Virtualization from the Datacenter to the Desktop

Building a comprehensive, end-to-end virtualization strategy

people ready

2007 CORE INFRASTRUCTURE OPTIMIZATION

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ViP virtualization performance

Introduction

Enterprises worldwide are embracing a digital work style to stay competitive in a dynamic and increasingly global business environment. This work style requires that teams collaborate seamlessly across organizations and time zones, while success relies on speed, mobility, and connectivity.

These trends place ever-increasing pressure on IT departments to provide rich, connected capabilities across the infrastructure, while protecting both the environment and its confidential data from intrusion and disruption.   The explosion of social networks and communication devices, and the exponential growth of information stored, accessed, and shared create an environment where compliance is daunting, security is threatened, and complexity becomes overwhelming.

Virtualization has gained much attention across organizations looking to address these challenges, improving the efficiency of their IT operations and enhancing their responsiveness to changing conditions. Originally focused on consolidating resources in the data center, virtualization now has applications across the IT spectrum, driving down costs and improving agility. This paper looks at the role virtualization should take in an optimized IT infrastructure, and presents a set of principles and best practices to help you build a comprehensive virtualization strategy for your organization.
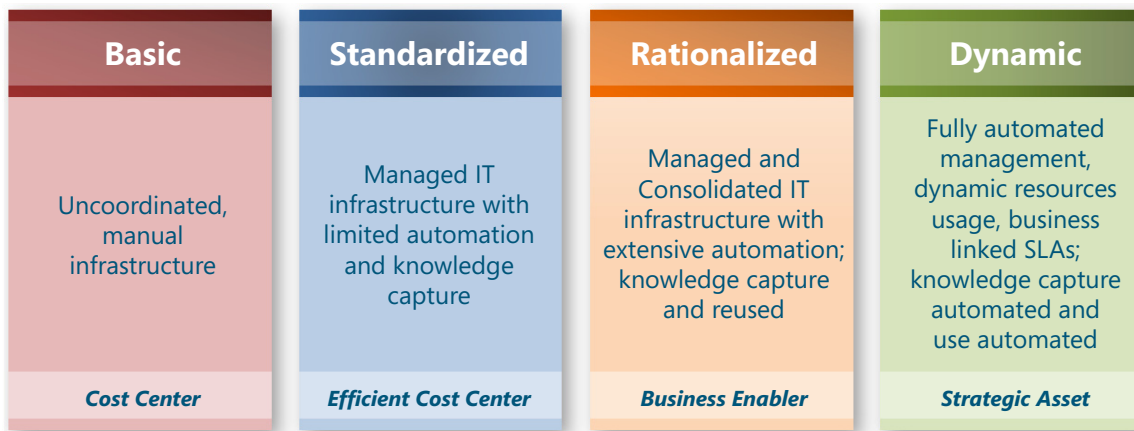
A well designed and managed virtualization strategy delivers value to the organization in three ways:

Control Costs	Improve Availability	Drive Agility
Optimize server utilization, reducing hardware, utilities, and space expense; reduce application compatibility testing; reduce overall system complexity	Provide more robust disaster recovery capabilities, streamline server maintenance, and isolate risk. On the desktop, enable access to any application anywhere	Facilitate dynamic resource allocation and streamline workload provisioning to efficiently support business growth and meet SLAs

Microsoft believes that virtualization is a key component of **Dynamic IT**, an environment that helps people in an organization anticipate and respond to business challenges and opportunities. Dynamic IT is a strategic asset to a company because it increases the ability of a business to meet changing demands with a quick and effective response. And Dynamic IT technologies—those that enable dynamic capability in systems—are an essential part of supporting the performance of businesses and the people in them.

The Infrastructure Optimization Model, identifying the four stages an organization passes through as its IT infrastructure matures, aids the journey towards Dynamic IT architecture. Each progression is made through a series of IT projects and processes; the value of the model is in identifying which projects are appropriate for a particular organization.

Here is an overview of the Infrastructure Optimization Model:

Basic	Standardized	Rationalized	Dynamic
Uncoordinated, manual infrastructure	Managed IT infrastructure with limited automation and knowledge capture	Managed and Consolidated IT infrastructure with extensive automation; knowledge capture and reused	Fully automated management, dynamic resources usage, business linked SLAs; knowledge capture automated and use automated
Cost Center	*Efficient Cost Center*	*Business Enabler*	*Strategic Asset*

Early progressions are accompanied by significant cost savings and improved service levels. As the IT infrastructure is optimized for cost, the focus then shifts to enabling business competitiveness, with IT becoming a key strategic asset for the organization.   An organization can be in different stages of maturity for different IT capabilities—for instance, it might be at a Basic level in Identity and Access Management, but at a Standardized level in Desktop, Server and Device Management. By completing a profiling assessment, an organization can identify where it stands on critical capabilities, and determine suitable projects to progress to a more mature state.

Virtualization is one of the key technologies that help an organization progress towards a dynamic state, providing more flexibility in IT systems and streamlining change.   This paper explores the various facets of virtualization, its role in a *Dynamic IT* infrastructure, and discusses the four key principles to successfully harness this powerful technology:

1	**Developing a cohesive, holistic virtualization strategy across the IT infrastructure**
2	**Integrating the management of virtual and physical computers with policy-based tools to reduce system complexity**
3	**Leveraging advanced security, continuity and recovery techniques to maximize business availability**
4	**Driving the necessary culture changes for effectively managing resources in a virtual environment**

Before exploring these principles in depth, let's look at the underlying concepts of virtualization.
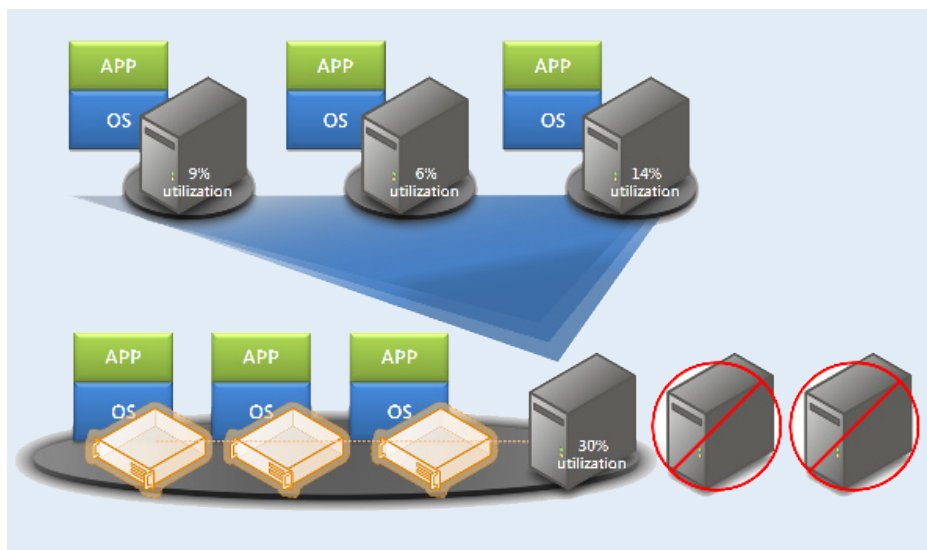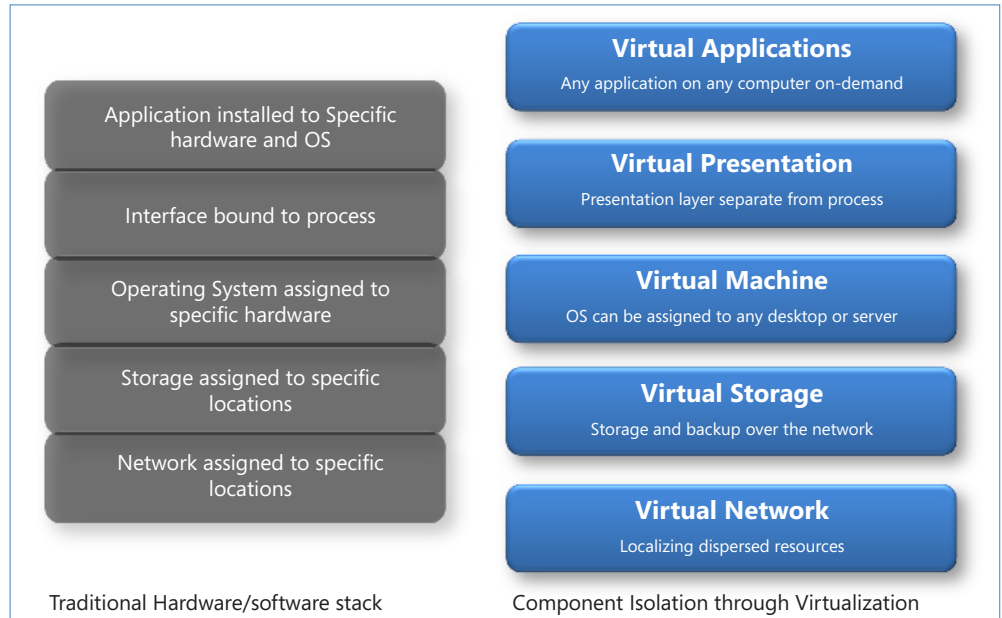
What is virtualization?

Virtualization in an IT environment is essentially the isolation of one computing resource from others. By separating the different layers in the logic stack, you enable **greater flexibility** and **simplified change management**—you no longer need to configure each element for them to all work together.

A good way to understand virtualization is to look at machine virtualization. Machine virtualization is where an operating system and application are packaged together to form a virtual machine, which is then hosted on a physical server running a host operating system or Hypervisor (a thin layer of software that provides the basic interface with the hardware). The most important concept to understand is that this virtual machine (OS+Applications) is operating independent of the OS on the physical server. This enables multiple virtual machines to run on a single physical server, while providing the isolation and security as if they were each on their own discrete hardware.

The rationale for machine virtualization is clear when you realize that most workloads only consume a fraction of the total capability of the hardware. By matching complementary workloads in terms of processing and

memory consumption, an IT organization can reduce the number of physical servers needed to support the operations of the business. The typical server utilization rate is about 15%—with 85% of server capacity going unused. Just increasing this utilization rate to 60% means a four-fold reduction in space requirements, hardware, and the electrical costs of powering and cooling the server farms. This is commonly called server consolidation.

Traditional Hardware/software stack	Component Isolation through Virtualization
Application installed to Specific hardware and OS	**Virtual Applications** — Any application on any computer on-demand
Interface bound to process	**Virtual Presentation** — Presentation layer separate from process
Operating System assigned to specific hardware	**Virtual Machine** — OS can be assigned to any desktop or server
Storage assigned to specific locations	**Virtual Storage** — Storage and backup over the network
Network assigned to specific locations	**Virtual Network** — Localizing dispersed resources

In addition to machine virtualization, the concept of virtualization can be applied to enterprise storage, networks, applications and desktops. Each of these scenarios provides benefits to the IT organization, but it is important that the IT manager understands which one to use for his or her unique circumstance, and develops them within the context of a comprehensive virtualization strategy. Think of virtualization as a ***complete toolset*** instead of just a way to reduce physical servers; a holistic view will help maximize the benefits derived from this technology.

Following is a summary of the different uses of virtualization:

Server Virtualization

Desktop Virtualization
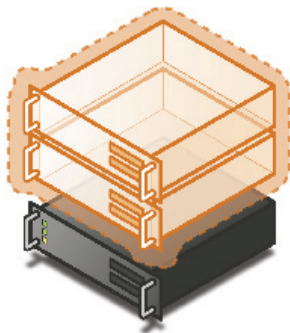
Server Virtualization creates a separate OS environment that is logically isolated from the host server. This allows greater density of resource use (hardware, utilities, space) while providing operational isolation and security.

Management Toolset

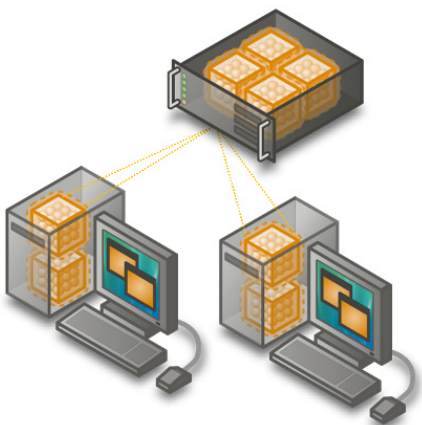Create, configure, monitor, and maintain virtual (and physical) assets
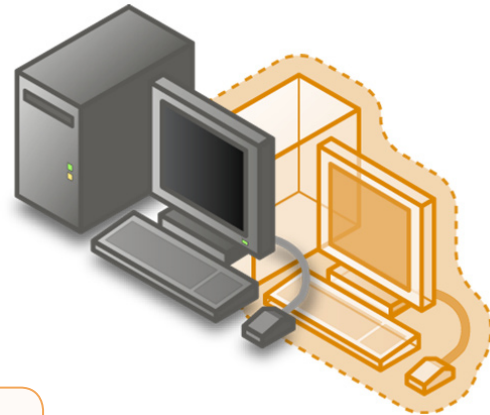
Desktop Virtualization creates a separate OS environment on the desktop, allowing a non-compatible legacy or LOB application to operate within a more current desktop operating system.
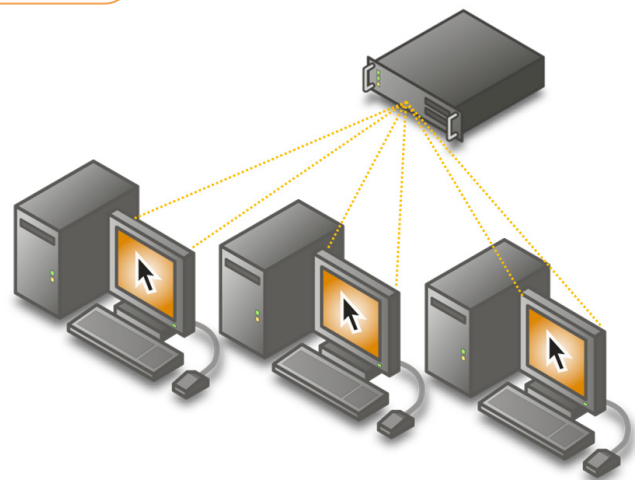
Application Virtualization

Presentation Virtualization

Application virtualization separates the application configuration layer from the OS in a desktop environment, reducing application conflicts, bringing patch and upgrade management to a central location and accelerating the deployment of new applications and updates.

Presentation virtualization isolates processing from the graphics and I/O, making it possible to run an application in one location but have it be controlled in another. This is helpful in a variety of situations, including ones where data confidentiality and protection are critical.

What are the benefits of virtualization?

An infrastructure built with well-managed virtualization will result in lower costs, higher service levels, and greater agility. Specifically, these benefits derive from:

- **Server consolidation**—By consolidating multiple workloads onto a single hardware platform, you can maintain "one application/one server" while reducing physical server sprawl. This allows you to fully provision the business with less hardware, resulting in lower equipment costs, less electrical consumption for server power and cooling, and requiring less physical space for the server farm.

- **Maximized uptime**—By compartmentalizing workloads, you prevent one application from impacting the performance of another, or causing a system crash. Even less stable legacy applications can be operated in a secure, isolated environment.

- **Robust disaster recovery**—A virtualization strategy allows you to maintain an instant fail-over plan that provides business continuity throughout disruptive events. With the right tools, you can enable automated back-up, replication, and rapid movement of servers, desktops, and applications.

- **Reduced application compatibility testing**—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 and prevents most compatibility problems.

- **Support legacy and LOB applications**—Terminal Services and/or desktop virtualization can enable applications written on older operating platforms to be supported in a current operating system without software code revisions.

- **Efficient server maintenance**—The flexibility of shifting workloads between physical servers with minimal disturbance to their operation allows planned server maintenance to be performed without service disruption.

- **Streamlined provisioning**—Adding workload resources can be accelerated and decoupled from a hardware acquisition process. If a particular business process requires additional capability to meet business needs (say, a web commerce engine), adding this capability is streamlined and immediate. In an advanced virtualized environment, workload requirements can become self-provisioning, resulting in dynamic resource allocation.

- **Reduced complexity**—When managing your virtual infrastructure with the same tools for physical assets, you can reduce system complexity and streamline changes made to the overall infrastructure.

"We see Virtual Server 2005 enabling significant cost savings for our customers"
Dennis Luciani, Senior Product Manager, Hosting Solutions, TELUS

Case Study: TELUS — Reducing system cost through server consolidation

Customer Size *2500 employees*

Organization Profile *TELUS is one of Canada's largest telecommunications companies, with more than CDN$7 billion of annual revenue, 4.8 million network access lines, and 3.6 million wireless subscribers.*

Business Situation *The company wanted to decrease the cost of web hosting for its customers and to increase the flexibility and control that customers have over their hosted solutions.*

Solution *TELUS is using Microsoft Virtual Server 2005 to consolidate customers' hardware servers and increase administrator productivity.*

Benefits

- *Deploys servers 10 times faster*
- *Restarts servers 20% faster*
- *Cuts customer costs by 30%*
- *Cuts troubleshooting time by 50%*
- *Secures access to virtual servers*

Hardware
HP DL380 servers
Software and Services
Microsoft Virtual Server 2005
Microsoft Windows Server 2003 Enterprise Edition

How should virtualization be used?

Adopting virtualization across the enterprise should naturally follow a maturation curve. While each scenario provides concrete and compelling benefits, it is best if an organization adopts these approaches in a reasonably defined order. Different circumstances will dictate some modification to this sequence, but the following roadmap can provide guidance on how to best employ virtualization in your organization.

Test and development environment

The natural place to begin piloting all types of virtualization is in the test and development environment. IT managers can model the OS, application, security, and management environment prior to putting these into production in a more streamlined and efficient way, providing greater flexibility and quickly identifying potential conflicts. Virtualization provides the mechanism to rapidly model different environments and experiment with different scenarios, without significant expansion of hardware and physical resources. Typically, virtualization in this scenario is more of a skunkworks project, with the IT staff experimenting with the technology and learning how to manage virtual machines and applications.

Server infrastructure

Consolidating workloads from a large array of discrete, underutilized physical servers to an environment where complimentary workloads are isolated and aggregated

"Virtual Server enables us to significantly scale up the number of environments we can test without purchasing additional hardware, because we can load numerous virtual machines on one server."

Joseph Paradi, Senior Architect, Accenture Technology Infrastructure Services

onto a smaller number of physical servers is the most common application of this technology, and is where immediate cost savings can be realized. Server consolidation is an ongoing process—it is more of a journey than an end state. Early on, IT organizations can and should focus on non-business critical production workloads, to harvest the low-hanging fruit while learning how to efficiently manage virtual and physical servers across their infrastructure. As their processes become more mature and the expertise improves, a more proactive strategy that includes business-critical applications makes sense for consolidation. Here, the benefits in disaster recovery and business continuity become more critical than simply cost savings. Finally, as the IT organization becomes adept at managing critical and tactical workloads across a rationalized server infrastructure, it can use virtualization to dynamically assign resources to improve flexibility and scale—increasing the strategic value to the organization. With the right tools and policy-based business processes, the IT organization provides an extremely responsive

Case Study: Accenture — Accelerating deployment from test to production environment

Organization Profile *Accenture is a global management consulting, technology services, and outsourcing company with 133,000 employees in 48 countries and annual revenues of U.S.$15.55 billion for the 2005 fiscal year.*

Business Situation *An Accenture project team needed a new test environment with four application servers and five client environments including Red Hat Linux and numerous versions of the Windows operating system.*

Solution *By building virtual machines with Microsoft Virtual Server, the team met its deadline one week ahead of schedule. Virtual machines now play a key role in the lab, as does Microsoft Operations Manager.*

Benefits

- *Reduced total cost of ownership*
- *Accelerated environment setup*
- *Streamlined system administration*
- *Improved IT responsiveness*
- *Enabled more robust testing*

Software and Services

Microsoft Operations Manager (MOM) 2005
Microsoft Virtual Server 2005
Microsoft Windows Server 2003
Microsoft Windows Storage Server 2003

IT infrastructure that supports business demands while efficiently controlling costs.

Desktop infrastructure—Applications

Managing numerous desktop images drives up IT cost and consumes significant IT resources, as does maintaining up-to-date applications and security patches. By separating the application layer from the operating system on the desktop image, an IT organization can remove much of the complexity and management challenges it faces every day. Significant application-to-application regression testing is typically required before deploying a major application or OS update. In an environment where applications are virtualized and delivered on demand to the desktop, application-to-application conflicts are nearly eliminated, since the applications execute without impacting the desktop operating system—or other applications. In addition, application maintenance and security patching is streamlined, since it only needs to take place at the source, not hundreds or thousands of individual desktops. This not only reduces labor needed for desktop maintenance, but ensures that any security vulnerabilities are adopted immediately and comprehensively. For application to OS compatibility issues, you can use a combination of desktop virtualization and presentation virtualization to run an application in its legacy operating system, hosted on the current desktop.

Desktop infrastructure—Presentation

In certain circumstances, it is critical that all data reside in a central location rather than becoming distributed across a constellation of desktop PCs. This might be due to confidentiality concerns, regulatory requirements, or end-user mobility needs. A virtualized presentation configuration places all data storage and processing in a central location, with the desktop being simply a presentation of the user interface.

Storage and network resources

Virtualizing enterprise storage and networks provides another avenue to consolidate resources for greater flexibility and scale. Managing storage and network resources in a virtual environment streamlines resource allocation, provisioning, and maintenance while reducing the apparent system complexity IT managers work with day to day.

"SoftGrid resulted in huge benefits right off the bat, including ease and speed of deploying applications, true roaming experiences, and the ability to easily swap out desktops. It's been a fantastic solution for us"

Mike Criss, Manager of Infrastructure Engineering, Swedish Medical Center

Overall infrastructure—Business continuity

Converting operating system and application instances into data files streamlines backup, replication and movement, providing a more robust business continuity capability and speeding recovery in the case of an outage or natural disaster.

Case Study: Swedish Medical Center — Application Virtualization

Customer Size 7245 employees

Organization Profile Swedish Medical Center, formed in 1910, is one of the largest, most comprehensive nonprofit health providers in the Pacific Northwest. Based in Seattle, Washington, it has three hospital campuses and multiple specialty and primary care clinics, as well home care services.

Business Situation Enable doctors and nurses to have their applications and data roam with them from device to device; efficiently migrate over 400 applications to XP and deploy a new clinical application; and eliminate regression testing.

Solution Implement and deliver applications virtually via the Microsoft Desktop Optimization Pack for Software Assurance using the SoftGrid Application Virtualization technology.

Benefits
- *Cut deployment time from 2-3 months to 3 days*
- *Reduced time to replace PCs from 8 hours to just a few minutes*
- *Saved $1M plus in deployment and support-related activities*
- *Enabled truly universal roaming*
- *Improved license tracking*
- *Reduced 20 desktop images to 3*
- *Improved Citrix management*

Software and Services

Microsoft SoftGrid

What are some of the challenges with virtualization?

Building an infrastructure with extensive use of virtualization will provide many business benefits, but without the right management tools, policies and processes can create a number of problems in their own right. When planning your virtual infrastructure, keep the following challenges and mitigation strategies in mind:

Challenge	Mitigation
While server consolidation can provide many business benefits, it can also add complexity to the IT infrastructure if the environment is not managed properly. The savings in hardware consolidation might be offset by increases in IT management overhead.	*It is important that organizations employing virtualization use a common tool set for virtual and physical servers. This will help reduce complexity while providing the flexibility to migrate workloads across physical and virtual server resources.*
Using different tools for virtualized resources can result in duplicate or competing processes for managing resources, adding complexity to the IT infrastructure.	*Make sure your management tools offer the rich functionality necessary for handling both physical and virtual resources and can scale up to the greater demands from the mixed environment.*
Ensure that your security processes and tools are appropriate for the infrastructure you have created. Are the VMs placed in the right place (DMZ, behind firewall, etc.) and have you properly isolated critical or vulnerable workloads?	*Assess the unique security needs of your critical workloads, and take care to isolate vulnerable workloads from those that might be unstable. In addition, placing workloads that need to be accessed by customers and partners in a DMZ will help contain any security risk.*
The ease of creating virtual machines can cause a sprawl that far exceeds physical server sprawl, and can outpace the tools used to manage them. When creating a new server is as simple as a few mouse clicks, it is easy to see how the environment can sprawl out of control.	*Create clear policy boundaries around virtual machine creation, and build these policies into a robust management toolset.*

"Virtualization without good management is more dangerous than not using virtualization in the first place"

Thomas Bittman, Gartner Research

How do I get the most out of my virtualization strategy?

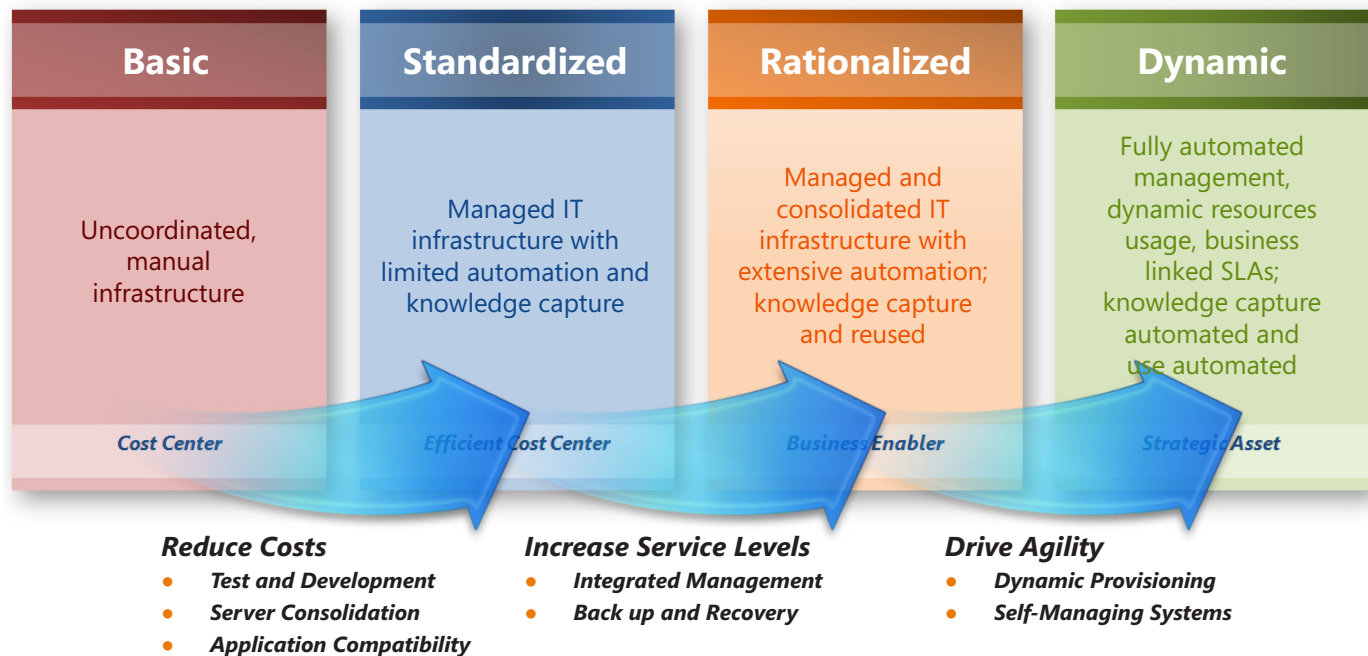| Best Practice	Implementation
1. Develop a cohesive, **holistic virtualization strategy** across the IT infrastructure	• Design your virtualization strategy with an end-to-end structure to minimize system complexity and capture maximum benefit • Create a continuous consolidation framework for ongoing optimization • Employ single-purpose servers to simplify management and provide optimal isolation, conflict reduction, and resource usage
2. **Integrate the management** of virtual and physical computers with policy-based tools to reduce system complexity	• Reduce system complexity by managing virtual server infrastructure in a common console • Leverage existing knowledge on server administration—ensure that the tools for managing virtual resources do not create knowledge gaps • Automate change management with advanced policy-based tools
3. Leverage advanced security, continuity, and recovery opportunities to **maximize business availability**	• Maintain snapshot-based back-up to provide more robust restore capability, and to provide tools for forensic analysis • Spread mission-critical workloads over multiple servers to distribute risk, avoiding interruption in the event of a hardware failure • Isolate high-risk workloads from high-vulnerability workloads and underlying OS
4. Drive the necessary **cultural changes** to effectively manage resources in a virtual environment	• Institute discipline around resource planning and virtual machine creation to prevent uncontrolled sprawl • Strive for commonality among management processes and tools • Recognize that all resources become data files in a virtual environment; capture the organizational best practices and skills for data management • Develop a framework and understanding for resource sharing across different sponsor organizations

Where do we start?

Returning to Microsoft's Infrastructure Optimization Model, the appropriate area of focus will depend on the level of IT maturity in your organization, and how familiar the IT organization is with virtualization techniques and tools.

Basic	Standardized	Rationalized	Dynamic
Uncoordinated, manual infrastructure	Managed IT infrastructure with limited automation and knowledge capture	Managed and consolidated IT infrastructure with extensive automation; knowledge capture and reused	Fully automated management, dynamic resources usage, business linked SLAs; knowledge capture automated and use automated
Cost Center	*Efficient Cost Center*	*Business Enabler*	*Strategic Asset*

Reduce Costs
- *Test and Development*
- *Server Consolidation*
- *Application Compatibility*

Increase Service Levels
- *Integrated Management*
- *Back up and Recovery*

Drive Agility
- *Dynamic Provisioning*
- *Self-Managing Systems*

For most situations, we suggest the following six-step assessment for developing a comprehensive virtualization strategy for your organization:

*Progressing from **Basic** to **Standardized** Infrastructure*
Primary benefit: Improve operating efficiency and reducing cost

1. **Begin with test and development environments**—Prior to deploying an application, IT professionals can create a virtualized instance of the image to ensure interoperability before placing it into production. This also builds familiarity with the tools and management issues of virtual machines. Windows Virtual Server provides the foundation to build a virtualized environment in the development lab.

2. **Review server consolidation options**—Analyze your server infrastructure and application workloads to identify underutilized physical resources. Profile application security needs and peak/valley utilization characteristics to identify complementary workloads, and then plan out an appropriate consolidation strategy. The use of advanced planning tools, such as Microsoft Virtual Machine Manager, part of the System Center suite of IT management tools, provides a comprehensive toolset to manage virtual machines and physical servers and reduce overall system complexity.

3. **Reduce application compatibility issues with application virtualization**—If application compatibility regression testing is consuming too many resources, consider adopting a strategy of application virtualization, providing applications to desktop users on demand, and managed from a central location. Microsoft SoftGrid virtualizes applications per user, per application incidence, without changing underlying source code. The result is a transformed environment, eliminating nearly all potential application conflicts.

*Progressing from **Standardized** to **Rationalized** Infrastructure*
*Primary benefit**:** Improve service levels and business continuity*

4. **Integrate management tools**—A virtualized infrastructure without appropriate management tools can be more costly and less responsive than no virtualization at all. Deploy a complete toolset that manages both physical and virtual resources in a common environment, to keep complexity at a minimum and streamline operations. A common management environment reduces required training, ensures uniform policy application and streamlines maintenance. Microsoft System Center provides a complete toolset for managing both virtual and physical system components.

5. **Implement back up and disaster recovery projects**—A virtualized infrastructure can streamline the development of a robust business continuity capability, with automated back up and replication providing a fail-safe environment for mission critical applications and LOB operations. In the event of a catastrophic event, a fail-over plan can protect against service interruption with more rapid movement of workloads to available servers. Microsoft System Center Data Protection Manager captures data changes in real time, and regularly synchronizes to protect both data and user productivity.

*Progressing from **Rationalized** to **Dynamic** Infrastructure*
*Primary benefit**:** Drive organizational agility*

6. **Enable dynamic provisioning and self-managing systems**—a mature infrastructure built on comprehensive use of virtualization technologies can enable a high degree of automation and facilitate rapid scale-up to meet the needs of a dynamic business environment. Provisioning resources becomes near real-time. Using the advanced tool set from Microsoft for creating, managing and protecting your virtualized infrastructure, your IT personnel are freed up from routine, low value-add tasks and are able to focus on enabling new capabilities to make your enterprise more competitive and successful.

7. **Review your desktop strategy in the context of virtualization options**—Identify the appropriate desktop configuration by class of user and specific security or compliance issues. In many cases, a mixed environment with rich clients (full PCs) and thin clients (powered by Terminal Services) will be appropriate. Planning out the environment and selecting the right management tools will help effectively manage diversity and provide greater flexibility and agility.

How do Microsoft products help me virtualize my IT infrastructure?

Microsoft provides a comprehensive, end-to-end toolset for creating, provisioning, managing, and securing *both* your virtual infrastructure and your physical infrastructure. Using familiar interfaces and common management consoles, an environment based on Microsoft technologies will deliver the promised *cost, service level,* and *agility* benefits, while reducing the system complexity that can result from disparate point-solutions. Your IT organization can harness the power of virtualization across the enterprise while simultaneously improving the efficiency and effectiveness of your operations.
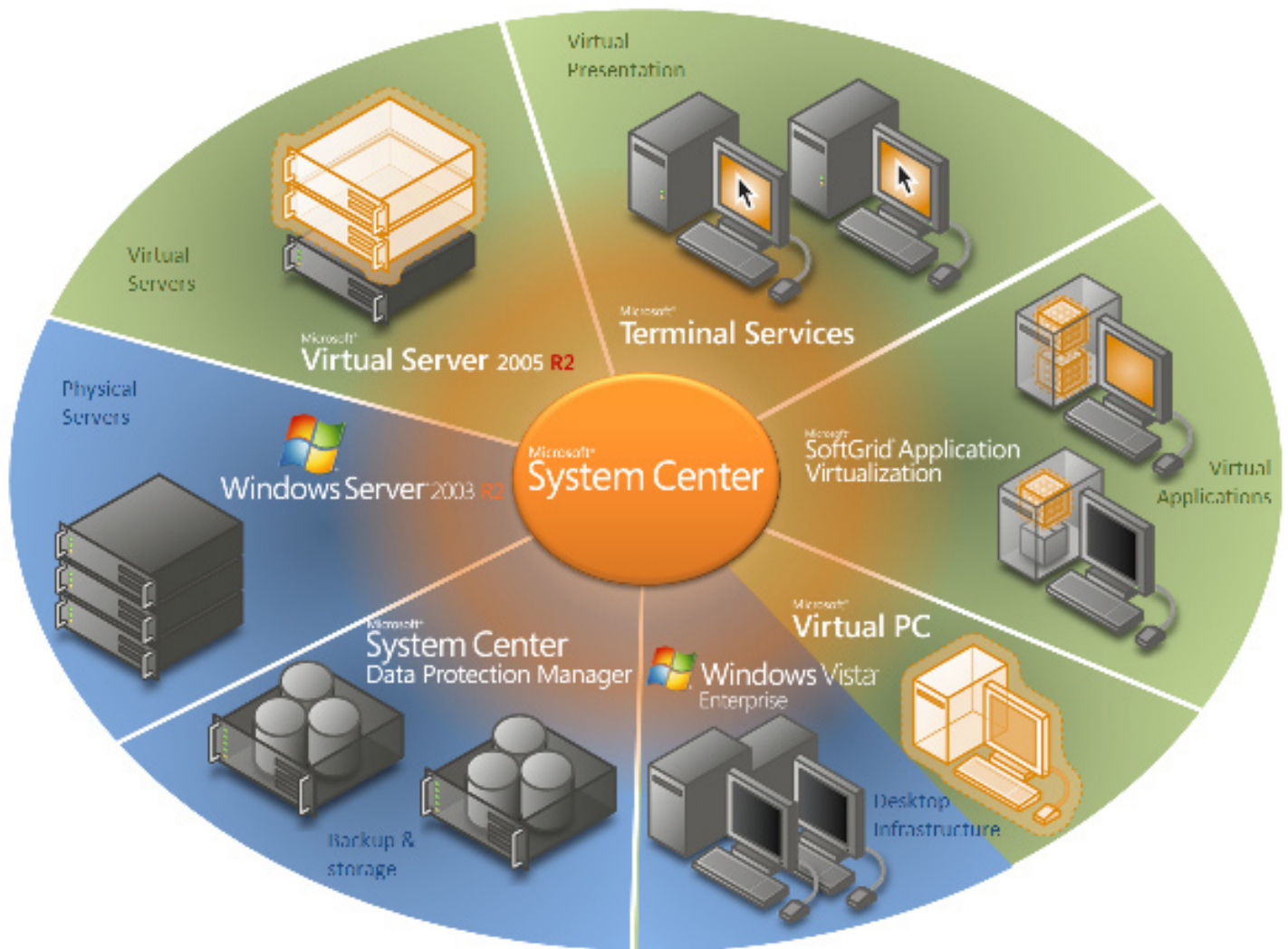
It is critical that you employ the right management tools to manage both your physical and virtual infrastructure. Microsoft System Center provides a comprehensive, integrated suite of tools to manage physical servers, virtual servers, storage and network assets, desktops and applications—all from a unified, familiar interface.

Key Microsoft virtualization technologies

Microsoft provides a full suite of technologies to enable an integrated, end-to-end virtualized infrastructure. Using familiar interfaces and common management consoles, a virtualized environment based on Microsoft technologies simplifies infrastructure management and delivers powerful capabilities.

Microsoft
Virtual Server 2005 R2

- Provides the virtual operating system that facilitates consolidated infrastructure, application, and branch office server workloads with rapid deployment and provisioning
- Runs most major x86 operating systems in the virtual machine guest environment
- Virtual machines utilize the Windows host operating system's qualified device drivers, ensuring robust and stable device support and broad device compatibility

Microsoft
System Center
Virtual Machine Manager

- Manages host configuration, virtual machine creation, library management, Intelligent VM placement, monitoring, rapid recovery, self-provisioning, and automation
- Seamlessly manages virtual server environment with existing familiar physical server management tools
- Provides complete scripted control of portable, connected virtual machines and enables easy automation of deployment, ongoing change and configuration

Microsoft
SoftGrid Application Virtualization

- Virtualizes applications and deliver them as an on-demand, streaming service to desktop users
- Simplifies desktop images by decoupling application layer from image
- Reduces number of server silos required to support Terminal Services
- Centralizes application permissions and control
- Enables centralized patching and updating of applications

Microsoft
Virtual PC

- Hosts legacy LOB applications
- Hosts applications not compatible with desktop OS

Microsoft
Terminal Services

- Virtualizes the presentation of entire desktops or specific applications
- Provides an architecture for consolidation of applications and data in the data center, while providing broad access to local and remote users

Microsoft
System Center
Operation Manager 2007

- Provides comprehensive monitoring and reporting of host OS and guest virtual machines, including discovery, state view, diagram view, alerts, tasks, and performance
- Identifies good candidates for conversion to virtual machines based on specified memory and CPU requirements

Microsoft
System Center
Configuration Manager

- Provides scalable migration and provisioning management
- Manages patch and upgrades in physical, host and guest OS

Microsoft
System Center
Data Protection Manager

- Captures data changes as they occur in real-time and synchronizes on regular intervals to ensure Windows data and user productivity are protected
- Enables IT administrators and end-users to easily recover data in minutes from easily accessible disk

Employing Virtualization technologies across the IT infrastructure is a major step towards creating a Dynamic IT   environment. From reducing the utility expense in the data center to avoiding extensive application compatibility testing for desktop deployments, virtualization significantly improves the efficiency of IT operations. From streamlining backup to rapid disaster recovery, virtualization is a cornerstone of a robust business continuity strategy. And from rapidly provisioning and scaling out servers to accelerated desktop deployments, virtualization drives operational agility. In total, a virtualization strategy spanning from the data center to the desktop is the key to staying competitive in an increasingly dynamic, global and connected world. Microsoft has the product, the people and the partners to make your end-to-end virtualized environment a reality.

For more information, please visit:

www.microsoft.com/virtualization

www.microsoft.com/virtualserve_r

www.microsoft.com/systemcenter/scvm_m

www.microsoft.com/softgri_d

www.microsoft.com/terminalserve_r

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virtualization performance