VIRTUALIZATION: From Concept to Reality

A White Paper Prepared by Insight

Presented in partnership with:

INSIGHT
6820 S. Harl Ave.
Tempe, Arizona 85283
www.insight.com 800.INSIGHT

Insight®

The complexity of managing multiple physical systems is driving the industry toward massive virtualization. That's because virtualization provides a wealth of cost-saving opportunities, especially in organizations that use systems for testing, development, training and support. In addition, virtualization is one of the key factors driving server consolidation.

According to Merriam-Webster's online dictionary (www.m-w.com/home.htm), virtual reality is "an artificial environment which is experienced through sensory stimuli (as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment." This is exactly what happens with virtualization: Virtual machine software creates one or more virtual workstations or servers on a real, physical system. Everything depends on what is available on the real machine: hard disk space, processor capability, and amount of RAM. The virtual machines that you create with virtualization software can support the installation and operation of any number of operating systems, including all versions of Microsoft® Windows®, MS-DOS®, Linux, Novell and so on. They can communicate with the physical host and other machines on the network just as if they were real machines in their own sense.

The ability to run multiple virtual machines on top of a single physical host makes this technology very exciting indeed for anyone who needs to create, set up and reuse machines running almost any operating system.

DEFINING VIRTUALIZATION

Virtual machine software was first created to emulate different operating systems-for example, Windows-on computers running another operating system-for example, the Macintosh OS. The objective was to allow users access to programs that did not run on their original operating system. With time, virtual machine software evolved as a product in its own right and has spurred a multimillion-dollar industry of its own. Today, there are several different virtual machine manufacturers. VMware Corporation[1], for example, offers VMware Workstation, VMware GSX Server, VMware ESX Server, VMware VirtualCenter, VMware P2V Assistant, and VMware ACE-a full panoply of tools. These tools let you create virtual machines on PCs and on servers that have an existing operating system, either Windows or Linux. ESX Server is a Linux-based custom operating system that is sold in an OEM hardware configuration and is designed solely to run virtual machines. By contrast, GSX Server and VMware Workstation require an existing operating system to run. VirtualCenter is a tool that allows you to manage multiple physical hosts running virtual machines. P2V Assistant allows you to capture a copy of a running physical machine and transform it into a virtual machine, and ACE is a special software component that lets you manage and deliver virtual machine solutions to end users.

Microsoft[2] also offers several tools of its own: Microsoft Virtual PC 2004, Microsoft Virtual Server 2005, and-for Virtual Server-the Virtual Server Migration Toolkit (VSMT). Virtual PC is for workstations and runs on either Windows or the Macintosh OS, Virtual Server is for servers and runs only on Windows, and VSMT is a tool that allows you to transform a running physical machine into a virtual machine.

[1] VMware Corporation: www.vmware.com

[2] Microsoft Corporation: http://www.microsoft.com/windowsserversystem/virtualserver/default.mspx

These virtual machine software packages run a variety of operating systems-a full list is available in Appendix A. This means that organizations using virtualization software can build entire networks or simply create a single machine by using this powerful technology (see Figures 1 and 2).

Figure 1: Using VMware Workstation. VMware lets you operate instances of an operating system (in this case, Microsoft Windows Server™ 2003) within your physical workstation.

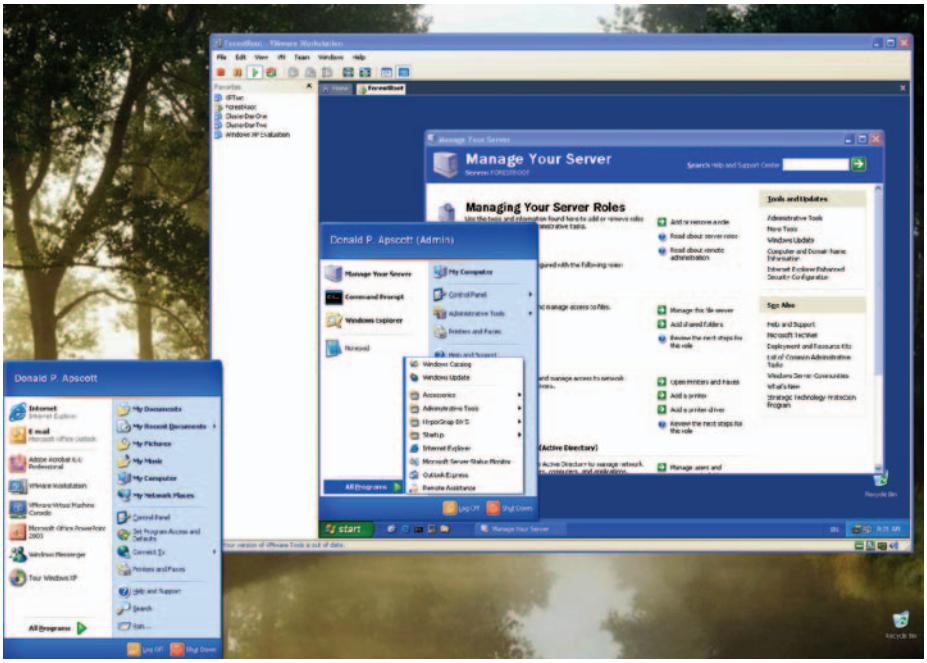
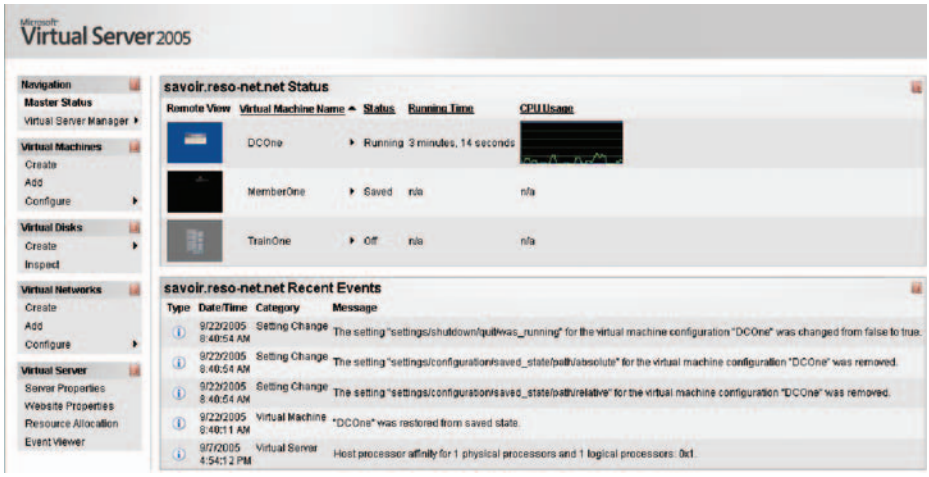


Figure 2: Using Virtual Server Virtual Server lets you operate several instances of an operating system within a physical server.



The key to proper virtualization is being able to properly size the capabilities of the physical machine or host machine to ensure that the virtual machines they will host can share those resources. Table 1 lists some suggested configurations depending on the version of the virtualization software you choose to use. Note that because ESX Server is an OEM installation, its requirements are customized based on the organizational need.

Table 1. Recommended Requirements for Virtualization Software

Manufacturer	Product	Host	RAM	Disk Space
Microsoft	Virtual PC	Microsoft Windows XP	1GB	80GB
VMware	Workstation	Windows XP	1GB	80GB
Microsoft	Virtual Server	Windows Server 2003	4GB	300GB
VMware	GSX Server	Windows Server 2003	4GB	300GB
VMware	ESX Server	ESX Server	Custom	Custom

Any machines running virtualization software must have access to as much RAM and disk space as possible. Disk space is required because each virtual machine generally starts at about 4GB in size. RAM is required because it must be shared and allocated between both the host and any virtual machine that may be running. In addition, the server editions of the virtualization software can take advantage of multiple processors, so server hardware must include as many processors as possible, depending, of course, on the purpose of the system.

VIRTUAL MACHINE COMPONENTS

One of the greatest advantages of virtual machines is that they consist of nothing more than a series of files that reside on a disk. In fact, there are usually two, sometimes three, different file types that make up a virtual machine.

Virtual Machine Hard Disk(s). Each time you create a virtual machine, the virtualization software will create a virtual hard disk, that is, a file that acts like a typical sector-based disk. When you install the operating system on the virtual machine, it will be contained in this file. Like a physical system, each virtual machine can have several disk files. Because it simulates a hard disk, this file is usually significant in size, though all virtualization engines support automatic growth, letting the system start with a smaller file and scale it as new content is added to the virtual machine.

Virtual Machine Settings File. Each time you create a new virtual machine, you create a virtual machine settings file, that is, a file that tells the virtualization software how to allocate physical resources from the host to the virtual machine. This file indicates where the hard disk file or files are located, how much RAM to use, how to interact with the network adapter cards, and, in some cases, which processor or processors to use. Because it only contains settings, this file is usually very small.

Virtual Machine State File. Like real machines, virtual machines support operational modes similar to Standby or Hibernation. In virtualization terms, this means saving the state or suspending the machine. When a machine is suspended, its suspended state is saved to a file. Because it only includes the machine state, this file is also very small.

There are other file formats that support the most advanced features virtualization offers, but the file types discussed above are the most common forms. In addition, each virtualization product supports "undoable" disks. This means that the product provides a means to return the virtual machine to a previous state by discarding changes that may have been made to the machine. This is a very powerful feature that is extremely useful in testing scenarios.

But because all virtual machines are composed of a series of files, it is very easy to duplicate them and repurpose them at any time-providing, of course, you have the appropriate disk space. Also, because virtual machines are always made up of at least two files, it is a very good practice to place each machine into a folder of its own on the host hard disk. Then, if you need to make a copy, you simply copy the whole folder. Virtual machines are also easy to back up and restore. Because backing up involves only copying a set of files, you can make regular backups at critical phases of any project. If anything goes wrong, it is easy to return to an previous version of the machine. No special backup agent is required because as far as the backup tool is concerned, virtual machines are stored on a file server.

VIRTUALIZATION SCENARIOS

Virtual machines can support several scenarios. These range in cost and capabilities, but each offers features that physical machines simply cannot support.

System Testing. Every information technology (IT) organization has put in place some form of testing laboratory for the purpose of examining and understanding new technologies and how they could fit into their network. Usually, these testing environments are scrounged together from bits and pieces that are left over from the production network. The result is a low-cost, but not very functional, testing environment. Virtualization can help by allowing IT to build comprehensive laboratory environments using only a few physical devices to host a plethora of virtual machines. Using undoable disks and virtual machine duplication, IT can duplicate any scenario and create very complex virtual testing environments. It is even possible to use physical-to-virtual capture engines to make a virtual duplicate of physical machines running in production.

Software Development. Every software developer has faced the need to have high privileges on their system. This is completely understandable because developers need to install and test software as they develop it. In locked-down environments, this can become a significant issue-but not if you are using virtual machines in support of the development effort. With a virtual machine running on a developer's workstation, the developer is free to have complete access rights in the virtual machine while the physical workstation remains completely locked down.

Training. Every technician who is responsible for the support of computer training centers will most definitely profit from virtualization. That's because each time a course is run, ordinarily you have to devise a means to return each PC to the course starting point. In addition, you need the means to repurpose the PC in support of other courses. Virtual machines are ideal for this for several reasons. First, they are very easy to repurpose-all you need to do is create a copy of an original machine for the course and then simply throw it away after the course is complete. Second, virtual machines can contain any operating system. This means that even a classroom that was originally created to support productivity training on tools such as office automation software can become a complete and comprehensive technical training center. All you need is the proper amount of RAM on the PCs, larger disk drives to contain virtual machine images, and a fast network to copy machines from a central location. After this is done, your training rooms can support operating system, complex IT infrastructure, and even development training. Of note: All of Microsoft's technical training courses now run on virtual machines.

Support Center. In environments that offer support center and support services, virtualization can bring huge benefits, especially if the technician needs to support multiple operating systems. Formerly, technicians needed to have access to multiple PCs with keyboard, screen, and mouse switches to change from one to another. Today, each support technician needs only a single PC with multiple virtual machines on it to support any number of clients. This is especially useful in outsourced support centers that have multiple clients, each with its own particular desktop environment.

Environment Standardization. One additional use of virtualization is in the control and deployment of custom applications. Using virtual machines, IT groups can prepare a working version of an application and instead of deploying the application on a physical machine, deploy a complete virtual machine to end users. This ensures standards compliance and can help keep support costs down.

Server Consolidation. Over the past decade, organizations have seen a proliferation of server machines for several different reasons. In many cases, these machines run with a very minimal utilization of their resources. Virtualization offers the opportunity to consolidate server hardware, reducing the number of physical hosts running in a data center but maintaining independent virtual machines for each function currently deployed in the organization. In addition, the availability of physical-to-virtual machine migration tools makes this scenario very attractive and very simple to deploy in any data center.

The most important point to remember about virtualization is that IT can treat each virtual machine as a physical machine within the network-a machine that can communicate with other machines, either virtual or physical. IT can manage virtual machines the same way it manages all other machines. In fact, IT can even send a command to the physical host machine to wake up a virtual machine before initiating an operation such as a software deployment.

CHOOSING THE RIGHT VIRTUALIZATION HARDWARE

The key to the proper implementation of a virtualization strategy is the hardware you select to run virtual machines. That's why Insight works with industry leaders, including Hewlett-Packard, in support of your virtualization goals. For either local or centralized virtualization scenarios, the choice of hardware you make must be focused on the following key components:

- Processor-the more powerful the processor or processors, the better the performance you can expect from the virtual machines.
- RAM-the more RAM you have access to, the more machines you can run at once.
- Disks-larger and faster disks will give better response times for your VMs.

For centralized virtualization environments, HP ProLiant Servers provide many options. Whether they are blade, rack-mounted, or standalone models, the ProLiant will provide an excellent platform for virtualization. These servers can use the Windows Server 2003 operating system to support the virtualization solution of your choice. Insight can help you configure these servers to best meet your needs today and into the future. For local virtualization environments, Insight recommends the new HP xw4300 Workstation. These workstations will support Windows XP Service Pack 2 in either 32-bit or 64-bit mode. In addition, they offer both single-core and dual-core processors, giving you very powerful choices for your local virtualization platforms.

THE VIRTUALIZATION RETURN ON INVESTMENT

Virtualization is a proven technology that can provide guaranteed return on investment (ROI) and help significantly lower total cost of operations. In any deployment program that aims to bring virtualization capabilities in-house, organizations should begin with a step-by-step approach to ensure that they understand the benefits of virtualization before moving to larger virtualization projects. For example, the most common virtualization scenarios today deal with testing, training, and software development. This may be the first place to start for anyone new to this technology.

HOW INSIGHT CAN HELP

As one of the world's largest providers of IT products and services, Insight offers proven strategies and practices to streamline the steps, reduce the risks, and ensure the success of critical IT deployments, including virtualization. Leveraging its proven methodology, Project Management Institute (PMI)-certified project management practice, International Organization for Standardization (ISO) 9001:2000-certified Custom Configuration and Advanced Integration labs, and its national services organization, Insight has successfully executed a number of virtualization projects. Insight features a comprehensive life-cycle management program that helps enterprises reduce the ongoing costs of virtualization, including build, deployment, and maintenance programs for virtual machines. For more information, contact Insight at **800.INSIGHT** or go to **www.insight.com/virtualizeit.**

About the Authors

Danielle Ruest and Nelson Ruest are IT professionals specializing in systems administration, migration, and design. They are authors of multiple books, notably two books published by McGraw-Hill Osborne, Windows Server 2003: Best Practices for Enterprise Deployments, ISBN 0-07-222343-X, and Windows Server 2003 Pocket Administrator, ISBN 0-07-222977-2, as well as Preparing for .NET Enterprise Technologies, published by Addison Wesley, ISBN 0-201-73487-7.

Insight®

APPENDIX A - AVAILABLE VIRTUALIZATION PRODUCTS

Product Name	Description	Host Operating System	Guest Operating System
VMware[3] ESX Server	Virtual infrastructure software for partitioning, consolidating, and managing systems in mission-critical environments		• Windows • Linux • Novell • Solaris
VMware GSX Server	Enterprise-class virtual infrastructure software for x86-based servers	• Windows 32-bit and 64-bit • Linux	• Windows • MS-DOS • Linux • Novell • FreeBSD • Solaris
VMware Workstation	Virtualization software for streamlining software development, testing, and deployment	• Windows 32-bit and 64-bit • Linux	• Windows 32-bit • Windows 16-bit • MS-DOS • Linux • Novell • FreeBSD • Solaris
Virtual Server Standard and Enterprise Edition	Virtual machine software for increasing operational efficiency in software testing and development, server consolidation scenarios, and application re-hosting	• Windows Server 2003, all editions except Web • Windows Small Business Server 2003 Standard and Premium Edition • Microsoft Windows XP Professional	• Windows Server 2003 32-bit except Datacenter • Microsoft Windows NT® 4.0 Service Pack (SP) 6a • Microsoft Windows 2000
Virtual PC	Software virtualization solution that allows you to run multiple PC-based operating systems simultaneously on one workstation, providing a safety net to maintain compatibility with legacy applications while you migrate to a new operating system	• Microsoft Windows XP Professional	• Only Windows editions

Available Virtual Tools	
VMware VirtualCenter 1.3	Virtual infrastructure management software that provides a central and secure point of control for an organization's virtual computing resources
VMware ACE	Software that gives security administrators control over the hardware configuration and networking capabilities of an unmanaged PC, transforming it into an IT-compliant PC endpoint.
VMware P2V Assistant	An enterprise-class migration tool that transforms an image of an existing physical system into a VMware virtual machine.
VMware VMTN Subscription	VMware Technology Network (VMTN) Subscription is a service for developers and testers that provides a suite of VMware products, support, and upgrades in a convenient annual subscription.
Microsoft VSMT	Tool that simplifies the migration of an operating system and installed applications from a physical server to a server running within a virtual machine that is provided and managed by Virtual Server 2005. **Free Download - requires Virtual Server.**
Microsoft Operations Manager (MOM) Virtual Server Management Pack	Management pack that monitors the performance and availability of Virtual Server and virtual machines. **Free Download - requires MOM.**

[3] For more information on VMware Guest Operating Systems, go to http://www.vmware.com/support/guestnotes/doc/.