client PC in a branch office).

# Data Center Challenges and Associated Virtualization Benefits

The primary reason that virtualization is growing so quickly is because of the challenges that many organizations are facing and the associated benefits that they can derive from virtualization. These include the following:

### **Increasing Server Utilization and Decreasing Server Sprawl**

An optimized infrastructure is becoming imperative as 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. Issues related to low server utilization can be addressed with the help of virtualization.

Virtualization allows organizations to reduce server count. Virtual machines enable more workloads to coexist on fewer physical servers, which results in a more efficient use of hardware resources. This can help companies save money on hardware, particularly in larger data centers where a single application may require three or more servers—one for production, one for fail-over operation, and one for testing.

### **Improving IT Service Levels**

Virtualization solutions enable organizations to rapidly deploy new servers and operating environments. Many of the problems associated with the traditional association of one server to one operating system are eliminated with virtualization, because IT can quickly deploy multiple operating systems and applications to fewer servers. IT can then focus resources on higher-value, strategic initiatives rather than on procuring, racking, and stacking hardware.

# Supporting Legacy Systems

Legacy hardware and systems become increasingly costly to maintain. Server virtualization can be used to re-host legacy environments and reduce the costs associated with legacy systems. Presentation virtualization can be used to provide end users with access to legacy systems from their current desktop environments.

# **Streamlining Management and Security**

Virtualization enables IT to enhance productivity and rapidly deploy new servers to address changing business needs. Integration with existing server-management tools facilitates management of Windows® operating system–based virtual machines. The ability to consolidate workloads in a hardware-agnostic environment, along with integrated physical and virtual IT management, enables IT administrators to lower operating costs and create more agile infrastructures. Furthermore, IT departments can use a centralized and optimized desktop, using a combination of desktop virtualization and presentation virtualization, to increase the security around sensitive information.

# **Reducing Application-compatibility Testing**

Most organizations consume valuable IT time and resources due to application compatibility issues. By virtualizing applications and delivering them on demand to desktops, application-to-application conflicts are nearly eliminated. This significantly reduces the amount of regression testing that is required prior to deployment as well as the number of help-desk calls that are received after deployment.



# The Dynamic Data Center

A data center comprises physical hardware and potentially virtual machines, application workloads, and models that govern service levels, regulatory compliance, and other IT and business policies. When you are evaluating your data center, it can be instructive to consider the different components or *layers* that make up your data center.

### **Physical Layer**

At the physical layer, it's important for the dynamic data center to be able to provision physical systems efficiently, configuring bare-metal hardware and installing and configuring all levels of software while minimizing manual intervention (such as scripting). Once systems are provisioned, they need to be patched and kept up to date without manual intervention. Finally, organizations need to be able to multicast configurations to provision numerous servers rapidly. Microsoft can help you do this with System Center Configuration Manager.



# **Virtual Layer**

The virtual layer includes the provisioning of the virtualization platform and virtual machines. With the Windows Server 2008<sup>®</sup> operating system, Microsoft provides Hyper-V<sup>™</sup> hypervisor virtualization technology as a feature of the operating system. Hyper-V is enabled through a server role.

# **Application Layer**

Many independent software vendors today are testing and validating their software to ensure it runs on the Microsoft virtualization platform. Since Hyper-V shares the benefits of the broad Windows Server technology ecosystem— Certified Hardware Devices, Certified Servers, "Certified for" Software—these Windows Server designations help customers identify products that deliver a high-quality computing experience. Customers can find the list of tested and validated software at www.windowsservercatalog.com.

After customers select validated software, it is time to start implementing their workloads in virtualized environments within their data centers, by migrating these workloads from a physical server to a server running within a virtual machines-physical-to-virtual (P2V) migration. This functionality is provided and managed by System Center Virtual Machine Manager 2008.

### **Model Layer**

Applications are typically deployed across many servers. In fact, many applications require three to five servers. Some even require hundreds of servers to operate effectively. A *model* cohesively brings together those applications, servers, and configurations. It also allows the people who build applications to understand the application components and configure them in a standard way.

Building an effective model starts with the business analyst, who comes up with the application requirements. An architect then defines the application architecture and deployment model. Developers implement the application based on the model, and the application is then deployed into the environment as dictated by the model. The model can also apply ongoing governance rules.

Microsoft has started to apply this visionary process in many of its products, including System Center Operations Manager, System Center Virtual Machine Manager, System Center Configuration Manager, and the Visual Studio® development tools. Furthermore, model-driven operations is an area where Microsoft will continue to invest.

### Management

The Microsoft data center management solution is provided by System Center, which manages physical and virtual environments, as well as heterogeneous operating systems and virtualization platforms.





# **Virtualization Scenarios**

There are several real-world scenarios in which Microsoft virtualization can help you evolve your data centers toward a Dynamic state. For each of these scenarios, centralized, policy-based management is required to effectively manage the physical and virtual infrastructure needed. The following scenarios are not the only scenarios that virtualization addresses, but they are some of the most common.

# Server Consolidation and Provisioning

#### Challenges

With greater demand on IT to solve business challenges, data centers quickly fill to capacity, and each new server purchase increases capital and operating expenditures as well as power and cooling costs. At the same time, servers are often underutilized. Typically, server workloads consume only 5 percent of their total physical capacity, wasting

hardware, space, and electricity. Because of application-compatibility issues, IT has to separate applications by running them in different silos and on different servers. resulting in significant server sprawl. Provisioning new servers is a lengthy, labor-intensive process measured in days and months, making it difficult for IT to keep pace with the much faster rate of business growth and change.



Non Virtualized Infrastructure

Server Consolidation and Provisioning Architecture

#### What Is Server Consolidation and Provisioning?

Server consolidation is performed by converting physical servers to virtual machine files that can be centrally stored and managed, allowing for dynamic deployment based on load and available resources. The number of required physical machines is reduced, while server utilization and business agility are dramatically improved.

#### **Benefits**

By consolidating multiple workloads onto a single hardware platform via server virtualization, you can maintain a one workload:one server ratio while reducing physical server sprawl. You will be able to more fully support your business with less hardware, which should enable you to lower equipment costs, lower electrical consumption (thanks to reduced server power and cooling), and reduce the physical space required to house your server farm.

Virtualization can also help you simplify and accelerate provisioning. The acquisition of workload resources and hardware can be decoupled. Adding the capability required for a particular business process (say, a web commerce engine) becomes streamlined and immediate. In a more advanced virtualized environment, workload requirements can be self provisioning, resulting in dynamic resource allocation.

While virtualization-based server consolidation can provide many benefits, it can also add complexity if the environment is not managed properly. The savings from hardware consolidation could be offset by increases in IT management overhead. Because creating virtual machines is so easy, an unintentional and unnecessary virtual sprawl can result that far exceeds physical server sprawl and that outpaces the tools used to manage virtual machines. A properly managed virtual infrastructure, however, automatically determines which servers are the best candidates for virtualization, converts them to virtual machines, and provisions them to the right hosts in minutes, rather than the weeks or months it takes to procure and configure physical servers manually.

# **Business Continuity/Disaster Recovery**

#### Challenges

In today's business environment, having robust disaster recovery is a necessity. Given the high probability and variety of events that cause outages, including natural disasters like hurricanes, earthquakes, snow storms, and flooding, and man-made events like power outages, terrorism, and viruses, a disruption to business systems is not a question of *if*, but *when*. In order for businesses to maintain continuity, disaster recovery needs to be at the core of any IT strategy, but implementing a reliable, rapid recovery strategy can be time consuming and expensive. Because of the difficulty and time required, many companies simply don't have comprehensive business-continuity or disaster-recovery plans to cover all of their devices, data, and applications.

#### What is Business Continuity and Disaster Recovery?

In light of frequent disruptions of hardware and software systems, planned maintenance, and the potential for a natural or man-made disaster, the resulting downtime can bring a business to its knees, leading to frustrated information workers and customers and an overwhelmed IT department. Virtualization can simplify the development and maintenance of bullet-proof continuity and disaster-recovery strategies. By compartmentalizing workloads, organizations can prevent one application from affecting the performance of another or causing a system crash, giving IT personnel time to help move the business forward.

#### **Benefits**

System Center Virtual Machine Manager makes disaster recovery and continuity as easy as copying a file. With a few clicks of the mouse, an IT manager can backup a site remotely and be confident that it is identical to the production site. System Center Data Protection Manager extends these capabilities by maintaining snapshot-based back-up for more robust restoring. Data Protection Manager captures data changes in real time and



synchronizes regularly, enabling IT and end users to recover data in minutes.

Microsoft virtualization can make maintaining bullet-proof continuity and disaster recovery strategies for all these assets simple. By compartmentalizing workloads, organizations can prevent one application from affecting the performance of another or causing a system crash. Less stable legacy applications can be operated in a secure, isolated environment.

To ensure application continuity, organizations can use Microsoft Application Virtualization, which turns applications into data files that can be treated and replicated just like other enterprise data files. Since applications that are virtualized using Microsoft Application Virtualization reside in a centralized location and are streamed to end-users' desktops on demand, organizations don't have to rebuild individual images across the organization. This reduces end-user downtime to minutes in most cases, instead of the hours or days it could takes to get users up and running after a system failure.

# **High Availability**

#### Challenges

Planned and unplanned downtime cost organizations money. Traditionally all layers of computing environments, including hardware, operating systems, applications, storage, and more, have been *static*, meaning they have been configured to interact properly and support a single, specific computing solution. Components are installed to particular computers, resulting in a tightly bound system that does not adapt well to changes. However, high availability has become a vital ingredient of IT strategies in a world where businesses need to operate 24 hours a day, seven days a week. The disruption of IT services can be fatal to a business.

# What Is High Availability Using Virtualization?

Server virtualization can help ensure that services are available when they are needed. By using virtualization to create a more efficient and dynamic server infrastructure, organizations can increase the availability of their server infrastructure, reduce disruptive events, and minimize the time and resources needed to support the infrastructure.



#### Benefits

One benefit of Microsoft

virtualization is the ability to

move virtual machines between hosts to keep them running during routine maintenance and to better balance server loads. System Center Virtual Machine Manager enables organizations to migrate virtualized guests from one physical

loads. System Center Virtual Machine Manager enables organizations to migrate virtualized guests from one physical host to another with limited downtime, easing servicing, planning, and reorganization while significantly limiting the detrimental effects of downtime on production servers.

Availability is increased through improved, automated centralized management that provides a unified view into network security and back-up data for the end user, thus increasing the usability for both IT and the end user. System Center Virtual Machine Manager provides solutions that simplify management responsibilities and increase business productivity.

Microsoft virtualization frees each element of a system from the other. By separating the different computing layers (hardware, operating system, applications, storage, and more), virtualization enables greater flexibility and simplified change management. Organizations no longer need to configure each element in order for them to all work together. Computing components are essentially turned into on-demand services that are instantly available. This makes it easy to add, update, and support all elements of the infrastructure, creating the foundation for utility computing and a much more nimble business.

# **Centralized and Optimized Desktop**

#### Challenges

Many organizations struggle to manage their desktop environments in an efficient manner. Varying end-user needs for applications and services require organizations to develop, deploy, manage, and support dozens of desktop images. Management of each image can cost an IT department tens of thousands, if not hundreds of thousands, or dollars each year.

#### What is a Centralized and Optimized Desktop?

Imagine employees accessing their personalized desktop, with all of their settings and preferences intact, on any machine, from any location. Virtual Desktop Infrastructure (VDI) from Microsoft enables IT staff to deploy desktops in virtual machines on secure and centralized hardware. The two core architectures that are possible with Microsoft VDI are static and dynamic.

- **Static**: In static mode, there is a one-to-one mapping of virtual machines to users. The more users you have, the more virtual machines you need. Virtual machines are stored on a server. Desktops are presented on the PC or thin client depending on the situation.
- **Dynamic**: In a dynamic architecture there is only one master image. Instead of having to manage many dedicated images—one for each user—you are able to support one image that is automatically replicated as needed for users. The user accesses applications on the virtual machine via Microsoft Application Virtualization (formerly known as SoftGrid) based on user profiles, and all data are stored centrally on the server via folder re-direction. This makes it easier to manage virtual machines and dynamically provision desktop environments. It also helps reduce maintenance and support costs.

#### **Benefits**

A centralized and optimized virtual desktop enables users to access and run their desktop and applications wherever they may be, while IT is able to build a more agile and efficient IT infrastructure. Flexible Windows desktop scenarios give organizations the ability to choose the client computing scenarios that best meet the unique needs of their businesses. The Windows Vista® operating system, the Microsoft Desktop Optimization Pack, and Windows Server 2008 offer technologies that enable the decoupling of the traditional desktop stack, making desktop management more efficient and easing change and user migration.

Organizations must balance the needs of providing an environment where users can be most productive while maintaining data compliance, reducing costs, and ensuring business continuity. With flexible Windows desktop scenarios, organizations have the ability to provide the best solutions for the differing needs of their users while meeting their IT requirements. As a result, they can manage their physical and virtual environment from one toolset, which provides better management scalability.

When an organization is managing its virtual infrastructure with the same tools it uses to manage its physical assets, it can reduce system complexity and streamline changes made to the overall infrastructure. By using some or all of these technologies together, organizations can provide very flexible solutions to support many user scenarios, including mobile knowledge workers, corporate knowledge workers, contract and offshore developers, contract employees, and end users in branch locations.

# **Centralized, Policy-based Management**

#### Challenges

As noted above, each of the scenarios requires centralized, policy-based management to be effective. Managing hundreds or even thousands of desktops, applications, and servers is incredibly complicated and requires vast resources. In traditional, static environments, where every layer of the stack is linked to another layer, significant manual labor is necessary to provision, upgrade, change, or remove elements of the infrastructure. For example, in order to install, terminate, or even troubleshoot applications, IT often is required to take possession of each client device and conduct a tremendous amount of testing and quality assurance before confirming that everything works properly.

Virtualizing the entire computing infrastructure provides tremendous time and cost savings, as well as flexibility benefits. However, attempting to separately manage each layer of the stack and each instance within those layers (such as individual virtual machines) creates a much more complex situation than is necessary. Using different tools for virtualized resources can result in duplicate or competing processes for managing resources, adding complexity to the IT infrastructure. This can undermine the benefits of virtualization. A virtualized world that isn't well managed can be less reliable and perhaps even more expensive than its non-virtualized counterpart.



#### What Is Centralized, Policy-based Management?

Centralized, Policy-Based Management Architecture

Centralized, policy-based management—of both virtual and physical assets—lets your IT department handle enterprise-wide provisioning and changes from a central location. This greatly reduces the resources and time needed to administer the infrastructure, and provides a unified toolset that manages both Microsoft applications and thirdparty virtualization hypervisors such as VMware.

#### **Benefits**

With virtualization, you will realize an enormous reduction in the resources and time needed to administer your business's computing infrastructure. This will allow you to simplify your support requirements, making you much more agile and responsive to business needs. In addition, with a unified toolset that manages both Microsoft and third-party virtualization applications, you should be able to improve your IT management capabilities.

# **Microsoft Virtualization Solution for Hosting Environments**

#### Challenges

The success of hosting providers depends on providing reliable, flexible services at price points that are attractive to customers and profitable for their own business. However, with success comes challenges.

Traditionally, dedicated hosting requires providing every customer with its own physical server. Each new customer requires new hardware and additional administrative time for provisioning and managing of servers. With shared hosting, hosting providers work on minimizing downtime and interruptions when problems with one customer's application bring down a server used by many other customers.

#### What is a Microsoft Virtualization Solution for Hosting Environments?

Microsoft virtualization technologies enable hosting companies to deliver capacity with greater flexibility, while ensuring high service levels and maximum profitability. Windows Server 2008 Hyper-V provides the ability to consolidate multiple servers as separate virtual machines running on a single host machine. Hosting companies can also run multiple operating systems— including Windows and Linux— on a single server, and use Quick Migration to move virtualized server workloads from one host server to another. They can also use System Center Virtual Machine Manager to host their heterogeneous virtualization platforms (see "Interoperability" section). System Center provides hosters with the ability to manage their entire virtual and physical infrastructures from a single pane of glass (see "Enabling Microsoft Virtualization Technologies section).

#### **Benefits**

Virtualization enables hosting companies to provide dedicated hosting services—even on shared physical resources which are more reliable, adapt much more quickly to changing customer needs, and are easier to manage and more profitable for your business.

- Improve customer availability: Use Host Clustering and Quick Migration (described in "Enabling Microsoft Virtualization Technologies") to increase availability and improve reliability during both planned and unplanned server downtime. Hosters can isolate every customer's virtual machines from all the others on the physical host, providing each with their own dedicated operating system and ensuring that one customer's disruptions will not affect other customers. In addition, by converting OS and application instances into data files, hosting companies can increase automation and streamline backup, replication, and movement to accelerate disaster recovery.
- Extend service with flexible, utility-based offering: Hosting customers can benefit from their virtual pool of resources by self-provisioning additional capacity for spike usage periods, and then de-provisioning when that capacity is no longer required.
- **Reduce costs:** Hosters can cut hardware costs through higher server utilization and consolidation, and reduce the associated power and cooling costs. Using integrated virtualization management tools, hosting companies can reduce labor and operating costs, by streamlining everything from provisioning and monitoring, to data protection and backup.

# Virtualization for Small and Medium Business

#### Challenges

Small and medium businesses know how challenging it is to keep IT infrastructure costs low while providing high availability and responsive service for customers. They typically do not have the budget to hire specialized IT staff to handle procurement, provision resources for their data center and desktops, protect data, manage upgrades and patches, and field help-desk calls. In addition, there usually is not enough funding for the technologies that have traditionally been required for high availability of key business applications, such as active/active fail-over, sophisticated clustering, or fault-tolerant hardware.

#### What is Virtualization for Small and Medium Business?

Specifically designed for small and medium businesses, System Center Virtual Machine Manager Workgroup Edition enables increased physical server utilization, rapid provisioning, and centralized management of virtual machines on up to five physical host servers. Used together with System Center Essentials 2007, small and medium businesses can enable simple monitoring and alert resolution for servers, clients, applications, hardware, and network devices; software distribution; update management; and software and hardware inventory.

#### **Benefits**

Server and desktop virtualization can change all this—lowering IT infrastructure costs, providing more responsive service to customers, and enabling higher business continuity—all with existing IT staff levels.

- **Reduce costs:** By increasing server utilization, small and medium businesses can consolidate physical servers and cut capital costs. Centralizing provisioning and management, and automating many tasks, can also significantly lower IT support costs while improving the productivity of IT staff.
- **Ensure business continuity:** Virtualization enables small and medium to have the same kind of high availability that, in the past, only larger enterprises could afford. These companies can protect the data and IT resources that run their business with simple provisioning, improved data protection, higher levels of availability, and streamlined backup and disaster recovery—without investing in a large replication infrastructure. In addition, many small and medium businesses are turning to their solution providers to provide off-site disaster recovery.
- **Improve service and responsiveness:** Because the IT staff isn't being used for time-consuming installations, provisioning, and maintenance tasks, they can adapt more quickly to changing business conditions and be more responsive to customer needs.

Specifically designed for small and medium businesses, System Center Virtual Machine Manager Workgroup Edition enables increased physical server utilization, rapid provisioning, and centralized management of virtual machines on up to five physical host servers. Used together with System Center Essentials 2007, small and medium businesses can enable simple monitoring and alert resolution for servers, clients, applications, hardware, and network devices; software distribution; update management; and software and hardware inventory.



# Using Microsoft Virtualization Solutions for a Diverse Employee User Base

Today, Microsoft virtualization products and technologies are helping companies automatically match computing capabilities to business needs. This section addresses a few ways customers are leveraging Microsoft technologies for their diverse user base:

# Mobile Knowledge Workers

Mobility is a major requirement for most organizations. Knowledge workers need access to their data and applications anywhere, anytime. More laptops are being deployed than desktops in many organizations around the world. While users expect flexibility and the ability to take their data with them wherever they go, the IT department needs to make sure that data is protected and end user productivity is not significantly impacted in the case of a lost or stolen laptop. Additionally, both the user and IT share the concern about easily having a "replaceable PC" to get the user back up and running with the same applications and, most importantly, the user's data, while reducing downtime.

Microsoft's recommended "replaceable PC" solution for mobile workers includes Windows Vista Enterprise Edition with BitLocker Drive Encryption to protect data, Microsoft Application Virtualization (formerly SoftGrid) to deliver user the applications they need for online and offline use without installing them, and Folder Redirection with Offline Folders to centrally store and make data available to the user, online and offline.

If a user's laptop running Windows Vista Enterprise with BitLocker Drive Encryption is lost or stolen, the data is better protected from unauthorized access; Folder Redirection helps ensure the data is still available to the user since it is stored on a network server and can be backed up centrally. Once the user receives a new PC, upon logging onto the network the data is automatically synchronized down to the local hard drive so it is always accessible, even when on the road, via Offline Files. Microsoft Application Virtualization (formerly SoftGrid) automatically delivers all the user's assigned corporate applications along with their application settings without any local installation required. Roaming User Profiles also makes sure application settings, system settings and other customizations follow the user to the new

PC. As an extension of this scenario, the IT department can provide the mobile user access to more sensitive applications which run centrally on a Terminal Server via Windows Server 2008's Terminal Server Gateway. These technologies in Windows Vista, Microsoft Desktop Optimization pack and Windows Server 2008 make the replaceable PC both a reality today and the preferred way to deploy your PC.

# **Office Knowledge Workers**

When in the office, many knowledge workers-such as analysts, architects, designers, and lawyers-typically run multiple applications which require a rich user experience to ensure high productivity. These applications run on the local PC using a dedicated CPU/GPU for the best performance. In addition, these users may need to access Line of Business applications which are run centrally on a server, for example, for compliance reasons when the application uses highly sensitive data.

To provide high levels productivity to these workers, it is important that organizations enable them to have access to their highly personalized set of applications and data locally on their PCs. It is equally important to provide the same list of applications from different PCs across organization, for situations where the workers need to continue uninterrupted work from a different office in case of a corporate move, bad weather or any other event.

Microsoft's recommended "hot desking" solution for such office knowledge workers who require locally running applications for productivity includes Microsoft Application Virtualization to deliver the applications the users need, Folder Redirection to make centrally stored data available to user, and access to centrally executed applications via Terminal services. For the centrally executed applications, as the user disconnects from the Terminal Services session, she can simply log on to another PC elsewhere, and reconnect to the application as if she never left. With Terminal Services RemoteApp™ in Windows Server 2008, an application hosted within Terminal Services can appear as a seamless application on the local PC even though it is executing remotely on the server. As a result, users are able to access their data on whichever managed PC they log into and benefit from the rich Windows Vista experience for applications, while IT is able to maintain their compliance and protection of sensitive data and can easily move users from one PC to another across their organization.

# **Contract and Offshore Developers**

Organizations which hire outside or offshore developers gain the benefit of their expertise, but must also cope with unmanaged, non-corporate PCs on their network as well as the need to protect sensitive source code. One possible approach Microsoft recommends that organizations can use to mitigate such issues is to provide these developers older PCs, owned by the organization, running Windows Fundamentals for Legacy PCs (WinFLP), and giving the developer access to a Windows Vista virtual machine hosted centrally from a Windows Server 2008 Hyper-V host. Using this Windows Vista Enterprise Centralized Desktop enables the organization to provide the same standardized and managed Windows Vista experience to less-capable PCs while helping ensure all processing and date (including developers' source code) is kept in controlled, central locations. Developers benefit from the Windows Vista experience, administrative access, and a full range of applications delivered by both Microsoft Application Virtualization and Terminal Services, and organizations benefit from reduced security concerns, improved manageability, and further reducing costs and being more environmentally responsible by extending the life of older equipment.

### **Task Workers**

Call center employees, warehouse workers, and retail employees are examples of users who tend to use one or few applications, such as bank branch teller software, terminal applications or even CRM or line of business applications. They usually do not have a dedicated work station and must be able to access their applications and data from any desk within their workplace. From the organization's standpoint, the most important capabilities for task worker scenarios are ensuring a highly secure, low-cost solution and enabling free-seating in an always-connected environment so that users can work productively from shared client devices, while data is stored more securely and centrally. Microsoft's recommended solution includes using Terminal Services to provide the user with access to the application they need to perform their task as well as Windows Fundamentals for Legacy PCs, which gives organizations the opportunity to extend the life of older PCs and provide task workers with a cost-efficient client device. This solution makes it easy for the organization to enable user roaming across the organization. In addition, the confidential data never leaves the data center, improving compliance and limiting risk of data theft.

Task Workers who need access to a full Windows Vista desktop experience or applications which require local computing power (CPU or GPU intensive applications, for example) can also be provided access to a complete Windows Vista Enterprise Centralized Desktop (VECD) running virtually on Windows Server 2008 Hyper-V.

### **Remote Workers**

There may be occasions where a user needs to access their applications or data but cannot get to their office (for example, during a snowstorm or other disasters) or they don't have access to their work PC (if they are visiting family while on vacation). Microsoft's Remote Desktop Protocol makes it possible for a user to access their work environment from virtually any location, over the Internet while the IT department can protect corporate data and maintain control of the environment.

Microsoft's recommended solution includes Windows Server 2008's Terminal Services Gateway, which enables users to access a single application or an entire desktop as well as their data via Terminal Services from any PC running Windows Vista with Service Pack 1 or Windows XP with Service Pack 3 from the Internet through Internet Explorer. When a user requires a more flexible remote desktop, one which provides a complete Windows Vista experience (for example, developers or users of an application requiring Windows Vista) Windows Vista Enterprise Centralized Desktop (VECD) virtual machines hosted on Windows Server 2008 Hyper-V can also be accessed through the Terminal Services gateway.

Additionally, users not requiring a complete Windows Vista experience can access a complete Terminal Server-based desktop, complete with their data and configuration settings. By using Microsoft Application Virtualization for Terminal Services all their applications will be accessible to them as expected.



# **Enabling Microsoft Virtualization Products and Technologies**

At this point, you've seen the vision of the dynamic data center, common data center challenges, and scenarios for addressing those challenges. Next, you will see a more in-depth examination of the technologies that come together to provide these virtualization solutions.

The foundation for data center virtualization is Windows Server 2008, which includes the Hyper-V hypervisor virtualization technology. Hyper-V is installed by the familiar administrative task of configuring a server role. Windows Server 2008 was designed for interoperability, and Hyper-V was specifically engineered to be a great hypervisor for Windows and Linux guests.

Unified and consistent management is provided by the System Center family of products. System Center Virtual Machine Manager provides the administrative console needed to provision and maintain virtual machines. System Center Operations Manager monitors physical and virtual environments and provides guidance to optimize IT operations. System Center Configuration Manager allows quick provisioning of physical servers, along with automated patching for physical and virtual environments. System Center Data Protection Manager provides the foundation for backup, restore, and disaster recovery, plus it allows IT to back up virtual machines and their internal workloads.

# Windows Server 2008

Windows Server 2008 provides many advantages for an organization. Active Directory® directory services integration allows you to use the same directory-management features for virtual machines and physical machines, and permits you to delegate management of the virtual environment and machines using the same techniques and policies that you currently use to delegate management of physical machines.

With 64-bit technology and SMP support, virtual environments can scale to meet the needs of demanding workloads. By supporting up to four processors in a virtual-machine environment, your virtual machines can get the most performance from multithreaded applications.

#### Hyper-V Hypervisor

The Hyper-V hypervisor is a thin layer of code on top of the hardware that presents a very small attack surface. The Hyper-V hypervisor was developed under the industry-leading Microsoft Security Development Lifecycle, which ensures

product team security education, threat modeling, code reviews, static analysis, fuzz and penetration testing, and a robust security response.

There are two kinds of hypervisors: monolithic and microkernel. A monolithic hypervisor is a relatively thick layer between the guest operating system and the hardware. Monolithic hypervisors carry their own hardware drivers. The hypervisor controls guest access to processors, memory, and input/output, and isolates guests from one another.

Because a monolithic hypervisor is relatively large and carries multiple drivers, it presents a significant attack surface. If the hypervisor is compromised, through either the hypervisor code or the third-party drivers that it loads, the entire physical host and all guests can be compromised, too.

Rather than accepting this unnecessary risk, Microsoft developed Hyper-V using microkernel architecture. In this model, the hypervisor is a thin layer between the guests and the hardware. The hypervisor provides simple partitioning functionality that leverages virtualization extensions to the processor. The hypervisor contains no third-party code that could introduce vulnerabilities. The microkernel hypervisor also supports more hardware, due to the fact that most OEMs already produce operating system drivers and need not produce separate hypervisor drivers.

With a guest using its own drivers, the size of the trusted computing base (TCB) is reduced because guests are not routed through parent partition drivers.



#### Hypervisor Architectures

Microsoft believes that a microkernel hypervisor is the best approach because it ensures that all of the hypervisor code is produced by Microsoft under the Security Development Lifecycle, presenting the smallest attack surface possible. Additionally, because OEMs are not required to produce hypervisor drivers, more hardware is available, and the possibility of systems performing differently when virtualized is diminished. Modern processors contain virtualization extensions, which allow the hypervisor to be a much thinner software layer.

#### Host Clustering and Quick Migration

IT organizations always strive to minimize downtime:

• For unplanned downtime, such as a physical host failure, customers use fail-over clustering or System Center Data Protection Manager, to enable the affected workload to automatically get up and running on a new host.

 For planned downtime, such as routine maintenance, Quick Migration can enable the rapid transition of a workload from one physical host to another, minimizing downtime. Quick Migration with Hyper-V requires the fail-over clustering service available through Windows Server 2008 Enterprise Edition or Datacenter Edition.

System Center Virtual Machine Manager 2008 enables customers to designate mission-critical virtual machines as "highly available". With this designation, virtual machines are properly sited and clustered.

### **System Center**

Virtualization technology is only a portion of the virtualization solution. All data center operations require management tools for both the physical and the virtual layers. Data centers also require the provisioning of software, as manual provisioning is not adequate to meet the needs of agile, cost-conscious businesses. Further, data centers require operational monitoring, alerts, and problem mitigation. Finally, data centers require quick and granular backup and recovery, scaling to full disaster-recovery scenarios as necessary. Microsoft provides this critical functionality through the System Center suite of products.

#### System Center Virtual Machine Manager

Microsoft understands that data centers tend to be heterogeneous environments, often containing a mixture of operating systems, databases, and application workloads provided by a variety of vendors. Organizations have said that it's critical for physical servers to host disparate operating systems and that they don't want separate management tools for each workload.

System Center Virtual Machine Manager 2008 manages Microsoft Virtual Server, Hyper-V, and VMware ESX. This enables you to access your virtual environment through a single pane of glass.

Organizations have also said that they value the ease of use of graphical management tools, as well as the wizards that make administrative tasks intuitive, consistent, and increase the productivity of IT personnel. Organizations have also said they need powerful scripting capabilities in order to perform consistent operations on hundreds or thousands of machines; scripting allows the unique circumstances and needs of individual businesses and data centers to be addressed. System Center Virtual Machine Manager 2008 provides both capabilities. At the end of every wizard function in System Center Virtual Machine Manager 2008, IT professionals are presented with the option to save the wizard's actions as a PowerShell<sup>™</sup> script. In fact, System Center Virtual Machine Manager are also scriptable. This provides IT managers with the effortlessness that Windows administrators expect, along with the power to script complex operations customized for the needs of the data center.

It's important to place virtual machines on physical servers that can provide the needed resources. System Center Virtual Machine Manager enables intelligent placement by analyzing and recommending the optimal server for placement of a new virtual machine and for migrating an existing workload with the goal of providing more resources. For Hyper-V virtualization, System Center Virtual Machine Manager allows instantaneous migration with the click of a button. When managing VMware ESX, System Center Virtual Machine Manager allows you to perform live migrations using the same intelligent placement. Even Live Migration and other ESX operations can be scripted as PowerShell command line interface scripts.

For mission-critical workloads, you can simply click a "highly available" check box and System Center Virtual Machine Manager will place the virtual machine on a clustered server. System Center Virtual Machine Manager handles all configuration on top of Windows Server 2008 clustering.

#### System Center Operations Manager

System Center Operations Manager allows you to monitor physical and virtual environments with a single tool. System Center Operations Manager has long allowed data centers to monitor operating systems and workloads, and this functionality continues whether the workload is running on a physical or a virtual server. In addition, System Center Operations Manager allows you to monitor the physical hosts running virtual machines.

It's important to monitor not just the overall CPU, memory, and input/output of hosts, but also the performance of the workloads within hosts in order to determine when more resources are needed so that workload performance meets requirements.

System Center is designed with these scenarios in mind, and coordinates between the physical and virtual environments. System Center Operations Manager also integrates with System Center Virtual Machine Manager, providing tips that System Center Virtual Machine Manager can use when recommending virtual-machine migration to more suitable hosts, and can even perform the migration automatically.

#### System Center Data Protection Manager

System Center Data Protection Manager forms the foundation of backup, restore, and disaster recovery functionality. System Center Data Protection Manager provides great functionality in its continual data protection for the workloads themselves, ensuring that you never lose more than fifteen minutes of data from SQL Server<sup>®</sup> database, Exchange Server, SharePoint<sup>®</sup> Server, and other workloads. System Center Data Protection Manager offers granular restore of such things as individual mailboxes all the way up to a complete bare-metal restore of machines.

System Center Data Protection Manager is capable of protecting virtual machines without hibernation or downtime. Using shadow copy-based block-level protection of your virtual disks, System Center Data Protection Manager delivers fast backup that does not consume inordinate amounts of disk space. This gives data centers a single backup and recovery tool for both physical and virtual workloads. With replication technologies, System Center Data Protection Manager facilitates disaster recovery by restoring system images to a backup data center.

### Desktop

#### Windows Vista Enterprise Centralized Desktop

Windows Vista Enterprise Centralized Desktop (VECD), customers are licensed to use the configuration whereby desktops are hosted in virtualized machines on a server in the data center. More information on how to license Windows Vista using VECD, can be found in Appendix B. This licensing information applies to any VDI environment for Windows desktop operating systems, regardless of the virtualization platform chosen.

#### **Microsoft Desktop Optimization Pack**

The Microsoft Desktop Optimization Pack, is a suite of desktop management tools that includes Microsoft Application Virtualization (formerly Microsoft SoftGrid Application Virtualization), which streams applications to desktops, servers, and laptops, transforming applications into centrally managed virtual services that are not installed and don't conflict with other applications. Additionally, Microsoft recently acquired Kidaro, a provider of desktop virtualization solutions for the enterprise. By combining Kidaro's virtualization technology with the Microsoft Desktop Optimization Pack, Microsoft's suite of desktop management tools, IT professionals can optimize their

desktop infrastructure by providing management capabilities for virtual PCs, streamlining deployments, and easing application compatibility issues.

#### **Microsoft Terminal Services**

Microsoft Terminal Services virtualizes the presentation of entire desktops or specific applications. It lets a standard Windows desktop application run on a shared server machine while presenting its user interface on a remote system, such as a desktop computer or thin client. This enables companies to consolidate applications and data in the data center, while providing access to local and remote users.

# Interoperability

Studies show that, more than ever, companies are using multiple virtualization platforms in their data centers. At the same time, they are looking for ways to simplify their IT environments. To address these needs, Microsoft has made investments in interoperability and the management of multiple virtualization platforms.

Microsoft supports Windows and Linux operating systems to ensure that an organization can virtualize its existing workloads using Microsoft technology. Additionally, Microsoft is also leading the industry with management support for virtualization platforms, allowing organizations to manage them from a single pane of glass.

# **Citrix Partnership**

Microsoft has partnered with Citrix to provide support for Xen-enabled Linux workloads on Hyper-V with the Linux Integration Components. With these components, Linux operating systems achieve performance benefits by avoiding hardware emulation and utilizing Virtual Service Provider (VSP), Virtual Service Client (VSC), and VMBus included in Hyper-V. This allows Hyper-V to host Windows and Linux workloads and ensures that those workloads have great performance and scalability characteristics.

In addition, Citrix and Microsoft are also collaborating in two different ways. First, Citrix is enabling XenEnterprise to manage Hyper-V, and second, Citrix's development of XenDesktop allows customers to connect to virtual desktops hosted in the data center on Windows Server 2008 with Hyper-V.

# **Microsoft Cross-platform Extensions**

Cross-platform extensions allow System Center Operations Manager to manage and monitor Linux operating systems, as well as open-source Web servers and databases such as Apache and MySQL. Microsoft has worked to ensure that Linux administrators would be comfortable using the cross-platform extensions, in part by building the extensions on top of such industry-standard technologies as WS-Management and OpenPegasus. Microsoft will be contributing code to, and has joined the steering committee for, the OpenPegasus project.

# **Multi-vendor Virtualization-platform Support**

Organizations have said they want to manage all their virtual platforms using a single set of management tools, and Microsoft is providing this support through System Center Virtual Machine Manager 2008.

 In addition to support for Hyper-V, System Center Virtual Machine Manager 2008 integrates multihypervisor management into one tool with its support for virtual machines running on VMware ESX infrastructure and Microsoft Virtual Server.

- System Center Virtual Machine Manager 2008 provides comprehensive support for VMware VI3, including moving virtual machines among virtual hosts using VMotion, through integration with VMware's VirtualCenter.
- System Center Virtual Machine Manager 2008 features such as Intelligent Placement, consolidation candidate recommendations, and others can be run against virtualized infrastructure on any supported platform.
- Windows PowerShell scripts for customization or automation are also supported across Hyper-V, VMware ESX, or Virtual Server implementations.

This functionality allows organizations to develop one set of management skills to manage all virtual workloads through a single pane of glass. System Center products integrate with one another to provide the best provisioning, management, and monitoring functionality available for both physical and virtual environments.

# Novell

As part of the historic bridging of the divide between open source and proprietary software, Microsoft and Novell have collaborated on management of virtualized SUSE Linux operating system environments. This work will greatly enhance interoperability between Linux and Windows, and give customers greater flexibility in their IT environments. Below are the Linux Distributions supported by Hyper-V as guest operating systems (virtual machines configured with one virtual processor only):

- SUSE Linux Enterprise Server 10 with Service Pack 2 x86 Edition and x64 Edition
- SUSE Linux Enterprise Server 10 with Service Pack 1 x86 Edition and x64 Edition

# Why Microsoft for Virtualization

# It's Windows

The primary differentiator for Microsoft is its ability to provide a full suite of technologies to enable an integrated, endto-end virtualized infrastructure that uses familiar, Windows-based interfaces and common management consoles. In terms of server virtualization, some of the benefits of Hyper-V include:

- As a feature of Windows Server 2008, Hyper-V easily plugs into a customer's existing IT infrastructure.
- Hyper-V is optimized and its performance tuned for the Windows platform.
- Customers can leverage the skills their staff has with Windows technologies, processes, available hardware, and application architectures to provide a smooth transition from a physical to a virtual infrastructure.
- Hyper-V shares the benefits of the broad Windows Server technology ecosystem, such as Certified Hardware Devices, Certified Servers, and "Certified for" Software. In fact, any server capable of running Windows can run Hyper-V. By contrast, customers considering VMware often need to test compatibility with hardware vendors.

# Integrated, Comprehensive View

Microsoft also provides a broader spectrum of virtualization solutions from the data center to the desktop that can yield important improvements in efficiency, flexibility, continuity, and agility. This includes the following:

- Server virtualization (through Hyper-V)
- Application virtualization (through Microsoft Application Virtualization)
- Presentation virtualization (through Terminal Services)



Desktop virtualization (including server-hosted desktop virtualization with VDI and client-hosted desktop virtualization through Virtual PC).

### **Integrated Management**

Microsoft provides a more comprehensive management solution, with coverage for both physical and virtual environments, from the desktop to the data center. A common management environment reduces complexity and required training, ensures uniform policy application, and streamlines maintenance. Additionally, through the System Center portfolio of management products, Microsoft provides you with the ability to manage your environments at the host, virtual machine, operating system, and application layers across virtual and physical machines. System Center also enables management across various virtualization technologies, including Windows Server 2008 Hyper-V, Virtual Server 2005 R2, and VMware ESX Server.

### **Best Value**

Microsoft has a compelling value proposition based on its pricing, with Hyper-V included with the most common licenses for Windows Server 2008 Standard, Enterprise, and Datacenter editions.

In addition, in order to provide more value to organizations like yours, Microsoft offers free Virtualization Solution Accelerators that accelerate successful implementation of Microsoft virtualization solutions.

### Interoperability

At Microsoft, virtualization is a means to enabling the long-standing vision of Dynamic IT, where people and computers get the resources they need the moment they need them. That's why Microsoft is applying company-wide resources in everything from product development and licensing strategies to interoperability initiatives and strategic partnerships to make virtualization a reality for all organizations.

# Server Virtualization with Advanced Management

In addition to the enabling technologies that Microsoft provides, Microsoft has developed guidance and offerings to help you be successful with your virtualization initiatives. Server Virtualization with Advanced Management is an offering from Microsoft Consulting Services that enables you to maximize the value of your infrastructure investments through managed virtualization by providing a proven methodology, best practices, and the highest level of expertise in the industry.

You can see increased IT system cost efficiency through server consolidation; a reduction in hardware, space, and utilities costs; and centralized management of physical and virtual server assets. This offering drives greater IT

operating efficiency through managed virtualization, helping to reduce costs, maximize system availability, and increase operational agility.

# **Tools to Get Started**

Microsoft provides a variety of tools to help you analyze your existing environment, calculate the cost and return-oninvestment (ROI) of virtualization, and perform an implementation.

### Microsoft Assessment and Planning (MAP) Tool

In order for a successful IT project rollout to become a reality, understanding the network environment is key. The MAP tool works as a remote inventory engine. By simply installing MAP on a single desktop or server, connecting it to the IT network, and confirming the correct credentials, you will be able to leverage WMI and other protocols to find and assess computers on the network. MAP can generate technology-specific assessments and recommendation reports in both Microsoft Word and Microsoft Excel.

Some of the features of the MAP tool include:

- Integrated portal with automated tools and guidance from desktops to servers
- · Agentless inventory of clients, servers, applications, devices, and roles
- Technology migration, readiness assessment, and proposal generation
- Hardware and device compatibility for Windows Vista, Windows Server 2008, and the 2007 Office System
- Server virtualization candidates for consolidation with Hyper-V and Virtual Server 2005 R2
- Infrastructure assessment for the environment in order to leverage Microsoft Application Virtualization

You can access the MAP tool at http://www.microsoft.com/map.

# **Infrastructure Planning and Design Guides**

The Infrastructure Planning and Design (IPD) guides are the next version of the Microsoft Windows Server System Reference Architecture. These guides are designed to streamline design processes for Microsoft infrastructure technologies, with each guide addressing a unique infrastructure scenario. Three of the guides focus on identifying the right virtualization technologies.

You can access these guides at http://technet.microsoft.com/en-us/library/cc196387.aspx

# **Offline Virtual Machine Servicing Tool**

The Offline Virtual Machine Servicing Tool is designed to manage the workflow of updating large numbers of offline virtual machines according to their individual needs. You can access this tool at http://www.microsoft.com/downloads/ details.aspx?FamilyId=8408ECF5-7AFE-47EC-A697-EB433027DF73&displaylang=en

### **Microsoft Integrated Virtualization ROI Tool**

The Microsoft Integrated Virtualization ROI Tool is designed to help organizations like yours make the business case for virtualization solutions and easily compare the cost of Microsoft solutions relative to competing technologies.



The ROI Tool can assist you in rapidly determining your particular ROI with Microsoft virtualization solutions. The tool allows you to enter information about your business's current infrastructure, including hardware, operating systems, and workloads. The tool assists in determining the virtualized infrastructure and estimating the cost to implement it, taking into consideration hardware costs and software licensing in order to provide the most comprehensive analysis. The ROI Tool also compares competitive products to illustrate the cost savings to your business for the Microsoft solution.

The Virtualization ROI tool can be found at http://www.microsoft.com/virtualization/roitool.

# Conclusion

IT Infrastructure is a strategic asset and the critical foundation upon which software can deliver services and user applications that your business may need in order to create a People-Ready Business. Dynamic IT can help you shift your IT organization from being a cost center to being a strategic asset of the business. With Dynamic IT, common data center tasks can be automated, freeing your IT organization from repetitive manual operations. As less IT time is consumed maintaining existing infrastructure, more time is available to focus on strategic initiatives.

Virtualization is a critical component to help you move toward Dynamic IT. However, virtualization can cause complexity by requiring the administration of physical and virtual servers. The key to reducing complexity is unified tools that manage, monitor, and provision the physical and virtual environment. System Center provides unified management of the physical and virtual environment, the operating systems, and the applications.

Data centers are heterogeneous environments. Virtualization will introduce even more heterogeneity if you introduce different virtualization platforms into your data centers. System Center is designed for heterogeneity, managing Windows and Linux workloads, as well as Microsoft and VMware virtualization platforms.

Microsoft virtualization solutions can help you maximize uptime and reduce the impact of disruptive events. Using Quick Migration and Host Clustering, workloads can be kept available during routine maintenance. In the case of a physical host failure, Host Clustering ensures that the affected workload can be automatically re-started. System Center can monitor the physical and virtual environments, and alert personnel to issues before they result in a service outage.

Microsoft provides a broad spectrum of virtualization solutions, including server, desktop, presentation, and application virtualization, with integrated management that ensures that you can have a complete view of your physical and virtual operations through a single management interface. Additionally, the price advantage of Microsoft-based virtualization solutions can provide you with a faster payback on your investments.

To get started on a path to Dynamic IT enabled by virtualization, consider inviting a Microsoft partner to conduct an analysis using the MAP tool to determine the level of impact that server virtualization could have on your organization.

# **Appendix A: Licensing Virtualization**

# Definitions

#### Server

A server is a physical hardware system capable of running server software. A hardware partition or blade is considered to be a separate physical hardware system, and, therefore, a separate server.

#### Instance

An instance of software is the set of files that make up the software, stored in executable form and ready to run. You create an instance of software by executing the software's setup or install procedure, or by duplicating an existing instance. Instances of software can run on physical or virtual hardware systems.

#### Examples

- An installed copy of the Windows Server 2008 operating system on a hard disk is an instance of Windows Server 2008.
- An installed copy of Exchange Server 2007 within a virtual hard drive (VHD) (or other image format) file is an instance of Exchange Server 2007.
- A VHD file with Exchange Server 2007 installed on top of Windows Server 2008 contains an instance of Windows Server 2008 and an instance of Exchange Server 2007. Copying that VHD file creates another instance of Windows Server and another instance of Exchange Server. Deploying that VHD file to another server creates an instance of Windows Server and an instance of Exchange Server on that server.
- You run an instance of software by loading it into memory and executing one or more of its instructions. Once this has occurred, an instance is considered to be running (whether or not its instructions continue to execute) until it is removed from memory.

#### Assigning a License

To assign a license simply means that you designate that license for one device or user. This designation avoids sharing a license across more than one device or user at the same time. For example, after you have assigned a software license to a server, you are permitted to run the software on that server. You may use whatever manual or technical method that works for you to ensure that you have the correct number of licenses to cover your software use.

#### **Operating System Environment (OSE)**

An "operating system environment" is an instance of an operating system, including any applications configured to run on it. More specifically, an operating system environment is:

- All or part of an operating system instance, or all or part of a virtual (or otherwise emulated) operating system instance that enables separate machine identity (primary computer name or similar unique identifier) or separate administrative rights, and
- Instances of applications, if any, configured to run on the operating system instance or parts identified above.

Two types of operating system environments exist: physical and virtual. A physical operating system environment is configured to run directly on a physical hardware system. Please note that the operating system instance used to run hardware virtualization software (e.g., Microsoft Virtual Server or similar technologies) or to provide hardware

virtualization services (e.g., Microsoft Hyper-V or similar technologies) is considered part of the physical operating system environment. A virtual operating system environment is configured to run on a virtual (or otherwise emulated) hardware system. A physical hardware system can have either or both of the following:

- one physical operating system environment
- one or more virtual operating system environment(s)

Technologies that create virtual OSEs require the appropriate licensing for the operating system and any applications running in the OSE.

#### **Physical and Virtual Processors**

A physical processor is a processor in a physical hardware system. Physical OSEs use physical processors. A virtual processor is a processor in a virtual (or otherwise emulated) hardware system. Virtual OSEs use virtual processors. For licensing purposes, a virtual processor contains the same number of cores and threads as its underlying physical hardware system.

### **Overview**

The following summary provides an overview of the licensing models and how virtualization affects them. Your review of this white paper should not be a substitute for careful review and understanding of your rights and obligations as described in your Microsoft Volume Licensing agreement.

Products	Licensing
All products in the Microsoft server licensing model of the Volume Licensing Product Use Rights	Use terms for each software license specify the number of instances of software that you may run on a particular server at a time, rather than the number of copies of the software that you may install and use on your server.
<ul> <li>(PUR), for example:</li> <li>Windows Server 2008</li> <li>Exchange Server 2007</li> <li>System Center Configuration Manager 2007</li> </ul>	Each software license allows you to create and store any number of instances of the software on any of your servers or storage media to make it easier for you to run those instances on any of your licensed servers.
	Before you use the software under a license for a server product, you must assign that license to a server.
	Each hardware partition or blade is a separate physical hardware system, and, therefore, a separate server.
	You may reassign software licenses for server products, but not on a short-term basis (i.e., not within 90 days of the last assignment). They may be reassigned sooner if you retire the licensed server due to permanent hardware failure.
	You may not separate software to run it in more than one OSE under a single license, unless expressly permitted—even if the OSEs are on the same server.

<ul> <li>Products in the Microsoft Server operating system and Microsoft</li> <li>Server client access license (CAL)</li> <li>licensing models of the PUR, for example: <ul> <li>Windows Server 2008</li> <li>Exchange Server 2007</li> <li>SQL Server 2005</li> </ul> </li> </ul>	<ul> <li>Each external connector license (EC) allows any number of external users to access any number of instances of the server software on a particular server, even if those instances are run under multiple licenses for the software.</li> <li>Each Client Access License (CAL) allows any number of OSEs on a particular device (e.g., client device) to access licensed instances of the corresponding server software. You do not need a separate device CAL for each OSE on a device.</li> <li>CALs and ECs permit access to your instances of earlier versions, but not later versions, of the server software, unless stated otherwise in the PUR. If you are accessing instances of an earlier version, you may use CALs and ECs that correspond to the version of the software you are running.</li> </ul>
Products in the Management	Each server management license allows one server OSE on a specific device to
Servers licensing model of the PUR, for example:	be managed by the server software. You need a separate server management license to manage each server OSE.
<ul> <li>System Center Operations Manager 2007</li> <li>System Center Configuration Manager 2007</li> <li>System Center Data Protection Manager 2007</li> </ul>	Each client management license allows one non-server (e.g., client) OSE on a specific device to be managed by the server software. You need a separate client management license to manage each non-server OSE. In addition, you may opt to license "per user." In this case, for one user, each client management license allows any number of client OSEs on that user's device(s) to be managed by the server software. Each System Center Server Management Suite Enterprise license allows any number of OSEs on a specific device to be managed by the server software. Each device-based Core CAL or Enterprise CAL suite license allows any number of client OSEs on a specific device to be managed by the server software.
Products in the Per Processor	Software run in a virtual OSE is licensed based on the number of virtual
licensing model of the PUR, for	processors used by that virtual OSE, rather than all the physical processors in the
example:	server. For licensing purposes, a virtual processor contains the same number of
BizTalk <sup>®</sup> Server 2006 R2	cores and threads as its underlying physical hardware system.
SQL Server 2005	If you run the software in virtual OSEs, you need a license for each virtual
<ul> <li>Microsoft Internet Security</li> </ul>	processor used by those virtual OSEs on a particular server, whether the total
and Acceleration (ISA) Server	number of virtual processors is less than or more than the number of physical
2006	processors in that server.
	If you run the software in a physical OSE, you need a license for each physical processor used by the physical OSE. You may run any number of instances in licensed physical or virtual OSEs.

Microsoft also provides expanded use rights for certain editions of Windows Server 2008, SQL Server 2005, and BizTalk Server 2006 R2. These expanded use rights are summarized in the following table. They apply only to the specific editions described.

Products Impacted	Use Rights
Windows Server 2008 Standard and	Each software license allows you to run, at any one time, one instance
Windows Server 2008 Standard without	of the server software in an OSE on one server. If the instance you
Hyper-V	run is in a virtual OSE, you may also run an instance in the physical
	OSE solely to run hardware virtualization software, provide hardware
	virtualization services, or run software to manage and service OSEs on
	the licensed server. We refer to this in shorthand as 1+1.
Windows Server 2008 Enterprise and	Each software license allows you to run, at any one time, four instances
Windows Server 2008 Enterprise without	of the server software in four OSEs on one server. If all four instances
Hyper-V	you run are in virtual OSEs, you may also run an instance in the
	physical OSE solely to run hardware virtualization software, provide
	hardware virtualization services, or run software to manage and service
	OSEs on the licensed server. We refer to this in shorthand as 1+4.
Windows Server 2008 Datacenter, Windows	After the number of licenses equal to the number of physical
Server 2008 Datacenter without Hyper-V,	processors on a server are acquired and assigned, you may run on that
and Windows Server 2008 Itanium Based	particular server: One instance of the server software in the physical
Systems	OSE, and any number of instances of the server software in virtual
SOL Server 2005 (licensed Server/CAL)	Uses. Each software license allows you to run any number of instances of the
Workgroup Edition and Standard Edition	server software in one physical or virtual OSE on a particular server at
Workgroup Earlien and Standard Earlien	a time.
SQL Server 2005 (licensed Server/CAL)	Each software license allows you to run any number of instances of the
Enterprise Edition	server software in one physical OSE and any number of virtual OSEs on
	a particular server at a time.
BizTalk Server 2006 R2 Enterprise Edition and	As an alternative to the model described above, after the number of
SQL Server 2005 Enterprise Edition (licensed	licenses equal to the number of physical processors on a server are
Per Processor)	acquired and assigned, you may run any number of instances of the
	server software in the physical OSE, and any number of instances of
	the server software in virtual OSEs.

# Details and Examples for the Server Licensing Models and Clarifications for Specific Products

The following sections provide details and examples for server licensing models and clarify enhancements for specific products.

#### License by Running Instance

All products in the Microsoft Servers licensing models are licensed by running instance. Each license gives you the right to run a certain number of instances of the software on a specific server at a time.

The use rights specify that you must first "assign" an acquired software license to a specific server. After the license has been assigned:

- That server is the "licensed server" for that software license.
- You may run instances of the software on the licensed server as specified in the license.
- You may create and store any number of instances of the software on any of your servers or storage media.

For example, each license for Exchange Server grants you the right to run one instance of Exchange Server at a time. That instance may be run in a physical or virtual OSE, but only on the licensed server. However, you may create or store any number of instances of Exchange Server on any of your servers or storage media. If you assign an Exchange Server license to server A, you may run one instance of Exchange Server in one physical OSE or in one virtual OSE

For example, imagine that a centralized library on the storage area network (SAN) contains six virtual hard drive (VHD) files, each with an instance of Windows Server 2008 and an instance of Exchange Server. Two VHD files are then deployed from the library onto the server at a time, depending on the domain that needs the support of additional instances. This centralized library scenario illustrates the deployment flexibility enabled by the licensing model. Instead of eight licenses, you need assign only two licenses for Windows Server 2008 Standard to server A because only two instances of Windows Server 2008 Standard are running at a time.

Similarly, instead of eight licenses, you need assign only two licenses for Exchange Server because only two instances of Exchange Server are running at a time. By assigning those licenses to server A, you are also able to create any number of instances of Windows Server 2008 Standard and Exchange Server on any of your servers or storage media, including a server's hard disk or the SANs.

It is worthwhile to underscore the fact that you can assign more than one license to a server to have the right to run more instances. For example, two Windows Server 2008 Standard licenses could be assigned to the server. Each license permits you to run an instance in a virtual OSE and an instance in a physical OSE. If you assign two licenses to the server, you may run two instances in virtual OSEs at the same time. While you also have the rights to run an instance in the physical OSE for each license, for technical reasons only one instance can run at a time in the physical OSE.

#### **Moving Instances of Software**

The ability to move instances of the software is ideal for data centers, where workloads move from one server to another. Regardless of whether a data center uses server blades, rack-mounted servers, or virtualization technology, it is easy to move an instance of software between licensed servers.

For example, assume there are two servers (server A and server B) and that server A and server B have each been assigned one license for Windows Server 2008 Standard and one license for Exchange Server 2007. If you need to run one instance of Exchange Server, you can redirect logical drives from the SAN towards server A. If server A becomes overloaded, you can choose to move the running instance of Exchange Server to server B, since server B also has an Exchange Server license assigned to it. However, you may run only one instance of Windows Server 2008 Standard and one instance of Exchange Server on server A at a time. Similarly, you may run only one instance of Windows Server 2008 Standard and one instance of Exchange Server on server B at a time.

#### Virtual Processors Have the Same Number of Cores and Threads as Physical Processors—Each Fraction of a Virtual Processor Counts as a Full Virtual Processor

This section is relevant if you are using Per Processor products on multicore processor systems. To boost reliability and performance, virtualization technology can allocate resources from separate physical processors in the server to create a virtual processor for use by a particular OSE. Virtual processors are considered to have the same number of threads and cores as each physical processor in the underlying physical hardware system. Microsoft adopted this definition to enable you to take advantage of the licensing policy we announced in 2004 for multicore processors. If the physical processors in the server have two cores, each virtual processor also has two cores from a licensing perspective, even if the cores are allocated from separate physical processors.

For example, assume a virtual processor used by a virtual OSE is allocated a core from a physical processor (physical processor 1) and a core from a second physical process (physical processor 2). Although that virtual processor is using cores from different physical processors, it is considered to be a single virtual processor because it has the same number of cores as the physical processors in the server. Consequently, you only need one license each for workloads on the server, such as SQL Server (licensed Per Processor) and BizTalk Server.

However, if a virtual OS environment uses only a fraction of a virtual processor, the fraction counts as a full virtual processor. The licensing requirements do not change if you choose to allocate only a single core to each virtual OSE; a full license is required for SQL Server and a full license is required for BizTalk Server.

#### **Reassigning a Software License**

Moving an instance of software from one server to another is not the same as reassigning a software license from one server to another. Moving an instance of software means to move the software bits from one server to another. Reassigning a software license means to assign that license to another server so that it becomes the server licensed to run that software.

For example, assume the instances of Windows Server 2008 and Exchange Server move from server A to server C and the licenses to run those instances are reassigned from server A to server C. If the licenses are not reassigned, server C cannot run the instances. By reassigning the licenses, however, server C is now the new server licensed to run the instances and Server A is no longer the licensed server.

As a Microsoft Volume Licensing customer, you may reassign software licenses for products in the Microsoft Servers licensing models, but not on a short-term basis. "Short-term basis" means more frequently than within 90 days of the last assignment (or reassignment). You may, however, reassign software licenses sooner if you retire the server sooner due to permanent hardware failure. For example, if server A is retired due to permanent hardware failure, you may then reassign the licenses for Windows Server and Exchange Server to server C.

#### Software May Not Be Separated for Use in More than One OSE under a Single License

You may not separate software to run in more than one OSE under a single license, unless expressly permitted by the use rights for a particular product. This condition applies even if the OSEs are on the same server.

For example, Windows Small Business Server 2003 Standard Edition (SBS Standard) includes Windows Server 2003 technology and Exchange Server 2003 technology. With a single license assigned to a server, you may run instances of that software in one physical or virtual OSE on that server.

Windows Server 2003 technology and Exchange Server 2003 technology must run together in the same OSE. To separate and run the technologies included in SBS Standard into two OSEs, you would need to assign two SBS Standard licenses to the server. This rule applies to licenses for all products.

#### External Connector Licenses (ECs) Licensed Per Server, Not Per Instance or OSE

For products in the Server OS and Server/CAL licensing models, each EC assigned to a server allows any number of external users to access any number of licensed instances of the server software on that server. You do not need a separate EC for each instance of the software, or for each OSE on that server. For example, even if server A is running multiple instances of Windows Server 2008, you need only one EC for any number of external users to access Windows Server 2008 on server A. It does not matter whether those instances of Windows Server 2008 are run under one or many licenses.

ECs permit access to your instances of earlier versions, but not later versions, of the server software, unless stated otherwise in the PUR. If you are accessing instances of an earlier version, you may use ECs that correspond to the version of the software you are running.

#### Device Client Access Licenses (CALs) Licensed Per Device, Not Per OSE on that Device

You only need one device CAL for each device that accesses the server software, regardless of the number of OSEs on the device. For example, even if device A has multiple OSEs, and each of those OSEs is separately accessing Windows Server 2008 on server B, you need only one CAL for device A.

CALs permit access to your instances of earlier versions, but not later versions, of the server software, unless stated otherwise in the PUR. If you are accessing instances of an earlier version, you may use CALs that correspond to the version of the software you are running.

#### Management Licenses Licensed Per Managed OSE or Per User

Each management license allows one OSE on a specific device to be managed by the server software. You need a separate management license for each OSE you need to manage. For example, assume server A is running more than one OSE. System Center Operations Manager 2007 which is running on server B is managing each of the OSEs in server A. In this case, you need one management license for each OSE on server A, for a total of four management licenses.

Note that another option would be to assign a single System Center Server Management Suite Enterprise license to Server A. This allows any number of OSEs on Server A to be managed by the server software.

For client OSEs, you may also opt to license "per user," in which case each client management license allows any number of client OSEs on a user's device to be managed by the server software.

Finally, the Core CAL and the Enterprise CAL Suites permit any number of OSEs on a client device to be managed by System Center Configuration Manager. The Enterprise CAL Suite also permits any number of OSEs on a client device to be managed by System Center Operations Manager.

#### Per Processor Products Licensed by Virtual Processor When Used in Virtual OSEs

In virtual environments, all products in the Per Processor licensing model are licensed by virtual processor. If you run the software in virtual OSEs, you need a license for each virtual processor used by those OSEs on a specific server,

rather than all the physical processors in the server. If you run the software in physical OSEs, you need a license for each physical processor used by the physical OSE.

The Per Processor licensing model is slightly different than for other Microsoft server products. Instead of stating how you may use the software on a server for each license, it states how you may use the software on a server after the server has been appropriately licensed. To license a server appropriately, you must follow three steps for each Per Processor product running on the server:

- Count the number of physical processors the physical OSE in which the software will run is using.
- Count the number of virtual processors each virtual OSE in which the software will run is using. (A virtual processor is considered to have the same number of threads and cores as each physical processor on the underlying physical hardware system. Fractions of virtual processors count as full virtual processors.)
- Add the numbers together and assign that number of licenses to the server on which the software will run.

After the server has been appropriately licensed, you may run any number of instances of the software in any number of physical and virtual OSEs on the licensed server.

Similar to hardware partitioning, the licensing model treats virtualization technology as a means of assigning and allocating processors to a specific workload. For example, to determine the required number of licenses for SQL Server Standard (licensed Per Processor) for server A (assume each processor is a single core processor):

- Step 1—There are no instances of SQL Server Standard running in the physical OSE. The count for this step is zero.
- Step 2—There are instances of SQL Server Standard running in two separate virtual OSEs. Each of those virtual OSEs is using one virtual processor. The count for this step is two.
- Step 3—To license server A appropriately for SQL Server Standard, you must assign it two SQL Server Standard licenses.

Similarly, to count the number of licenses for BizTalk Server for server A:

- Step 1—There are no instances of BizTalk Server running in the physical OSE. The count for this step is zero.
- Step 2—There are instances of BizTalk Server running in two separate virtual OSEs. Each of those virtual OSEs is using one virtual processor. The count for this step is two.
- Step 3—To license server A appropriately for BizTalk Server, you must assign it two BizTalk Server licenses.

The number of licenses required is not affected by the number of instances of the software running in a particular OSE. It is based on the number of physical or virtual processors used by each OSE running the software.

Under this model, you may find that you assign more virtual processors to virtual OSEs than the total number of physical processors in the server. For example, assume SQL Server Enterprise Edition is running in five virtual OSEs, each of which is using one virtual processor. Assigning five SQL Server Enterprise Edition licenses to server A is one way to license it appropriately. However, SQL Server 2005 also provides an alternative for SQL Server Enterprise Edition. With SQL Server Enterprise Edition, you may license all the physical processors on a server and then you may run any number of instances in OSEs on that server without licensing the virtual processors. This would be the most cost-effective way to license the scenario below. BizTalk Server 2006 R2 Enterprise Edition has the same licensing option.

Finally, instead of acquiring six Windows Server 2008 Standard licenses, you could acquire four Windows Server 2008 Datacenter processor licenses, one for each physical processor. You would then have the right to run any number of Windows Server instances on the licensed server. You could also acquire two Windows Server 2008 Enterprise licenses, which provide the right to run up to eight (four for each license) Windows Server 2008 instances in virtual OSEs at the same time.

Instances of Per Processor products on servers that are not using virtualization technology run in the physical OSE of the server, and a license is required for each physical processor in the server. For example, you would need four processor licenses for SQL Server if there were four physical processors in the server. The number of licenses required is not affected by the number of instances of the software running in a particular OSE. It is based entirely on the number of physical or virtual processors used by the OSE running the software.

As discussed above, both BizTalk Server 2006 R2 Enterprise Edition and SQL Server 2005 Enterprise Edition have expanded use rights. If you license all of the physical processors on a server, you may run any number of instances of the server software in the physical OSE and any number of instances of the server software in virtual OSEs. In this case, you do not need to license virtual processors. For example, by assigning four licenses of SQL Server Enterprise Edition to a server with four physical processors, you may run any number of instances of SQL Server Enterprise Edition in the physical and virtual OSEs.

# Run Multiple Instances of Windows Server 2008 on a Server under a Single License

A single license for Windows Server 2008 Enterprise allows you to run multiple instances of the software on a server. Each software license allows you to run, at any one time, four instances of the server software in four OSEs on one server. If all four instances are running in virtual OSEs, you may also run an instance in the physical OSE solely to run hardware virtualization software, provide hardware virtualization services, or run software to manage and service OSEs on the licensed server. In addition, you may run instances of Windows Server 2008 Standard or even prior versions of Windows Server Standard or Windows Server Enterprise in place of the instances of Windows Server 1008 Enterprise in any of the OSEs. For example, assume server A is running five separate instances of Windows Server in five separate OSEs. Server A's physical OSE is running an instance of Windows Server 2008 Enterprise. Two of server A's virtual OSEs are running instances of Windows Server 2008 Standard, one is running an instance of Windows Server 2003 R2, and another one is running one instance of Windows Server 2008 Enterprise. By assigning a Windows Server 2008 Enterprise license to server A, you may run all five instances on server A under that single license.

Almost everything discussed above applies to Windows Server 2008 Standard. However, unlike Windows Server 2008 Enterprise, each license for Windows Server 2008 Standard allows you to run only one instance in the physical OSE and one instance in the virtual OSE. Also, if the server is licensed for Windows Server 2008 Standard, you cannot run Windows Server 2008 Enterprise in place of Windows Server 2008 Standard on the server. You may run prior versions of Windows Server Standard only.

If you decide to run all five permitted instances under a license for Windows Server 2008 Enterprise, the instance running in the physical OSE is restricted to running hardware virtualization software, providing hardware virtualization services, or running software to manage and service OSEs on the licensed server. In other words, in this situation, you can run any software in the physical OSE as long as it is used solely to manage or directly support the management of the virtual OSEs on the licensed server. When running all five instances at the same time, you may not run software in the physical OSE for any other purpose.

Finally, if you have a server running an instance of Windows Server 2008 in a physical OSE, all users or devices that access the physical or virtual OSEs on that server must have Windows Server 2008 CALs. This is true regardless of the software version/type running in the virtual OSEs because any workloads running in the virtual OSEs use the virtualization services of the Windows Server 2008 software running in the physical OSE.

# Run Any Number of Instances of Windows Server 2008 Datacenter on a Server Licensed by Physical Processors

Windows Server 2008 Datacenter enables you to run any number of instances of the software on a server, as described below. Each server must be licensed according to how many physical processors are in the server. (Virtual processors are not used for the licensing of Windows Server 2008 Datacenter) After you have determined the number of licenses required, you must assign those licenses to the server, at which point you may run the following at any one time:

- One instance of the server software in the physical OSE, and
- Any number of instances of the server software in virtual OSEs

In addition, you may run instances of Windows Server 2008 Standard, Windows Server 2008 Enterprise, or even prior versions of Windows Server instead of Windows Server 2008 Datacenter in any of the OSEs. For example, assume server A is running five separate instances of Windows Server in five separate OSEs. Server A's physical OSE is running an instance of Windows Server 2008 Datacenter. One of server A's virtual OSEs is running an instance of Windows Server 2008 Standard, one is running an instance of Windows Server 2008 Enterprise, one is running an instance of Windows Server 2008 Standard and one is running an instance of Windows Server 2008 Datacenter.

In general, it is much easier to consolidate on Windows Server 2008 Datacenter than it is on Windows Server 2008 Standard or Windows Server 2008 Enterprise.

# Appendix B: Windows Vista Enterprise Centralized Desktop Licensing for Virtual Desktop Infrastructure

Windows Vista Enterprise Centralized Desktop: Quick Reference Guide

# **Microsoft Virtualization Solutions**

Today, Microsoft virtualization products and technologies are already helping companies automatically match computing capabilities to business needs.

Imagine your employees accessing their personalized desktop, with all of their settings and preferences intact, on any machine, from any location. Or the workloads running on servers in your data center automatically being redeployed to respond to a sudden surge in demand for a specific capability. Or your entire infrastructure restoring itself instantly following a catastrophic power outrage.

Today, all of these scenarios and more are possible with Microsoft Virtualization Solutions: an end-to-end strategy that can profoundly impact nearly every aspect of the IT infrastructure management life cycle. It can drive greater efficiencies, flexibility and cost-effectiveness throughout your organization.

# **VDI from Microsoft**

Virtual Desktop Infrastructure from Microsoft enables your IT staff to:

- Deploy desktops in virtual machines on secure and centralized server hardware.
- Enable users to access and run their desktop and applications wherever they may be.
- And build a more agile, and efficient, IT infrastructure.

In static mode, there is a one-to-one mapping of virtual machines to users. The more users you have, the more virtual machines you need. Virtual machines are stored on a SAN or NAS and execute on the server. Desktops are presented on the PC or thin client, depending on the situation.

In a dynamic architecture there is only one master image. Instead of having to manage many dedicated images, you support one image that is automatically replicated as needed for users. The user application access is provisioned onto the virtual machine via Microsoft Application Virtualization (formerly known as SoftGrid) based on user profiles, and all the data are stored centrally on the server via folder re-direction. This makes it easier to manage the virtual machines and dynamically provision your desktop environments, and helps reduce maintenance and support costs.

# **Microsoft Technologies**

VDI from Microsoft is a carefully-matched combination of Virtualization Technology and Licensing. Together, they make possible a host of benefits to your company, including the centralization of data, enhanced security, and increased business continuity.

On the technology side, the core components of Microsoft's offering for VDI are:

- Windows Vista Enterprise Centralized Desktop the foundation on which all user applications run on Virtual Machines.
- Windows Server 2008 with Hyper-V
  - » Windows Server 2008 the most advanced Windows Server operating system ever offered by Microsoft.
  - » Hyper-V the next generation hypervisor based server virtualization technology from Microsoft.
- System Center Management Suite Virtual Machine Manager (or VMM) simplifies the deployment, provisioning, and management of virtual servers.
- **Microsoft Application Virtualization (formerly SoftGrid)** delivers applications that are never installed, and are dynamically delivered on demand.
- Microsoft Terminal Services virtualizes the presentation of entire desktops or specific applications.

Together with solutions from partners, such as Citrix XenDesktop running on top of Windows Server 2008 with Hyper-V, Microsoft technologies can create a dynamic IT environment that uses desktop virtualization to centralize employee desktops, provide business continuity to employees, streamline system changes, and offer employees greater operational flexibility.

# **VECD** Licensing

Windows Vista Enterprise Centralized Desktop (VECD) is a unique licensing option of Windows Vista for VDI. It is a device-based and instance-based license that counts the number of accessing devices and allows organizations to install an unlimited number of copies of Windows operating systems as virtual machines on server and storage devices.

VECD can be licensed for both thin clients and PCs. For thin clients, Windows VECD is a subscription license which includes Microsoft Software Assurance benefits. For PCs (or rich clients), Windows VECD for SA is a subscription license for PCs covered under Software Assurance.

Devices licensed for either version of VECD are eligible for Windows Vista Enterprise and are eligible to run prior versions of operating systems (e.g., Windows XP Professional) in virtual machine instance. Users can access up to 4 concurrently-running virtual machine instances under each VECD subscription license.

An unlimited number of virtual machine environments can be created and stored on any number of internal network servers. Access up to 4 running instances per subscription license.

# **Licensing Scenarios**

The following Licensing Scenarios are provided to give you a better idea of how best to make VECD licensing offer work for your company in a VDI from Microsoft infrastructure.

#### Scenario 1: Standard Users

My company has 100 PCs and 100 users that access Windows Vista running on virtual machines using VDI. However, only 50 virtual machines are running at any one time.

License: VECD is device-based, you will need 100 licenses. If your PCs are already covered under Software Assurance (SA), then 100 Windows VECD for SA licenses would be needed for your PCs. If they are not covered, then they need to be covered under Software Assurance and Windows VECD for SA.

#### Scenario 2: Shift Workers

My company has 100 PCs, with 300 workers accessing these PCs in shifts. At any time, 150 XP virtual machines are being accessed using VDI.

License: Again, VECD is a device-based license so the required number of licenses is 100. Also, these licenses should be Windows VECD for SA when the PCs are covered under Software Assurance.

#### Scenario 3: Mixed Desktop Hardware

I have 100 PCs and 100 thin-clients (running a minimal OS such as Windows FLP or Windows XP embedded for purposes of accessing a VDI). Only 100 devices are used at a time and I have 100 virtual machines of Windows Vista.

License: If the 100 rich clients are covered under Software Assurance, then the required licenses would be 100 Windows VECD for SA licenses and 100 Windows VECD licenses. If the rich clients are not covered under SA, then they need to be first covered with Software Assurance and then purchase Windows VECD for SA.

#### Scenario 4: Standard User Home Use

My company has 100 employees who are the primary users of 100 PCs covered under Windows VECD. These employees occasionally work from home and access the corporate virtual machines via VDI.

License: Windows VECD licenses include home use rights for the primary ("named") user of a company-owned PC

Note: For Microsoft Office use, you must have a Microsoft Office license with SA coverage and register for Home Use Rights at no additional cost.

#### Scenario 5: 100% Home User

My company has 100 workers who work from home and will access Windows Vista virtual machines via VDI from their company device at home

License: The company device will have to be licensed with Windows VECD for SA (requires Software Assurance) for rich clients or Windows VECD for thin clients.

#### Scenario 6: Roaming Users

I have 300 devices throughout my company and only 100 users who roam from station to station.

License: As a device-based license, all 300 devices must be licensed with either Windows VECD for SA or Windows VECD.

#### Scenario 7: Non-corporate-owned PCs

I have 100 contractors that are working for 6 months, and then 100 different contract workers that are employed the other 6 months of the year.

License: 100 Windows VECD licenses are required for the contractors to access VDI environment for the benefits of the company and assuming each contractor worker only has 1 unique device to access the environment.

Please contact your Microsoft Sales Specialist for more details or to discuss your company's specific scenarios and needs.

### **VECD Licensing**

Operating System on Client Access Device	Required VECD Licensing SKU
Client OS covered under Windows Software Assurance (SA) such as Windows Vista Enterprise	Windows VECD for SA (per access device)
Windows XP embedded, Windows CE, Linux, Others (OS is considered thin client for licensing purposes)	Windows VECD (per access device)

#### Additional License Information:

Microsoft Office volume licensing or Software Assurance is required for Microsoft Office use in the VDI scenario.

Standard Windows Server and Client Access Licenses (CAL) also apply.

Check with your Microsoft Sales Specialist for more details.

#### Additional Resources

For more information about Microsoft VECD, please visit: http://www.windowsvista.com/virtualization

For more information about Microsoft Virtualization, please visit: http://www.microsoft.com/virtualization

For more information about System Center, please visit: http://www.microsoft .com/systemcenter

For more information about Windows Server 2008, please visit: http://www.microsoft.com/windowsserver2008

For more information about Windows Terminal Services, please visit: http://www.microsoft.com/terminalservices

# Appendix C: New Microsoft Licensing and Support Eases Path to Virtualization

[Press Release]

# Customers "Get Virtual Now" with increased flexibility and broader support when virtualizing Microsoft server applications

REDMOND, Wash. - Aug. 19, 2008 - New licensing, expanded product support policies and a worldwide series of events from Microsoft Corp. help business customers create more dynamic data centers and enterprise IT systems with virtualization software. Beginning Sept. 1, 2008, customers will be able to move any of 41 Microsoft server applications between servers within a server farm as often as necessary without paying additional licensing fees, and they can take advantage of expanded specialized technical support.

"Businesses are taking steps to make their IT operations more dynamic and are delving into virtualization as a cornerstone strategy," said Zane Adam, senior director of integrated virtualization in the Server and Tools Business at Microsoft. "Microsoft recognizes this and is innovating its licensing policies, product support and a wide range of IT solutions to help customers get virtual now."

To highlight the recent innovations in virtualization, Microsoft also will begin a worldwide series of "Get Virtual Now" events this month that will showcase Microsoft virtualization products and partner solutions, reaching more than 250,000 IT professionals.

#### **New Licensing Flexibility**

Microsoft is updating its software licensing terms for 41 server applications (http://www.microsoft.com/licensing/ resources/volbrief.mspx), including Microsoft SQL Server 2008 Enterprise edition, Microsoft Exchange Server 2007 Service Pack 1 Standard and Enterprise editions, Microsoft Dynamics CRM 4.0 Enterprise and Professional editions, Microsoft Office SharePoint Server 2007, and Microsoft System Center products. With the new terms, the company is waiving its previous 90-day reassignment rule, allowing customers to reassign licenses from one server to another within a server farm as frequently as needed. For many customers, the change will reduce the number of licenses they need to support their IT systems, increase agility, and simplify the tracking of application instances or processors because customers now can count licenses by server farm instead of by server.

"IDC research is finding that the use of server virtualization is moving past the early adopter stage and is quickly becoming a mainstream solution," said Al Gillen, research vice president for system software at IDC. "As IT professionals update their standard server images for new installations, they are increasingly integrating virtualization to simplify deployments, to increase the system flexibility, boost usage rates and increase portability of the applications. With this latest update to its licensing rules, Microsoft is knocking down barriers to virtualized deployments, which should help further accelerate the adoption rates."

#### **Expanded Technical Support**

Microsoft has updated its technical support policy for 31 server applications (http://support.microsoft.com/kb/957006) so that customers can receive technical support when deploying those applications on Windows Server 2008 Hyper-V, Microsoft Hyper-V Server or any other third-party validated virtualization platform. Now customers can get the same level of product support in a virtualized environment that they are accustomed to with nonvirtual environments. More information is available at http://support.microsoft.com<http://support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.microsoft.com</html?/support.

To enable this support policy, Microsoft launched the Server Virtualization Validation Program in June 2008 (http://windowsservercatalog.com/svvp). The program is open to any software vendor to test and validate its virtualization software to run Windows Server 2008 and previous versions of Windows Server. To date, Cisco Systems Inc., Citrix Systems Inc., Novell Inc., Sun Microsystems Inc. and Virtual Iron Software Inc. are participating in the program.

"Technical support of virtualized images is an industrywide challenge," said Roger Levy, senior vice president and general manager of open platform solutions at Novell. "Novell and Microsoft continue to collaborate to optimize bidirectional virtualization between Windows Server and SUSE Linux Enterprise with Xen. Microsoft's Server Virtualization Validation Program provides customers with additional peace of mind when they run Windows as a guest in a validated environment such as SUSE Linux Enterprise."

#### Microsoft Worldwide Events Help Customers Get Virtual Now

This month, Microsoft begins a worldwide series of events designed to educate more than 250,000 IT professionals on Microsoft virtualization products, deployment tools and partner solutions. The series of more than 100 events started Aug. 3 in South Africa, continues Sept. 8 with a U.S. kickoff event and eventually will cover more than 50 other countries. The U.S. "Get Virtual Now" event will feature Microsoft executives Bob Muglia, senior vice president of the Server and Tools Business; Kevin Turner, chief operating officer; and Bob Kelly, corporate vice president of infrastructure server marketing within the Server and Tools Business. More than 40 sponsoring partners will be in attendance, including Platinum sponsors Advanced Micro Devices Inc., Citrix Systems, Compellent Technologies Inc., Dell Inc., Hitachi Data Systems Corp., HP, IBM Corp., Intel Corporation, Juniper Networks Inc., NetApp, Novell and Sun Microsystems. More information about the events and registration is available at https://www.getvirtualnow.com.

Founded in 1975, Microsoft (Nasdaq "MSFT") is the worldwide leader in software, services and solutions that help people and businesses realize their full potential.

Note to editors: If you are interested in viewing additional information on Microsoft, please visit the Microsoft Web page at http://www.microsoft.com/presspass on Microsoft's corporate information pages. Web links, telephone numbers and titles were correct at time of publication, but may since have changed. For additional assistance, journalists and analysts may contact Microsoft's Rapid Response Team or other appropriate contacts listed at http://www.microsoft.com/presspass/contactpr.mspx.

The information contained in this document represents the current view of Microsoft Corporation on the issues discussed as of the date of publication. Because Microsoft must respond to changing market conditions, it should not be interpreted to be a commitment on the part of Microsoft, and Microsoft cannot guarantee the accuracy of any information presented after the date of publication.

This white paper is for informational purposes only. MICROSOFT MAKES NO WARRANTIES, EXPRESS OR IMPLIED, IN THIS DOCUMENT.

Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced, stored in, or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), or for any purpose, without the express written permission of Microsoft Corporation.

Microsoft may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from Microsoft, the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property.

© 2008 Microsoft Corporation. All rights reserved.

Microsoft, list Microsoft trademarks used in your white paper alphabetically are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

