Realtime publishers

The Definitive Guide™ To

Virtual Platform Management

sponsored by

Anil Desai

Copyright Statement

Chapter 2: Virtualization Scenarios and Applications

Every once in a while, a new type of technology comes along and promises to revolutionize the way organizations manage their IT departments. In some cases, the promises remain unfulfilled due to a variety of challenges and unexpected problems. In other cases, the changes "stick" and it's difficult to imagine a technology-focused environment that does not take advantage of it. Virtualization is proving itself to be in that latter, more successful group. Although there are certainly potential problems and limitations with the current state of virtual platforms, it's clear that the benefits of this technology are here to stay.

Furthermore, the use of virtual machines is not limited to just internal projects for data center administrators. Rather, it's applicable to many different areas of an organization. For most IT and business decision makers, this changes the question from, "Should we use virtualization?" to "How can we make the most of virtualization technology in our environments?" Assuming that organizations have a solid basic understanding of virtualization technology (see Chapter 1 for more information), the organization can build on this foundation of knowledge through the information in this chapter, which looks at many examples of how virtual machine technology can be used throughout a business environment.

Although the term "virtualization" is generally used to refer to a technology that allows multiple workloads to run on the same system at the same time, the most commonly used approach is the implementation of virtual machines utilizing a virtualization software layer that runs within a host operating system (OS). The technical focus in this chapter will be on this method—generally called server virtualization or hardware virtualization. Other approaches, such as application virtualization (which allows multiple applications to run independently within a single instance of an OS) as well as virtualization solutions that run directly on the host hardware through a "Hypervisor," will be covered in later chapters.

Why Virtualization Matters

The general idea behind server virtualization is to allow multiple independent OSs to run concurrently on the same computer. Non-technical users might wonder why this is such a difficult challenge. After all, if many applications and services can run at the same time, why not do the same with OSs?

The key issue is that most current OSs are designed to monopolize the hardware on which they run. The primary design goals were to optimize for performance, reliability, and usability. Indeed, the purpose of the OS is to manage physical computer hardware and to dish out resources to applications and services that require them. Figure 2.1 provides an example the relationship between layers of a standard computer.

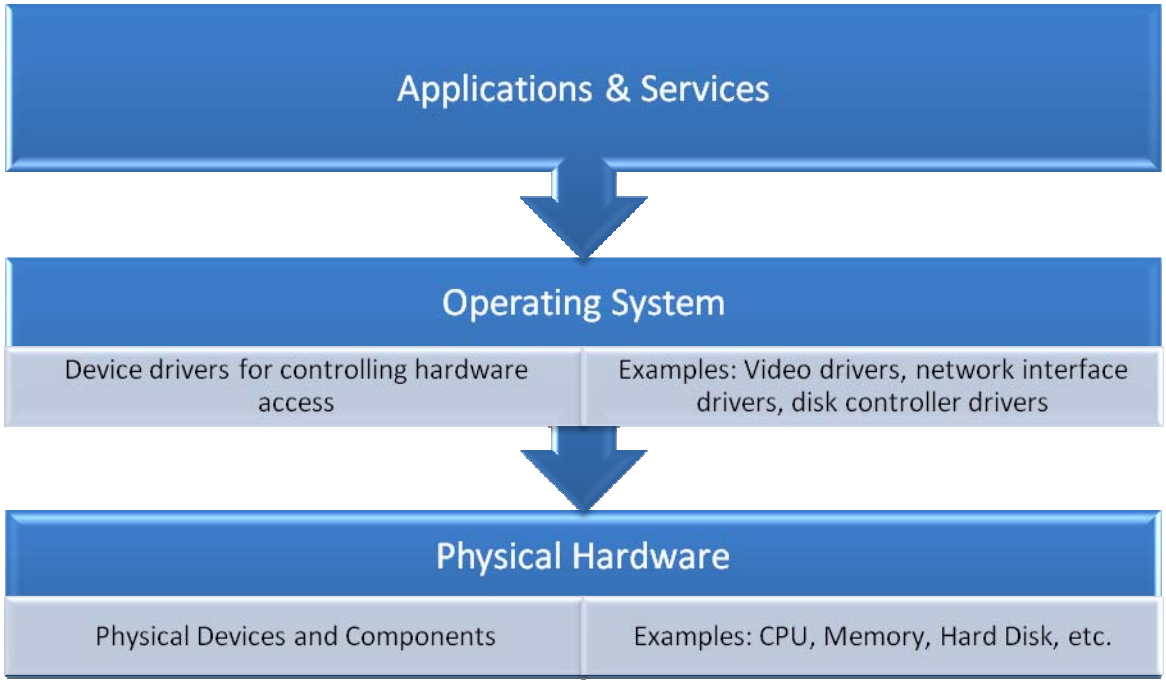

Figure 2.1: An overview of the direct relationships between OSs and hardware.

Virtualization technology creates a layer of abstraction between an OS and the hardware on which it is running. Important resources such as CPU, memory, disk, and network subsystems can then service multiple "virtual machines". Each virtual machine believes that it is running in an isolated environment. The focus in this chapter is on the technology of server virtualization. With this approach, each virtual machine environment appears to be a complete computer to the guest OS and the applications that run within it (see Figure 2.2).

It's important to note that there are other approaches to virtualization, such as application-level virtualization and virtual platforms that run directly on the host hardware. Later chapters will cover these methods.

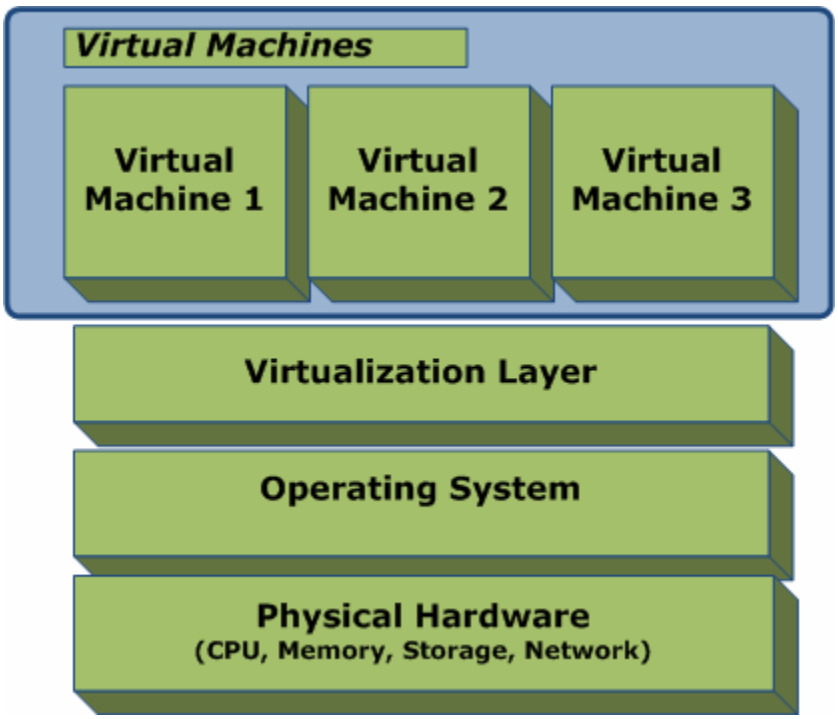

Figure 2.2: Using virtualization to reduce coupling between OSs and underling hardware.

Throughout, this chapter will look at many practical applications for the benefits of server virtualization. Let's start with some general benefits.

Reducing Overall Costs

For most IT environments, costs related to implementing and managing data center resources can be a significant drain on organization's overall budget. Major costs are related to capital purchases (including hardware, software, and networking equipment). Within the data center, factors such as physical space limitations, power, and cooling can all add significantly to operational overhead.

Virtualization technology provides many benefits in these areas. By providing the ability to run multiple workloads on the same computer at the same time, the total number of devices that must be supported is dramatically lowered. Because an entirely new physical server is no longer required in many cases, data center overhead is reduced. And, as hardware tends to be far better utilized, the task of server consolidation can dramatically decrease overall IT costs.

Allowing Standardization

Managing differences between OSs (and even different versions of OS platforms) can place a heavy burden on IT staff. Often, when deciding to purchase physical hardware, care must be taken to ensure compatibility with the applications and OS features that are intended for that platform. Virtual machines can help level this playing field by providing a consistent and uniform environment for management. Although the underlying hardware might be changed due to server upgrades or migrations to new technology, the environment within the virtual machine can remain constant. Thus, the resources that end users actually rely upon will remain available, even when an IT department needs to make changes for technical reasons.

Virtualization Features

Before we delve into ways in which virtualization features can be applied to solve business and technical problems, it's important to gain an understanding of the features that virtualization solutions provide. This section examines general technical benefits of using virtual machine technology. The chapter will then revisit these concepts in seeing how they apply to helping users throughout a typical organization to achieve their goals.

Ability to Roll Back

The primary component of a computer that is responsible for "persistence" is the hard disk system. For most computers, data stored on hard disks is relied upon to be available after the machine is rebooted. It provides for the long-term "memory" of the machine. When working with physical computers, changes are usually a permanent, one-way process. New data that is stored on hard disks will remain there until it is actively changed by another application or service.

When working with computing resources in a variety of different environments, it can be helpful to make some changes and then roll back the computer to its previous point in time. For example, software developers and systems administrators might want to install a major OS update to test its compatibility on a particular system. For a variety of reasons, they might then want to "roll back" the system to its initial state (before changes were made).

Virtual machines and virtual hard disks (VHDs) on most virtualization platforms allow for this option. Although the specific terminology might differ, the primary approaches involve separating read and write operations. In a standard configuration, all disk-based read and write operations are performed directly to a single VHD file that resides on the host's file system. In this respect, the changes are committed to the disk immediately, and they cannot be automatically undone. This is analogous to hard disks that are attached to a physical computer.

Through the use of other VHD options, however, physical disk write operations can be stored to a separate file. Figure 2.3 provides an example of how this might work. When the virtual machine is first started, all the data that it requires is located on its virtual hard disk files. Whenever the OS or applications require changes to be made and committed to the hard disk, however, the write operations are actually recorded in a separate file. To the guest OS, the process is seamless. The virtualization layer determines where to read and write data, so no special guest OS support is required.

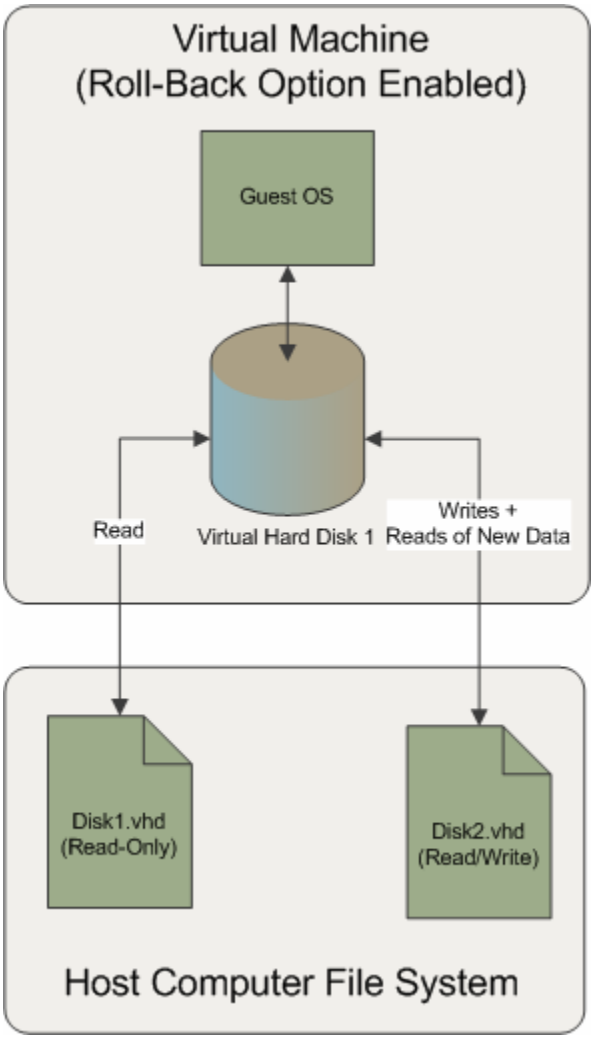

Figure 2.3: A conceptual overview of how read and write operations can be maintained separately with VHDs.

Whenever the virtual machine is shut down, users have several options. First, they can choose to retain both files. This, in effect, will make the system behave as if any changes that were made while the guest OS was running were committed. The next time the virtual machine is started, users can pick up where they left off. However, they will still have the ability to choose to revert to the initial state of the virtual machine at a later time.

The second option is to permanently commit the changes to the original VHD file. This option is useful when, for example, changes are made for test purposes and the user has decided that he or she wants to make them permanent. Finally, the third option is to simply discard the changes that have been made since the virtual machine was started (or since the separate file for write operations was created). This effectively rolls back the state of a virtual machine to how it appeared before these tasks were carried out. Figure 2.4 provides an example of available options when choosing to shut down a guest virtual machine from with Microsoft's Virtual Server platform. Similar options are available when using solutions from VMware (such as VMware Server and VMware ESX Server) and other platforms.

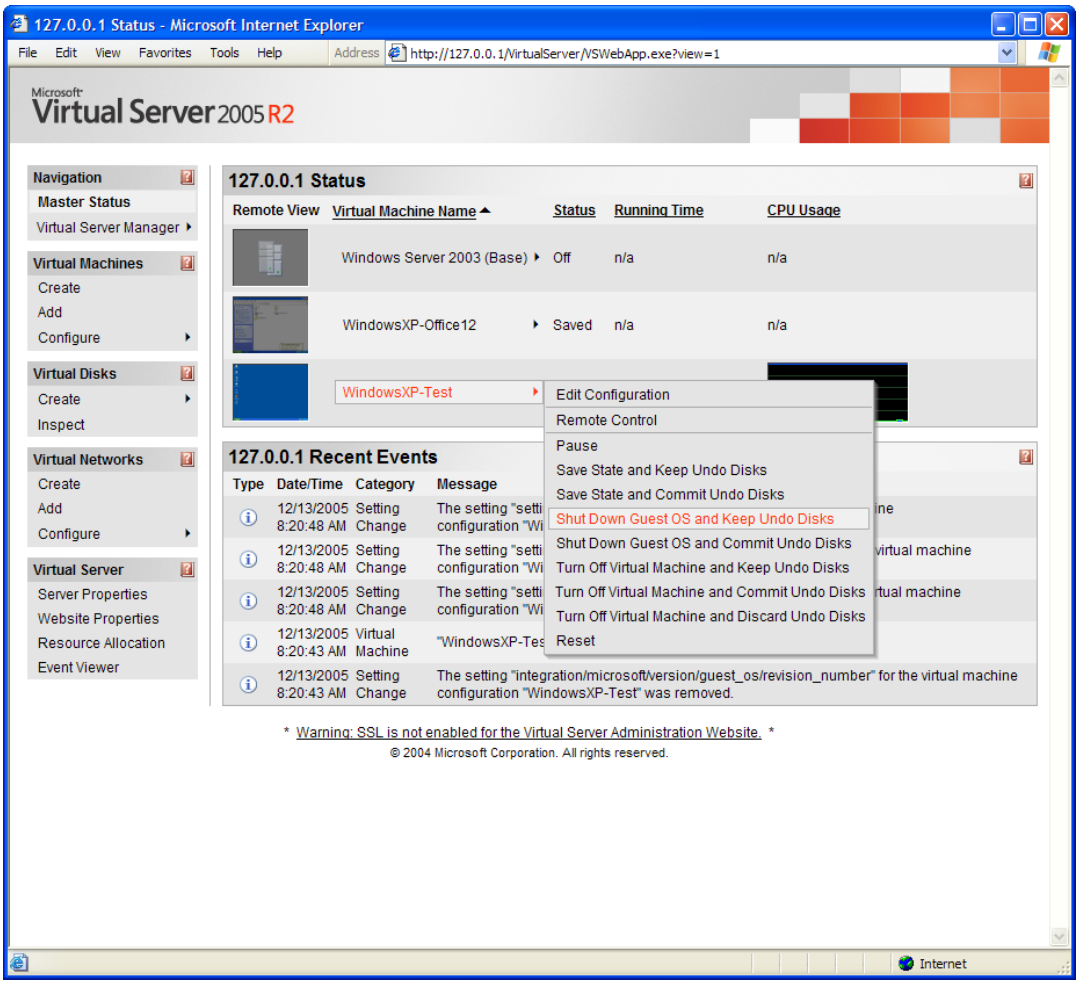

Figure 2.4: Options when shutting down a Microsoft Virtual Server 2005 virtual machine.

Portability: Moving and Copying Virtual Machines

A useful operation for most IT departments is the ability to make a duplicate of an existing server configuration. This task might be performed in order to roll out new devices (for example, when a Web server farm needs to be expanded to add capacity). Or, testers and other users might need the ability to set up environments that mimic their production systems.

Regardless of the reason, systems administrators can move virtual machines to new host computers or make duplicates of existing virtual machines within a matter of minutes. The advantages are especially great when comparing this process with configuring new physical machines. An added benefit for end users is that the provisioning and deployment process is much quicker and more efficient.

Guest OS and Network Security

Securing new computers—whether they're physical or virtual ones—is an important concern for all IT staff. An improperly configured or out-of-date OS can open the entire environment to vulnerabilities. To limit the potential security impact of new virtual machines, users and systems administrators have several options. The first is to run a virtual machine (or even the entire virtualization platform itself) with a limited set of permissions. This can help ensure that, even if the security of the guest virtual machine is compromised, the amount of damage that can be performed is reduced. Although the guest OS itself might have significant problems, the host computer (which is likely running several other virtual machines) will remain safe.

Additionally, virtual networking options allow users to quickly and easily set up a completely independent environment for their virtual machines without making changes to the physical network design. Although the same result may be achieved through the use of Virtual Local Area Networks (VLANs) or isolated network segments, knowledgeable network administrators are generally required to set up those configurations. Since one or a few virtual machines will only be able to talk to each other, this approach can greatly reduce the amount of risk associated with running new OSs. It can also limit network management headaches that might be caused by systems that are not properly configured according to IT standards. Figure 2.5 provides an example of how physical and virtual networks can be divided.

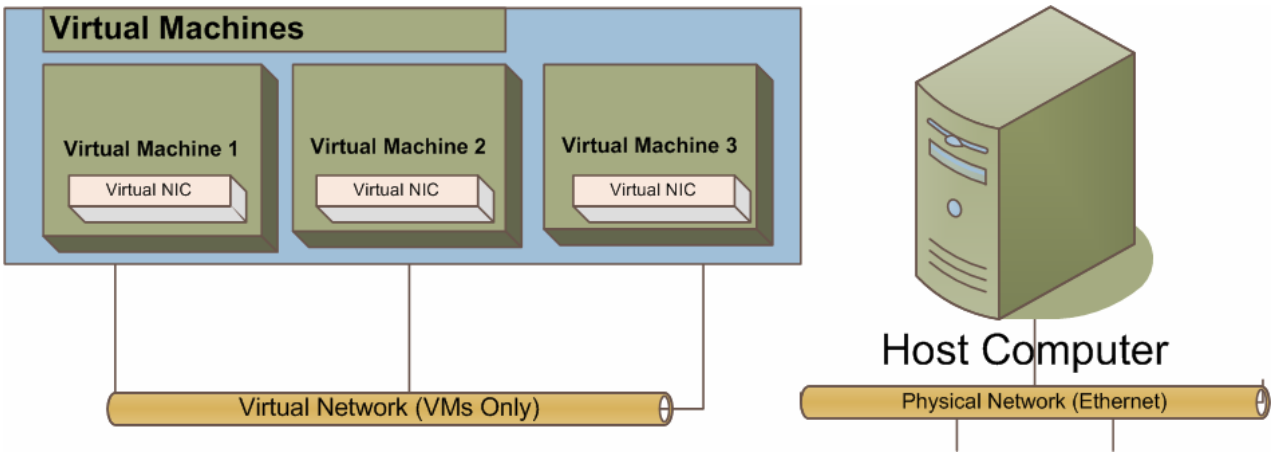

Figure 2.5: Placing virtual machines on a separate network from physical machines.

Management and Automation Features

Many IT tasks tend to be repetitive and time consuming if done manually. Virtualization platforms can be automatically managed using a variety of methods, starting with the creation of simple scripts. Entire groups of virtual machines can be started, stopped, or reconfigured with relatively simple sets of code. Performing the same operations on groups of physical computers can be more difficult, due to security concerns and network connectivity requirements. More complicated operations can be performed through the use of complete Web or native applications. Finally, third-party tools and utilities are available for seamlessly managing both physical and virtual machines. With this overview of the many benefits of virtualization technology, let's look at how different types of users can benefit from this technology.

Scenarios for Systems Administrators

One of the most immediately recognizable applications of virtualization is within the data center. Most IT departments have already decided that the ability to perform server consolidation is a huge benefit that cannot be overlooked. Although that is certainly true, there are numerous additional ways in which virtualization can help reduce costs and simplify administration.

Scenario: Data Center Management Challenges

This section will focus on a typical data center scenario: An IT department is tasked with supporting numerous business units of the organization. Common requests include the deployment of new servers in order to support business initiatives and new applications. Most requests require resources "as soon as possible," and systems administrators are finding it difficult to keep pace with the amount of change. Additionally, data center resources such as physical space, power capacity, and cooling capacity are limited. With each new server that is deployed, overall management becomes more difficult. The IT staff has determined that many of the systems they support are underutilized. That is, the server resources that are being used are far below the capacity of the systems. Finally, the IT staff has the need to support "legacy" OSs and applications. However, the hardware on which these systems are being run is very old and has become difficult and costly to support. Based on these significant challenges, let's look at some ways in which server virtualization can help alleviate some of these pains.

Data Center Administration Benefits

As much as they might like to ignore it, systems administrators are often faced with tasks that involve significant physical labor. The age-old ritual of rack-mounting new server hardware has long been seen as a necessary aspect of making new computing resources available to the business. Often, this task is only the beginning of a long series of events. Once the machine has been physically installed, it must be connected to the appropriate power connections and network devices. Every new server adds to the number of cables and network ports that are required. In some cases, all this effort might be exerted in order to support temporary computers that are used only for a time-limited project.

In some cases, this effort is unavoidable. Additional CPU, hard disk, memory, or network requirements make it necessary to deploy new devices. In other cases, however, users might be just as well served through the deployment of a virtual machine. Except in situations in which there are specific hardware requirements, virtual machines can provide all the resources that users need. In fact, it's often difficult for an end user to determine whether an OS is running on a physical or on a virtual machine. Virtual networks can be created with a few mouse clicks and tasks such as allocating physical memory or additional hard disk space are simple tasks that can be completed remotely and without opening a physical server.

Overall, by reducing the number of physical computers and devices that are required in a data center environment, systems administration can be simplified. In addition, precious data center resources such as physical space and electricity can be preserved. It is important to note, however, that managing a mixed physical and virtual environment can be an added burden (especially in IT environments in which virtualization-aware management tools are unavailable).

Future chapters will look at methods for managing such an infrastructure.

Reducing Server Sprawl

For IT departments that support many different areas of the organization, it might often seem that there is simply not enough available hardware to meet needs. Users from any department might request new resources to support a new business initiative or a new application. In the past, IT departments would often deploy new systems quickly, and with little validation of requirements. Unfortunately, many of these computers were either unnecessary or were only required because certain applications or services could not be installed on an existing server due to compatibility issues.

The end result is that IT departments often end up supporting large numbers of machines that are under utilized (at best) or even completely unused. When data center-related costs—such as power, cooling, and physical space—are factored in, the costs can be tremendous. The use of virtual machines can help reduce these costs (and many of the associated administration headaches). For users that require a new "server" for compatibility reasons (rather than for performance), a new virtual machine might be the best approach. Because it's often easier to find additional capacity on an existing server than it is to purchase and ready new hardware, IT departments can focus their time and effort on other tasks.

It is also worth noting that a related (and equally serious) problem can occur: virtual machines are quicker and easier to deploy than physical computers, so IT managers often find themselves supporting large numbers of virtual machines (many of which the IT department may not have deployed). These virtual machines often don't adhere to the IT department's security and configuration management policies and can quickly become a significant liability. This phenomenon is often known as "virtual machine sprawl."

📖 Later chapters will look at ways in which this problem can be mitigated.

Reducing Deployment Times

IT staff can often have a very difficult time keeping up with deploying new computing resources to support business initiatives. Often, stakeholders will complain that it takes far too long for a new server to be deployed and made ready to support their needs. From the viewpoint of IT staff, a significant amount of effort is required to set up a new machine and to ensure that it is configured for security and reliability.

Figure 2.6 provides a simple comparison of the number and types of tasks that are often required to deploy a physical machine. The related steps for a virtual machine are far fewer and much simpler. Through the use of virtualization technology, systems administrators can rapidly deploy new computing resources into their environments. The end result is a more responsive IT team (in the eyes of business stakeholders) and more efficient IT environments.

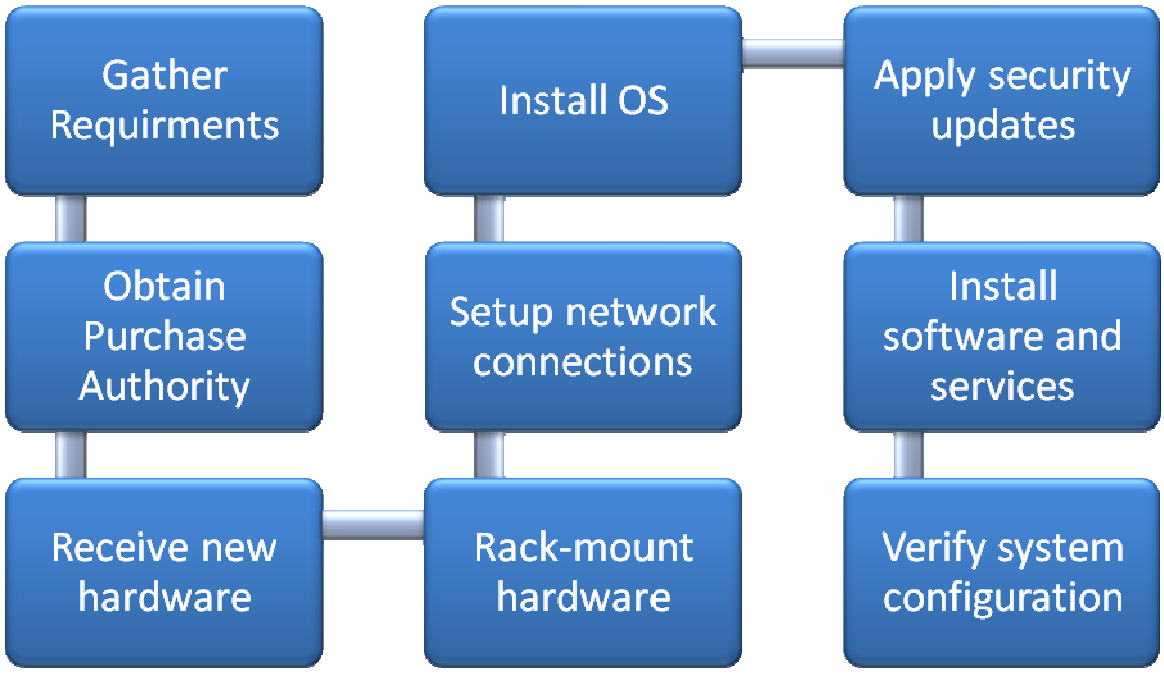

Figure 2.6: Steps that are required to deploy a new physical server.

Often, all that is requires is to make a copy of the virtual machine configure and related files. Once this is done, the configuration steps can all be performed using the virtualization platform's tools. Best of all, the entire process can usually be accomplished remotely.

IT Agility

In an ideal world, once a server has been configured and deployed into production, it would never need to change. The applications and services it supported would meet the needs of users well into the future, and the server would keep chugging along until its eventual retirement. For most IT environments, this scenario is little more than wishful thinking. Modern organizations change rapidly and require their infrastructures to keep pace. At the same time, many IT departments are faced with limited budgets and a lack of personnel resources to implement those changes.

Fortunately, virtualization technology can help alleviate some of these problems. In addition to the systems administration benefits we've talked about thus far, virtualization allows IT staff to quickly change the roles and responsibilities of a physical computer. Instead of completely reinstalling an OS or reconfiguring hardware, a virtual machine can be moved or copied to another server.

Managing Performance

As difficult as it is to predict the exact hardware and software configuration for a particular application, it can be even more challenging to ensure optimal performance over time. Perhaps an application that was originally intended for three users has now become a critical line-of-business tool for an entire department. Or perhaps the application that was once the Marketing department's "killer app" is now used only for historical reporting purposes. In these cases, it's likely that the hardware configuration for the application no longer meets the organization's needs. Either the system is being underused (leading to increased costs) or has insufficient capacity to keep up with users' demands. Both cases are clearly less than ideal.

By deploying applications within virtual machines, IT departments can create a much more agile environment. This is accomplished by loosening the coupling between an OS and the hardware on which it is running. Because virtual machines can be quickly and easily relocated, IT departments can safely move applications between physical servers. Now, the data analysis application that just couldn't seem to get enough CPU cycles on an older physical computer can be moved to more capable hardware. Best of all, virtual machines greatly reduce the amount of risk that would otherwise be associated with reinstalling an application on another machine. Figure 2.7 provides a "before" and "after" picture.

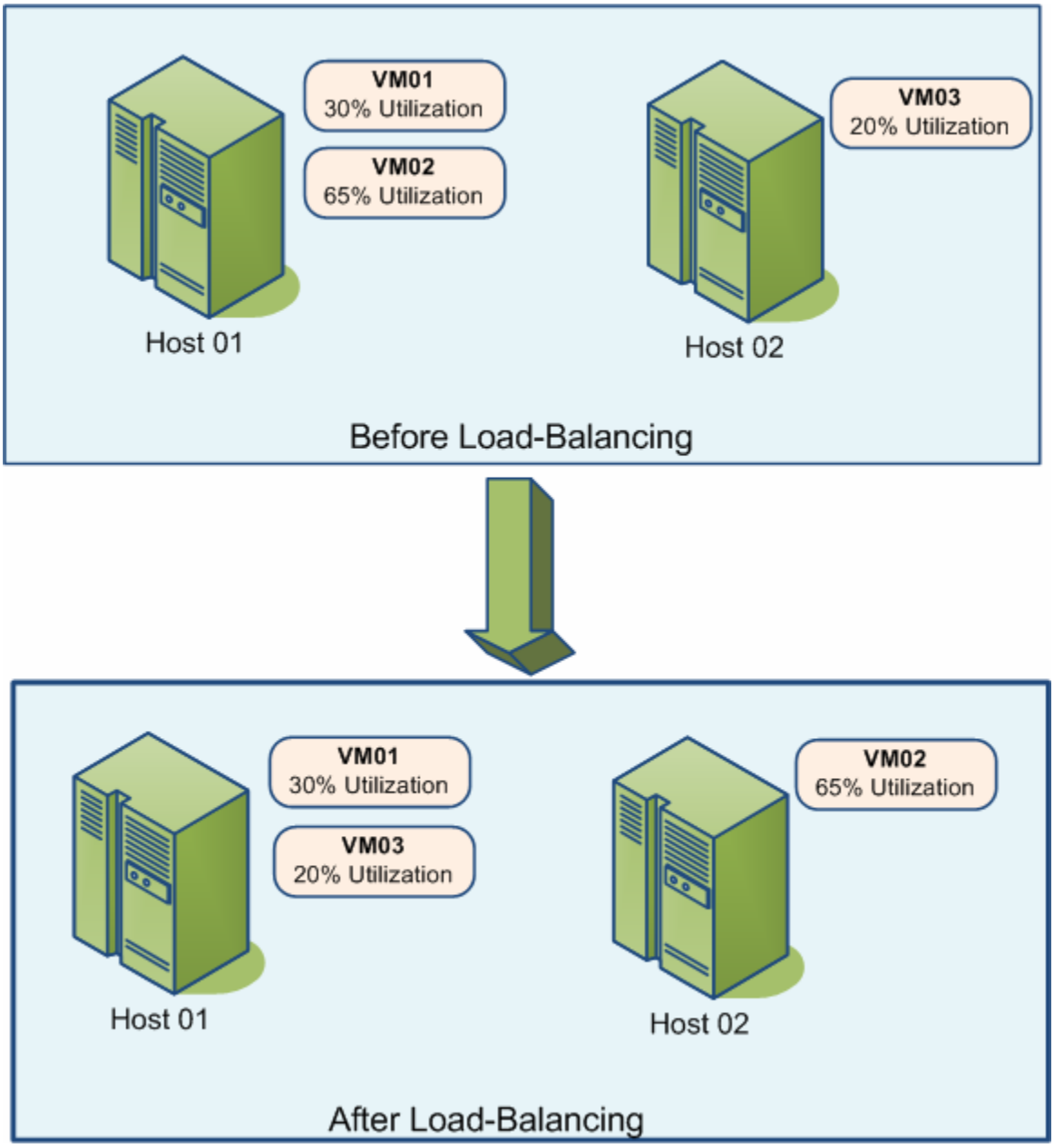

Figure 2.7: Rebalancing virtual machine load based on resource requirements.

Standardization

A large part of the difficulty in maintaining IT environments is based on managing large numbers of disparate devices. Even a small IT organization is likely to support several brands of server hardware. Each manufacturer, in turn, is likely to provide its own set of drivers and hardware-related utilities for managing the platform. Systems administrators must maintain knowledge about each type of system and often must manage them separately.

The use of virtual machines can help reduce this complexity and simplify administration. Although virtualization may not eliminate the need to properly configure physical hardware on a host computer, it can significantly reduce the number and types of hardware platforms that are required. Virtual machines on a particular virtualization platform have similar virtual hardware platforms and devices, regardless of the underlying hardware on which they're running. Assuming that an organization has been able to consolidate and reduce the number of supported machines, the end result can be a simpler environment for management purposes.

Table 2.1 provides an example by listing the virtually emulated hardware configuration of a virtual machine running on Microsoft Virtual Server 2005. The hardware configuration itself is far from state-of-the-art (especially by current-generation IT standards), but it has been designed with compatibility in mind. By presenting older hardware to the guest OS, the virtualization layer can be more compatible with a larger number of platforms. The virtual hardware platform can also be upgraded over time (through support from the virtualization vendor) so that future OSs and platforms are also supported.

Component	Specifications
Chipset	Intel 440BX
CPU	Based on the host CPU
BIOS	AMI BIOS
Video	S3 Trio 32/64 with 4MB of video memory
Memory	Up to 3.6GB
Input Devices	PS/2 Mouse and Keyboard
Floppy Drives	Up to two 1.44MB 3.5" floppy drives
Communications Ports	2 Serial Port 1 Parallel Port
IDE Controllers	Two channels, each of which supports up to two devices each (up to four IDE total devices)
SCSI Controllers	Up to four Adaptec 2940 SCSI Controllers (each supports up to 7 devices; 28 devices total)
Network Interfaces	Up to four Intel 21140 10/100Mb network interface cards

Table 2.1: The virtual hardware configuration for a Microsoft Virtual Server 2005 R2 virtual machine.

Additionally, if the IT team decides to standardize on a particular vendor or manufacturer of server equipment, their main concerns are limited to support for the virtualization platform. In the case of hardware failure, systems administrators can move virtual machines to another system while the main host computer is being repaired. When the time comes to move to newer hardware, many of the messy details related to reinstalling and reconfiguring complex applications are removed. Usually, the virtual machine can be seamlessly transferred as-is to another different hardware platform without the need for significant application or OS reconfiguration.

Supporting Legacy Hardware and Applications

Some computers in an otherwise modern data center might appear to be an anachronism. An early Pentium-class server might be sandwiched next to two eight-core servers that could outperform it by a factor of well over 100. Common sense might dictate that the older computer should have been replaced or upgraded years ago. After all, it's probably pulling as much power, occupying as much space, and generating as much heat as other more capable systems.

The answer to this mystery is often that the older server is running a "legacy" OS or software that cannot be moved to another system. For example, the organization might have initially deployed a state-of-the-art application on a Windows NT 4.0 OS. Since that auspicious day, the expertise required to reinstall or reconfigure it might have left the organization. Or, perhaps the application does not run properly on a newer OS. Nevertheless, it's still in active use and trying to move it to modern hardware would be risky.

There are many compelling reasons to upgrade older hardware. Apart from the power, cooling, and space requirements of older, slower machines, maintenance is a significant issue. Computer hardware has a finite lifetime, and older components often have a significantly higher risk of failure. Worse yet, finding replacement parts for old hardware can be difficult (if not impossible). As it's likely that support contracts for the machine have long since expired, the computer (and the users that depend on it) is likely to be living on borrowed time.

Again, virtualization can come to the rescue. Older OSs usually run just fine within a virtual machine, regardless of the physical hardware platform on which they reside. In the case of our Windows NT 4.0 legacy application, it can be reinstalled within a new virtual machine. Tools are also available for performing physical to virtual (P2V) machine migrations automatically. Regardless of the approach, the end result is the best of both worlds: Moving the application to new hardware without having to deal with OS compatibility issues.

Optimizing Workload Distribution

One of the most important goals for an IT department is to make the most effective use of the capital assets that it supports. From desktop computers to notebooks to servers and networking equipment, getting the most "bang for the buck" is the primary goal. Part of the process involves determining the exact requirements for an application or service prior to purchasing hardware. Unfortunately, requirements can (and often do) change quickly.

A common occurrence on modern computers is that there is often some type of bottleneck that limits overall performance. For example, a mid-range server with eight CPU cores might have plenty of spare processing power but not enough disk I/O bandwidth to support a critical Web server application. Or another computer might have excellent disk throughput but might be hindered by having only a single CPU. Taken from a high-level standpoint, wouldn't it be great if you could combine these two applications on the same server?

Virtualization allows systems administrators to do just that. They can get the best possible utilization out of their systems by combining those workloads that have different types of resource requirements onto the same computer. An important first step in this process is to measure the current requirements of applications and services and categorize their resource utilization by type. One workload might be labeled as being "CPU intensive" while another might exhibit a large amount of random disk I/O operations.

Once this information is obtained, systems administrators can make informed decisions about which virtual machines will play well together in a production environment. The overall goal is just what IT is looking for—optimal usage of critical hardware assets. The associated translation for the business is just as good: reduced costs and better performance.

Scenarios for Training

A significant challenge for many organizations is keeping employees up to date on the latest software and skills that can help them more effectively do their jobs. When it comes to computer-related training, instructor-led classes are a popular option. Traditional training labs generally include numerous computers. Each student usually has his or her own computer for performance exercises and completing hands-on instructions. In addition, the instructor will likely have one or more computers—perhaps one for presenting slides and another for performing demonstrations.

Maintaining all these computers can involve a significant amount of labor. For example, instructors often have to set aside time to ensure that all the computers in the classroom are properly configured. Even when using automated tools, the process can take hours and is error-prone. Also, the hardware itself must be monitored and maintained. In larger training labs, hardware failures may be common and must be addressed quickly. Finally, after a class is over, the instructor or lab administrator generally needs to revert the computers back to their initial state for the next class.

Scenario: Providing Enterprise Training

An IT training group is responsible for ensuring that employees throughout the organization remain up to date on new applications and policies. For example, during the rollout of a new OS version, all staff must complete mandatory training that introduces them to new features and any related policies. Similarly, when a new application is purchased and deployed, users who will be affected should receive training on its proper use. Although training is a high priority, the organization as a whole has realized that there can be significant loss of productivity when employees have to travel in order to attend classes. Additionally, the IT training group is finding it difficult to maintain their training labs to support a larger number of students. All these challenges can be made much easier by replacing the physical computers with virtual machines. Let's take a look at some of the benefits in detail.

Quick and Consistent Setup

One of the challenges with setting up a training lab is ensuring consistency for all the students that will be participating. Ideally, all of the computers will have a similar or identical configuration and disk-imaging or other techniques can be used. However, the time that it takes to prepare and deploy images (and to manage any failures) can be significant. And, in larger training environments, hardware failures might be common (based on the laws of statistics).

An alternative method to deploying and maintaining multiple physical computers is to make copies of virtual machines on a few centralized virtualization host computers. The initial virtual machine might include a base OS. Instructors can quickly add exercise files, install applications, and make other changes to facilitate the goals of the class. Once the virtual machine is properly configured, numerous copies can be made. Typically, at least one virtual machine will be available per student. To further automate the task, simple scripts may be created to make changes to the virtual machines.

Rather than having mid- to high-end computers at each desk, students in the training class can use older or lightweight clients to connect to the virtual machines. Figure 2.8 provides an example of this configuration. By reducing the purchase and maintenance costs related to students' computers, organizations can significantly reduce the total cost of maintaining a training lab. When technical needs demand hardware upgrades, only a limited number of host computers must be touched.

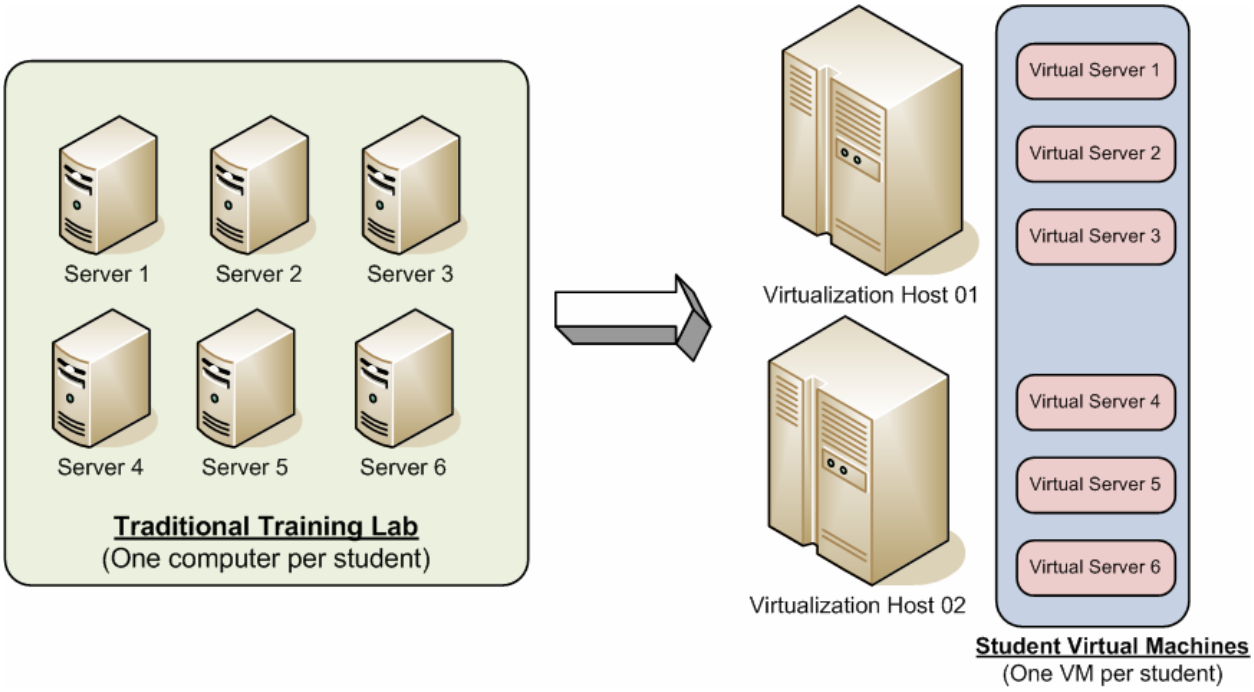

Figure 2.8: An overview of a training lab that uses virtual machines.

Instructor-Led Remote Training

Many organizations have the need to support a geographically distributed workforce. The option of making students travel to a single location to obtain training can present significant costs and reduction in productivity. A viable alternative is to provide the same training content remotely over the Internet. Using this method, users connect to a virtual machine using a remote desktop tool. The student has an experience that is nearly identical to sitting in front of a physical computer without having to perform significant reconfiguration of his or her computer.

Trainers can simulate an experience that is similar to participating in a "live" classroom through the use of audio and video conferencing. For performing exercises, class participants can connect to a virtual machine over the organization's Wide Area Network (WAN) or through the Internet. Regardless of the approach, the training experience can be "delivered" without requiring users to physically travel.

On-Demand Remote Training

Another major issue related to providing training is that of scheduling. It's often difficult to find common times that work for groups of students without significantly impacting their productivity. This is where the idea of on-demand training comes in. One of the drawbacks of using methods such as books and audio or video presentations is that instructors are often unable to provide a simple method for students to perform hands-on work. In some cases, specialized hardware or software configurations are required, and most users will not have the expertise to set up the necessary environment.

A ready solution for these problems can be implemented by allowing users to connect remotely to virtual machines that are hosted within an organization's data center. Connection information can be provided to each student, or students can request certain virtual machine configurations on demand. Regardless of the approach, they will have direct access to a private environment that contains the OSs, applications, and services that they need.

There are some excellent examples of this approach on the Internet. For example, Microsoft provides its Virtual Labs for free to the public (one example is the Microsoft Developer Network Virtual Labs site at http://msdn.microsoft.com/virtuallabs/). Once users have signed up, they will be given login information to connect to a particular virtual machine. Some configurations (for example, those that simulate working in a domain-based network environment) can contain groups of multiple virtual machines. Generally, these resources are ready within minutes of users' requests.

Support for Complex Configuration

In some cases, the purpose of a training class will be to orient users with a single new application or process. If the goals of the class are simple enough, a single virtual machine per student will generally be adequate. In other cases, however, more advanced classes (such as a multi-tier application development course) might require more complex configurations. In these cases, additional virtual machines can be created for use by each of the students. Since overall performance is rarely the primary goal, running many different virtual machines on the same server can make the process significantly simpler.

In addition, students will have the ability to roll back the configuration of a virtual machine if they make a mistake or in order to support future exercises. Because all of this can be managed centrally on a relatively small number of virtualization host computers, class instructors can more quickly and easily prepare for new lessons.

Scenarios for Developers and Testers

In the early days of software development, the tasks of software development were significantly less complex. For example, on a mainframe computer, the developer had the benefit of working in a fixed, well-defined environment. Though programming methods (such as punch cards) were rudimentary compared with modern standards, the specific compatibility requirements were known. Over time, the advent of personal computers made the task more complex. Now, the developer would rarely know the exact configuration of the machine on which her code would run, and compatibility testing became significantly more important.

Modern enterprise applications have scaled to even more complexity. These applications often involve multiple "tiers" (such as presentation, business objects, and databases) as well as the ability to support many servers per logical division. Although development tools and technologies have evolved to keep pace with some of this, the fact of the matter remains that the processes of designing and testing software are significantly more complicated than they have been in years past. Add in factors such as the increasing reliance of organizations' success based on IT and the critical importance of security, and these challenges can be significant.

Scenario: Supporting Complex Application Development

An organization's Engineering group is responsible for developing complex applications. Some of these products are used inhouse (to support new business initiatives), while others are commercial applications that are available for purchase by the public through retail channels. Software developers have always required access to a large testing lab during the development cycle. Recently, however, new requirements and products have made it difficult for the IT team to maintain adequate resources for testing. Additionally, developers and quality assurance staff have requested the ability to quickly set up and tear down temporary test environments in order to provide for more rapid testing and simulation of critical customer problems. With this stage set, let's look at some ways in which virtualization technology can help.

Testing on Multiple Platforms

One of the benefits of working in the modern world of computers is that there are a tremendous number of options when choosing a computer. There are numerous vendors that provide products that meet the needs of different types of users. They often differ significantly in their hardware configurations and supporting software. An important general goal in software development is to ensure compatibility with as broad a range of systems as possible. Even with Web-based applications, testing various OS versions, updates, security settings, and browsers is important. Without adequate testing, developers might claim that, "It worked on my development system!" That's where the need to test on multiple platforms comes in.

Without the use of virtual machines, compatibility testing labs could easily include dozens of dedicated computers. Each set of hardware might have a different OS version installed. The goal is to test as many different configurations as possible. Figure 2.9 provides an example of some combinations that might need to be tested for a standard desktop application. And, some computers might have been configured in "multi-boot" configurations (where an OS could be chosen during the boot process). Regardless of the approach, the details could be complicated. Maintaining a test environment can easily by a full-time job (and might require a large dedicated team in complex environments).

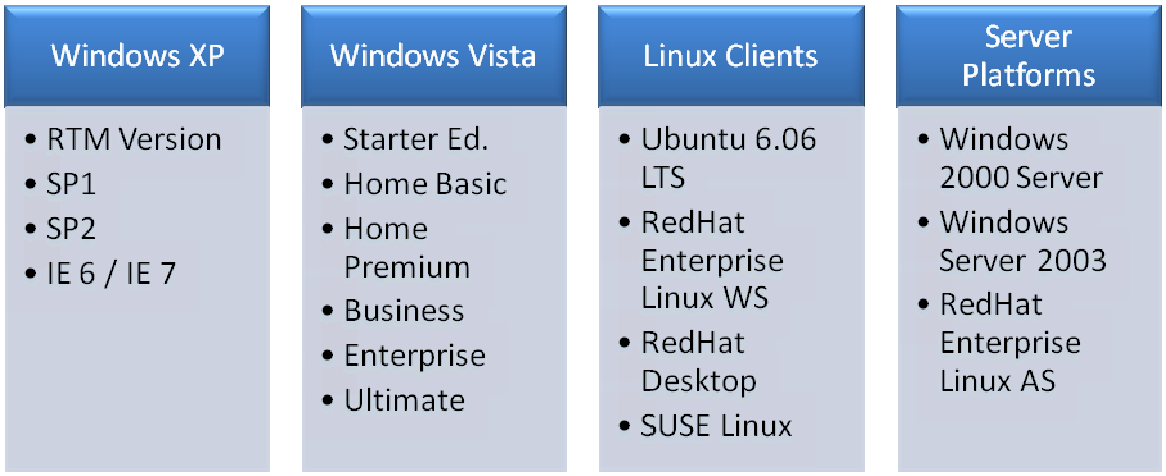

Figure 2.9: Examples of testing for different OSs and platforms.

Through the use of virtual machines, software developers and testers can perform compatibility verifications on multiple platforms much more quickly and easily. As a new virtual machine can be copied from existing ones, testing small configuration variations (such as service packs and security updates) can be as simple as copying a virtual machine and making a change.

Resetting the Test Environment

Resetting a test environment to its initial configuration can be a challenging task on physical machines. In some cases, technical staff might be required to completely wipe a hard disk and perform a manual reinstallation of the target OS. In other cases, automated utilities such as disk duplicators or network-based installations can save time. Regardless of the approach, it can be time consuming (which ultimately will limit the amount and types of testing that are performed).

Virtual machines can greatly simplify the maintenance of test environments through the use of features that allow for "rolling back" the configuration of a virtual machine. As mentioned earlier, the process can be as simple as a few mouse clicks. Usually within seconds, the virtual machine is back to the state it was in before testing began. This helps facilitate multiple iterations of testing without requiring significant downtime or personnel resources.

Simulating Complex Environments

Much software development is performed in "condensed" environments. The process of setting up separate Web servers, business logic servers, and database servers is often overkill when writing initial versions of code. For simplicity, developers will install all the required services on one or a few computers. The problem, however, is that many enterprise applications require the interaction of several components in order to work successfully in a production environment. For example, a data access middle-tier component might require adequate security to access a relational database server. Setting up such an environment can be time consuming, especially if it's necessary to simulate the use of multiple machines.

Virtual machines can help solve this problem. Instead of provisioning new hardware, a developer or tester can quickly create or connect to a virtual machine running on his own computer. It is running its own OS, so the virtual machine can be configured in a way that is similar to that of a production server. By using multiple virtual machines, a single physical computer can simulate an entire "stack" of systems that's required for a production deployment of a complex application.

Maintaining Security

An important consideration when working on creating software is that of ensuring that security is maintained. A simple fact of software development is that bugs and other issues are highly likely during the development process. In some cases, software that does not behave as it was intended can cause havoc on other computers. If, for example, the offending code was executed on a production network, it could cause problems to production servers and desktop machines.

Another potential issue is mitigating security-related issues that might be caused by improper OS configuration. Computers that are running in test lab environments are rarely administered with the same level of scrutiny as are production computers. This creates new risks, which, in a worst case, can cause problems to occur throughout the environment.

In most cases, network administrators will set up dedicated networks for test purposes. However, through the use of virtual networks, many virtual machines can be configured to interact independently of production resources (we saw an example earlier in Figure 2.5). Additionally, features that developers might have to contend with in the "real world" (such as firewalls and content caches) can be simulated on a virtual network. Multiple virtual networks can be safely created and reconfigured as needed, and without a significant level of network expertise.

Reproducing Defects

There are many challenges that software developers and quality assurance engineers face when trying to fix defects or bugs in software. In many cases, the complexity of the code itself can make it challenging to find and eliminate the source of the problem. But what if the issue is intermittent and occurs very rarely? Or what if it can only be recreated on a specific OS and software combination? With the wide array of platforms that modern software must support, this can be a very difficult problem to troubleshoot.

The primary issue is that, in order to fix a problem (and to verify that it has indeed been fixed), developers must be able to reproduce it. With physical computers, this can be difficult. If a problem occurs rarely, a programmer may be unable to determine the problem. Virtual machines provide a useful benefit that can greatly simplify the process. As virtual machines can be placed into a paused or saved state and moved around, the person who discovers a defect can immediately make a copy of the virtual machine and make it available to a developer. The problem is reproducible in that virtual machine, so it can be re-tested (and changes can be rolled back) as often as is needed to find the solution.

Overall, virtualization technology can help simplify some of the most arduous and technically challenging problems that face engineering teams. Most developers and quality assurance staff will have no problems creating their own virtual machines, so this can free up dedicated test lab management staff to work on other tasks.

Benefits for Sales and Marketing

When it comes to evaluating product offerings from software companies, potential customers often believe that working with the product is far better than just hearing or reading about it. “Show, don’t tell,” is a common request. It’s the technical equivalent of taking a car for a “test drive” before deciding to purchase it. Traditionally, software companies have relied upon distributing physical installation media to potential customers. This approach, however, leaves much to be desired.

Problems with Traditional Demonstrations

For simpler applications (such as a desktop productivity suite), installation and configuration can be a burden on the end user. Generally, he or she will have to either download the required files and/or obtain physical media. The potential customer will then have to walk through the steps required to properly install and configure it. Finally, once the evaluation is over, the application must be removed and all related changes must be rolled back.

This proposition can increase the mental barrier for many customers. It takes time and effort to evaluate the software, and there is always some risk of causing unwanted problems on a desktop computer. There are other challenges for the vendor: Distributing the installation media—whether by using physical media or the Internet—can be costly. Care must be taken to make sure that intellectual property and usage rights are secured through the use of licensing and copy-protection methods.

More complex application suites (such as an Enterprise Resource Planning—ERP—system) present even more problems. Potential customers will often require several computers in order to simulate a production configuration. Even when the hardware and personnel resources are available, the process can be time consuming. Worse, any problems that are encountered during this stage can leave users with a poor impression of the product. All of this leads to increased time due to the evaluation period of a sales cycle, and to potentially lost sales due to the difficulty of evaluating the product itself. Virtualization technology can help resolve some of these issues in several ways.

On-Demand Demonstrations

One of the best ways for potential customers to learn is by doing. Many well-designed software applications often have to be seen to be understood. The traditional process of downloading application code, setting up the code, and requesting licenses can be so cumbersome and tedious that many users might choose not to bother. In some cases, dedicated demonstration staff or sales engineers might be required to provide an adequate experience. All of this can add up to significant time and effort requirements on behalf of the vendor and the potential customer.

Through the use of virtual machines, the process of software evaluation can be simplified. By providing access to preconfigured virtual machines over the Internet, organizations can provide users with nearly instant access to a dedicated test and evaluation environment. Figure 2.10 provides an example.

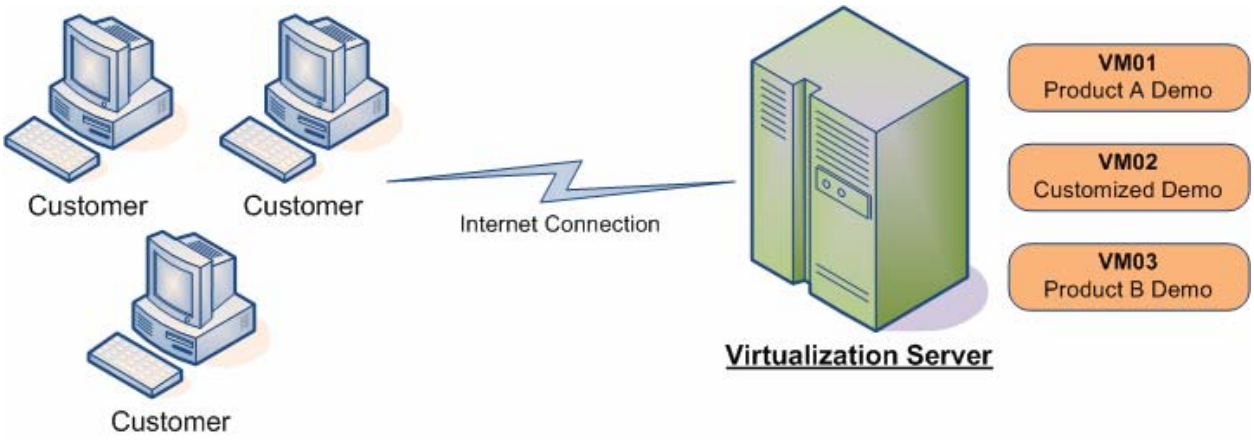

Figure 2.10: Connecting to virtual machines over the Internet for product evaluations.

One example of this approach is Microsoft's TechNet Virtual Labs (http://www.microsoft.com/technet/traincert/virtuallab/default.mspx). Using this free system, potential users of the company's many products and technologies can quickly and easily work with the products. This method can even simulate relatively complicated applications that require several different servers and applications to be properly configured. The end result is an optimal experience for the evaluator with minimal effort on behalf of the sales team.

Customized Product Evaluations

Complex enterprise applications are notoriously difficult to set up and evaluate. Often, the demonstration process requires the participation of multiple sales engineers and involves many days of effort. Customers might be required to provide hardware that can be used for the evaluation as well as the associated data center personnel resources. One key reason for this difficulty is that enterprise solutions must often be customized for client environments.

Again, through the use of virtual machines, business and technical staff can preconfigure virtual machines and make them available to users for download onto their own computers. The virtual machines themselves can run using either a desktop virtualization platform (such as VMware Player or Microsoft Virtual Server). They run in an isolated environment, so problems related to configuration and device compatibility can be all but eliminated. Examples of companies that are using this approach include VMware (access the company's Virtual Appliance Marketplace at http://www.vmware.com/vmtn/appliances/) and Microsoft (see http://www.microsoft.com/vhd).

Additional Benefits of Virtualization

Throughout, this chapter has provided ways in which virtualization technology can benefit users throughout an organization. This is by no means a complete list and specialized applications of virtual machines are likely to come up frequently. Areas such as disaster recovery and business continuity planning are important applications of virtual servers. And even desktop users can benefit from having their environments run directly on a powerful data center host computer. Business units such as Customer Support can benefit from being able to simulate users' problems in their own isolated environments.

Summary

This chapter began by looking at an overview of several features of server and hardware virtualization. Capabilities such as the option to roll back the configuration of a virtual machine and the simplicity of moving or copying a virtual machine make this technology a compelling option for many areas of a typical organization. The focus of the chapter was on ways in which various business units and personnel can take advantage of these features. Specific groups included systems administrators, training staff, and software developers.

Regardless of the specific ways in which virtual machine platforms are used, the conclusion is that this technology is not just a passing fad in IT environments. Virtualization technology can readily improve operations and lower costs throughout an entire organization. As stated at the beginning of this chapter, the question is no longer related to whether a company can benefit, but rather how to best take advantage of the features of this approach to IT management.

Download Additional eBooks from Realtime Nexus!

Realtime Nexus—The Digital Library provides world-class expert resources that IT professionals depend on to learn about the newest technologies. If you found this eBook to be informative, we encourage you to download more of our industry-leading technology eBooks and video guides at Realtime Nexus. Please visit http://nexus.realtimepublishers.com.