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Virtualization

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Learn to:

- Differentiate among the different types of virtualization
- Build a business case for virtualization
- Avoid some well-known pitfalls



Bernard Golden

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Virtualization

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DUMMIES®

3RD HP SPECIAL EDITION

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by Bernard Golden



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Introduction



The world is changing. Today, everything is mobile, connected, interactive, immediate, and fluid. Gaining a competitive or service advantage in the face of these new customer and constituent patterns requires technology that is at the very forefront of enterprise innovation and growth. Over the last few years, virtualization technologies have enjoyed uncommon growth.

Virtualization has moved from an efficiency tool to being the way IT gets done. Fueled by proven results in lowering hardware and energy costs, delivering greater admin efficiencies, increasing availability, and even lowering client computing costs, it shows no sign of slowing down, especially with the current interest in cloud computing. If you have the feeling that you can get much more out of virtualization or are just trying to understand what it is, take heart.

The purpose of this book is to provide you with an introduction to the subject so that you can understand its promise and perils — and create an action plan to decide when, where, and how to apply virtualization for maximal results. This book will help you sort out the hope from the hype and give you tools to feel confident in making your virtualization decisions.

Virtualization draws on pretty well-established technology, but certain combinations of conditions happening over the past few years have brought it into new prominence. Virtualization is being widely applied today with excellent operational and financial results — but it continues to evolve and change.

About This Book

If you're convinced that virtualization deserves a closer look, and you want to know how to implement it in your organization, this is the book for you.

Although virtualization may seem exciting (and, if not exciting, it can certainly be financially rewarding), it's not entirely painless. There's software to obtain, perhaps new hardware infrastructure to support it, people who have to be trained, and the project work necessary to migrate all your existing physical hardware to the new virtualized environment. All these things are necessary, and failing to do them raises the probability of a poor outcome for your virtualization project. Fortunately, I address these topics in this book and provide tools for you to better find virtualization happiness.

Virtualization For Dummies, 3rd HP Special Edition also discusses HP's offerings in the world of virtualization.

Icons Used in This Book

Throughout this book, you find a series of icons in the margins that help to flag special information.



This information is important. Keep it in mind, and file it away in your brain.



This icon flags a shortcut or some information that's really useful.



This icon flags technical information that you don't really need to know, but which you may find interesting.

Chapter 1

Why You Need Virtualization

In This Chapter

- ▶ Explaining virtualization's popularity
 - ▶ Saving money on hardware
 - ▶ Reducing hardware risk
 - ▶ Lowering IT operations costs
 - ▶ Increasing application availability
 - ▶ Using less energy
-

Virtualization is an approach to pooling and sharing technology resources to simplify management and increase asset use so that IT resources can more readily meet business demand. With servers or networks, virtualization is used to take a single physical asset and make it operate as if it were multiple assets. This improves asset utilization and efficiency, and decreases costs by reducing the need for physical assets. With storage or networks, virtualization is an abstracted view of underlying physical devices. This allows multiple physical assets to be combined and presented to servers and applications as if they were a single, larger asset. This dramatically simplifies server and application architecture and reduces costs. And with desktops, virtualization is used to centralize management of data and applications to reduce administrations costs and data risk.

Why Virtualization Is Hot, Hot, Hot

Four trends have come together in just the past couple of years that have moved virtualization from the musty main-frame backroom to a front and center position in today's computing environment.

Underutilized hardware

Prior to the recent surge in virtualization popularity, many data centers had servers and storage running at 10 percent or less of total capacity. In other words, 90 percent of a device's potential was unused.

It doesn't take a rocket scientist to recognize that this situation is a waste of resources. There ought to be a better way to get better use of hardware. And that's what virtualization does — by separating the logical representation from the actual underlying physical device or devices. By applying virtualization, organizations can raise their hardware utilization rates from 10 or 15 percent to 70 or 80 percent.



Virtualization enables resources to be optimized for efficiency. It breaks the one-to-one relationship of the physical assets or devices and the system view and creates *pools* of IT components that can be dynamically allocated and used as needed.

Data centers run out of space

Businesses are far more computing-intensive today than they were just 20 years ago. Many processes that used to be paper-based are now run through software systems. And, of course, the rise of the Internet has meant massive increases in e-mail, websites, video, and mobile applications.

The net effect of all this is a real estate problem for companies: They're running out of space in their data centers.

Virtualization, by offering the ability to host multiple guest systems on a single physical server, allows organizations to reclaim data center territory, thereby avoiding the expense

of building out more data center space. This is an enormous benefit of virtualization, because data centers cost in the tens of millions of U.S. dollars to construct.

Energy costs go through the roof

Power costs used to rank somewhere below what brand of soda to keep in the vending machines in most companies' strategic thinking. Companies could assume that electrical power was cheap and endlessly available. The cost of running personal computers, servers, and storage coupled with the fact that many of the devices in the data center are running at low utilization rates, means that virtualization's ability to make more efficient use of compute resources can significantly reduce the overall cost of energy for companies.

IT operations costs mount

Computers don't operate all on their own. They require care and feeding by system administrators, the people who keep the machines humming. Common system administration tasks include: monitoring hardware status, replacing defective hardware components, installing operating system (OS) and application software, patching broken applications, and overseeing end-user support costs.

Consequently, IT operations costs have risen in lockstep with the growth of overall computing resources. Companies are challenged to find ways to operate their IT infrastructures with less labor and lower costs. Virtualization, by reducing and centralizing the overall number of systems, and also by providing more flexible infrastructure, can reduce IT operations costs.

Virtualization Increases Business Agility

When business and government conditions change — and they're changing more rapidly today than they have anytime in recorded human history — it's vital for organizations to be able to respond in an instant. But the old processes

associated with physical provisioning of hardware meant that it was difficult, if not impossible, to react quickly to a changed business environment.

Virtualization makes it much easier — and much quicker — to spin up computing resources. Although it used to take days (if not weeks) to install, configure, and begin operating server, network, and storage resources, these processes can now be accomplished in minutes. Virtualization allows dynamic provisioning of resources to support applications when capacity is needed most, helping close the gap between what an organization needs and what IT can deliver.

Virtualization Increases IT Operational Flexibility

IT organizations must deal with the day-in and day-out complications of running a sophisticated infrastructure. Machine components fail; operating systems get overloaded; applications crash, necessitating restart — IT operations can be a repetitive, even Sisyphean job.

Responding to hardware failures can be a difficult task. If a key server, storage device, or even desktop device loses a critical hardware resource, it can take hours or days to replace the hardware and bring the machine back online.



Virtualization can help you deal with hardware failures or application/operating system crashes. Virtualization software can be configured to keep track of virtual machines and, if one goes down, immediately restart another instance on the same machine or even a different machine.

Virtualization Reduces IT Operations Costs

One of the biggest challenges for IT organizations is managing hardware. Obviously, hardware failures cause immediate problems. However, even in the absence of failures, IT has to maintain equipment.

Before virtualization came along, the task of maintaining and upgrading servers, storage, and PCs was anything but easy. Because production devices can't be taken out of service, maintenance and upgrades were typically scheduled for off-hours. In fact, important maintenance activities were sometimes skipped due to the difficulty of scheduling the work, which, naturally enough, led to hardware failures as poorly maintained equipment failed.

Virtualization can make maintenance and upgrades significantly easier and less expensive. On servers, it enables a running virtual machine to be migrated to another server very quickly, freeing up the original server to be worked on. Virtualized PCs (also called virtual desktops or virtual clients) allow for centralized upgrades, patching, and repair because some or all of the PC's applications and data reside in the data center rather than on the PC itself.

Of course, virtualization reduces IT operational costs in a more direct way. What does virtualization enable you to do? Use fewer physical machines. By allowing software virtual machines to take the place of physical machines, operational costs related to hardware maintenance may be cut by 60 percent or more, depending on the ratio of virtual servers to physical servers.

Virtualization can also reduce operations costs when you consider the challenges of data management. Data is increasingly vital to organizations, and the sprawl of servers has made managing data an enormous challenge for most IT organizations.



The solution many IT organizations are moving to is storage virtualization. By moving all data to a centralized system, IT organizations can manage their total data as one item, rather than piecemeal, spread across hundreds or thousands of individual servers.

By using storage virtualization, data replication is simplified. Most storage virtualization solutions come with a replication capability, enabling the same storage management system to handle the entire life cycle of data, from allocation to offline storage. By collapsing the number of tasks related to managing storage, storage virtualization reduces IT operations costs.

Quality of Service

Virtualization — when managed effectively and efficiently — can raise the quality of service provided by IT organizations.

By implementing consistent management practices backed up by software systems that track and manage IT infrastructure, whether physical or virtual, IT organizations can ensure that IT services avoid outages or uncoordinated activities.

Furthermore, by raising the quality of service, IT organizations can also ensure that the overall business service delivered to end customers is performed effectively and consistently.



Virtualizing without a plan leads to higher costs, compliance issues, and rapidly outdated technology. The last thing your company wants is random acts of virtualization. Be sure to develop an overall virtualization plan that includes hardware, software, processes, and people.

High Availability

Think of *high availability* (also called HA) as disaster or downtime avoidance. You want business applications to remain online and accessible in the event of failures to hardware, software, or facilities. Server virtualization can help to avoid both planned and unplanned downtime, including the ability to move live, running virtual servers from the affected host to another host. Some shared storage systems also feature no-single-point of failure architectures to keep storage online through a variety of failure scenarios. These architectures, when combined with server virtualization HA capabilities, minimize downtime without the complexities of traditional server clustering approaches. For more on high availability, see Chapter 3.

Disaster Recovery

Disaster recovery (also called DR) is like life insurance for IT organizations. When disaster strikes, IT operations must be brought back online as quickly as possible.

A common mechanism for DR is to have a second, backup data center with computing resources and applications ready to be made available at a moment's notice. Unfortunately, a couple of problems tend to arise when you do this:

- ✓ Keeping a second set of equipment and applications available is wasteful and expensive. Having costly resources sitting ready but unused is unworkable in today's business environment.
- ✓ A second issue is keeping data consistent between two data centers. It doesn't do much good to maintain a backup data center if all the data in the systems is weeks out of date.

Virtualization is a fantastic solution for DR. Virtual machines can be easily transferred within seconds or minutes to a backup data center; in tough circumstances, many virtual machines can be run on a smaller number of physical servers, reducing the cost of physical resources required for DR.

Furthermore, virtual shared storage can be used to replicate data across data centers, ensuring that data is consistent and making it easier to bring systems back online immediately.

End-User Manageability and Security

Virtualization is no longer limited to servers. Its benefits have been extended to end-user computers — the everyday desktops and laptops most people use.

These are fantastic devices, but they pose problems — how do you keep them up to date with application and operating system patches, virus definitions, and the like. And how do you ensure that the data on them — a critical corporate resource and often subject to strict legal and regulatory requirements — is kept safe in a world where laptops are often lost or stolen?

Between the IT operations work to keep client devices up to date and the risk of data loss, client devices impose significant costs — and IT organizations have been searching for a

way to achieve the benefits of client computing while reducing the costs and risks associated with them.

Client virtualization — the use of virtualization on client devices — enables client software images to be maintained on centralized servers and pushed out to client devices to be used in personal working environments. This centralization of client computing images makes it easier to ensure updates and patches are applied regularly. In addition, some flavors of client virtualization keep all client data on centralized servers, ensuring that data isn't stored on devices that can be lost or stolen.

One of the things driving client virtualization is that server and storage virtualization back in the data center can easily host client images and user data, making it possible for a user to operate with a single client environment from any convenient device. The user logs on from the device, and the user's client system is served up from a virtual machine hosted on the server and accesses the data stored in virtual shared storage — a virtualization trifecta! For more on the topic, see Chapter 2.

Virtualization Is Green

It's no secret that people are concerned about the phenomenon called *global warming*. Concern about the use of resources is shared widely throughout our society. You don't have to be a fortuneteller to forecast that reducing energy usage reduces costs, and being more efficient in general is important for every company.

Virtualization is ideally suited for companies wanting to reduce energy use. Rather than powering thousands of machines or disk drives, most of which are running at very low utilization rates, virtualization enables IT organizations to reduce the total number of machines and disk drives by up to 90 percent. Additional savings are possible if new, power-sipping servers are used. Even greater energy savings are possible if you look at using the newer generation of machines that are designed to serve as virtualization platforms. These machines, which include blades as well as traditional rack-mount servers from companies like HP, Oracle, and IBM, are built from the ground

up for virtualization duties. This makes them much more suitable for a virtualized infrastructure than repurposed general use servers pressed into virtualization duty.

Finally, transitioning to more secure and reliable thin clients to access virtualized computing resources from traditional, “thick client” PCs can deliver power savings as great as 80 percent.



Fortunately, virtualization supports the movement toward greater environmental responsibility and accountability extremely well. Virtualization saves enormous amounts of energy, reduces the need to manufacture so many machines, and helps data centers run more efficiently. If you think being green is going to be an issue for your organization, you need to begin planning your virtualization project right away. Companies will increasingly be judged not only on their profits, but also their environmental record and how they address the *triple bottom line* (people, planet, profit).

Chapter 2

Understanding Virtualization Technologies

In This Chapter

- ▶ Looking at server and storage virtualization
- ▶ Following virtualization throughout the data center
- ▶ Watching virtualization come to client devices

Virtualization has a number of common uses, all centered around the concept that its technology represents an abstraction from physical resources. In fact, enough kinds of virtualization exist to make it a bit confusing trying to sort out how you might apply it in your organization. The two most common types of virtualization applied in the data center are server virtualization and storage virtualization. Within each main type there are different approaches or “flavors,” each with its benefits and drawbacks. This chapter explores these basic flavors of virtualization technologies to make you better equipped to figure out exactly what your company needs.

Server Virtualization

Three main types of server virtualization exist: operating system virtualization (often referred to as containers); hardware emulation; and paravirtualization, which is designed to deliver a lighter weight (in terms of application size), higher performance approach to virtualization. I don’t cover operating system virtualization in this book.

Hardware emulation

In *hardware emulation*, the virtualization software (called a hypervisor) creates a virtual machine by emulating an entire hardware environment. The operating system that is loaded into a virtual machine is a standard, unmodified product. As it makes calls for system resources, the hardware emulation software catches the system call and redirects it to manipulate data structures provided by the hypervisor. The hypervisor itself makes calls to the actual physical hardware underlying the entire software agglomeration. Please see Figure 2-1 for a picture of a hardware emulation virtualization.

Hardware emulation is often called *bare metal virtualization*, to symbolize the fact that no software sits between the hypervisor and the “metal” of the server. In this approach to hardware emulation, the hypervisor intercepts system calls from the guest virtual machines and coordinates access to the underlying hardware directly.

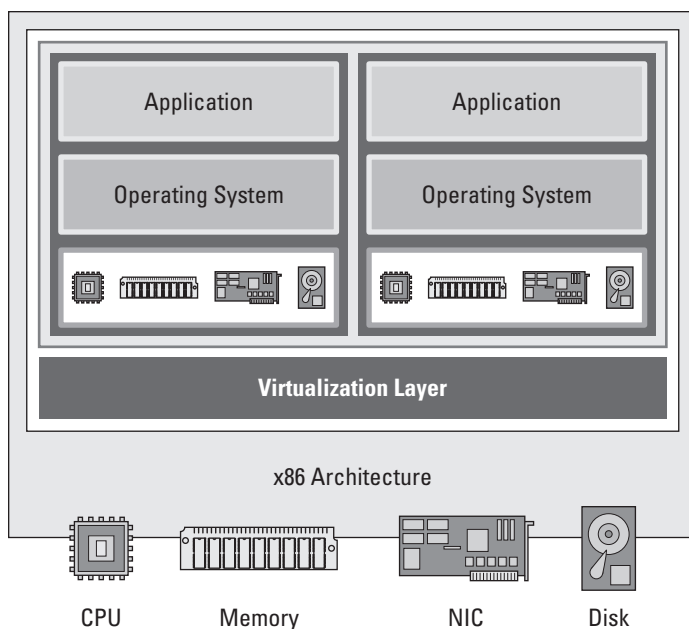


Figure 2-1: Hardware emulation virtualization.

Hypergeeky?

Hypervisor is a bit of a play on words, in that an operating system is sometimes referred to as a supervisor, so the virtualization software acts as a

supervisor of the supervisors and is therefore dubbed a *hypervisor*; this is what passes for humor in the computer science world.

Paravirtualization

Paravirtualization doesn't attempt to emulate a hardware environment in software; rather, a paravirtualization hypervisor coordinates (or *multiplexes*) access to the underlying hardware resources of the server. The architecture of paravirtualization may be seen in Figure 2-2, depicting Xen.

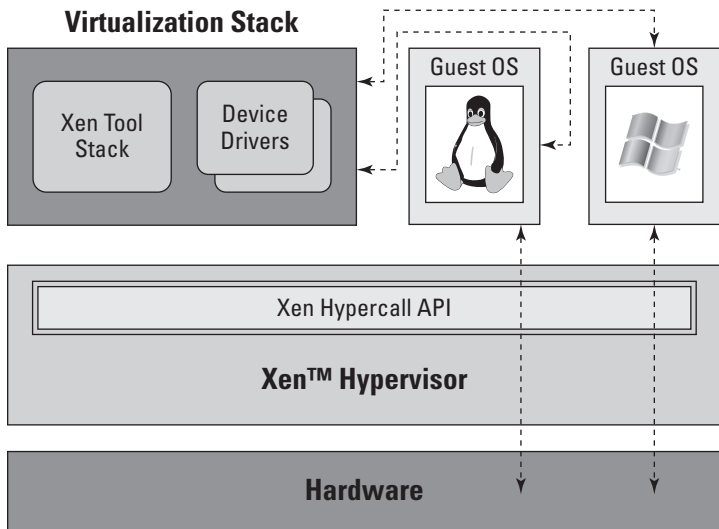


Figure 2-2: A look at paravirtualization.

In paravirtualization, the hypervisor resides on the hardware (thus, paravirtualization is a bare metal virtualization architecture). One or more guest operating systems (equivalent to the virtual machines in hardware emulation virtualization) run on top of the hypervisor. A privileged guest runs as a guest virtual

machine, but has privileges that allow it to directly access certain resources on the underlying hardware.

Virtualization players

There are three major x86 server virtualization players: VMware, Citrix, and Microsoft. There are also vendors who deliver virtualization specific to their own compute platforms such as HP. It's important to know about each of them to understand your options in moving your data center to a virtualized operation.

- ✓ **VMware:** VMware is the best-established virtualization provider with a large installed base of server virtualization customers. VMware's flagship platform, vSphere, uses hardware emulation.
- ✓ **Citrix:** Citrix, which offers a server virtualization product called XenServer, uses paravirtualization. The privileged guest (called the Control Domain in Xen parlance) and the Xen hypervisor work in tandem to enable guest virtual machines to interact with the underlying hardware.
- ✓ **Microsoft:** Microsoft's server virtualization product is called Hyper-V. Its architecture is very similar to that of Xen. Instead of the term *domain* being used to refer to guest virtual machines, Hyper-V refers to them as *partitions*. The counterpart to Xen's Control Domain is called the Parent partition.
- ✓ **Hewlett-Packard:** Hewlett-Packard provides a broad portfolio of virtualization products across server, storage, network, and client hardware, as well as management software, consulting services, and outsourcing services. It works closely with the other virtualization technology leaders to integrate these capabilities into deployment-ready solutions. HP's integrated delivery and outsourcing capabilities can capitalize your assets and return on investments.

Storage Virtualization

The amount of data that organizations are creating and storing is exploding. This tremendous growth in storage requirements has made storage virtualization increasingly important.

Storage virtualization is the process of abstracting logical storage from physical storage. The physical storage resources (such as disk drives) are aggregated into storage pools, from which the logical storage is created and presented to the application environment.

Storage virtualization can be implemented within the storage arrays themselves (*array-based* virtualization) or at the network level where multiple disk arrays or networked storage systems from different vendors, scattered over the network, can be pooled into a single monolithic storage device. This allows the multiple arrays to be managed uniformly as if they were a single pool.

Virtualized storage arrays offer more flexibility, simplified management, and better performance and capacity utilization in comparison to traditional disk arrays.

There are two major types of shared networked storage systems where you will find storage virtualization incorporated: NAS and SAN systems.



A shared storage system (SAN or NAS) is required for your company to take advantage of the advanced capabilities of server virtualization, such as migrating live virtual machines, high availability, fault tolerance, and disaster recovery.

Network-attached storage

Network-attached storage (NAS) is a storage device that sits on your network and offers storage to servers on the network. It allows multiple clients, like PC users, and servers to share files over a Local Area Network (LAN). NAS uses file-based protocols such as NFS or SMB/CIFS where it is clear that the storage is remote, and computers request a file rather than a disk block. Moreover, with all the files moved to a central location, it is much easier to manage them — instead of having to keep track of files spread among dozens, hundreds, or even thousands of machines, all the data is located in one place, enabling better backup, archiving, and so on.

One advantage of NAS is that it is IP based and simple to deploy and manage. Common uses of NAS include rapid file storage for rich media, document and backup files, and e-mail.

Storage area networks

A *storage area network (SAN)* is a storage device (such as a disk array or tape library) accessible to servers so the devices appear as locally attached to the operating system. A SAN typically has its own network of storage devices that are generally not accessible through the regular network by regular devices. A SAN alone doesn't provide the "file" abstraction like NAS, only block-level operations.

Most SANs use *Fibre Channel connectivity*, a network technology specially designed to handle storage communications, or *iSCSI*, which is an IP-based networking standard for linking storage devices.

Companies move to SAN storage to centralize the management of corporate data. Common uses of a SAN include provisioning of transactionally accessed data that require high-speed block-level access to the storage hard drives such as e-mail servers, databases, and high usage file servers.

I/O Virtualization

Server virtualization addresses machines operating on a physical server, making it possible to run multiple virtual machines on a single physical system. Storage virtualization enables data to be shifted to a centralized, shared storage pool, allowing it to be managed efficiently and cost-effectively. However, getting data off the machine requires going through network and storage endpoints on the server, which can raise another set of issues.

What good does it do to have virtual machines and storage that can be virtualized and migrated as needed, when the physical endpoint I/O devices that reside on the server are not agile? Manually managing a key resource in a virtualized environment means that an IT organization can operate only as efficiently as it can manually manage these I/O devices.

Fortunately, there has been a movement afoot to virtualize these devices as well — to make them more intelligent and able to have I/O context switched among physical devices,

thereby enabling quick system migration and removing the agility barrier of physical devices.

Network Virtualization

Well, if everything else is virtualized, it's obvious that the network itself must also become more agile and more capable of being managed as a virtual resource, rather than requiring manual activity to respond to changing workloads or business conditions.

Therefore, virtualization has been moved into the network itself. Instead of network changes being accomplished by moving cables between and among different physical network resources, virtualization technology is applied to the network itself.

Network virtualization allows the network to be reconfigured on the fly without any need to touch a single cable or device. Instead, virtualization-capable network devices are managed remotely and can be reconfigured logically.

This ability to perform network modification remotely and logically completes the virtualization of the data center. Every type of resource — from server to storage and everything in between — is no longer physically tied to specific pieces of hardware. Instead, every type of resource can be addressed logically and reconfigured without any need to physically set hands on it.

Client Virtualization

Virtualizing doesn't solve all the problems of IT organizations — far from it. A vast number of client devices are used throughout companies; in many companies, nearly every employee has his or her own PC, whether a desktop device or laptop, plus smartphones and notepads are now in the mix.

Keeping all those devices current with operating system patches, application updates, virus and spyware definitions, and so on is a virtually (pun intended) unending task. It's

made all the more difficult by the fact that these machines are located with the user — far flung among offices and, increasingly, in home offices and temporary work locations like Starbucks. Keeping track of the devices themselves and ensuring they're kept secure has lent impetus to the move to client virtualization.

Application virtualization

Application virtualization refers to a separation of program execution from program display; in other words, a program like Microsoft Word executes on a server located in the data center, but the graphical output is sent to a remote client device. The end-user sees the full graphical display of the program and is able to interact with it via keyboard and mouse.

A variant of application virtualization is one in which the application doesn't execute on a server in the data center, but on the client device. The difference from the traditional mode of application use lies in the way the application is managed — instead of being installed permanently on the client device, it is sent (referred to as *streamed*) to the client device each time it is fired up. This “install at every use” mode may seem repetitive, but it enables an IT organization to control the application better — to ensure that it is kept up-to-date with versions, patches, and all that jazz.

Desktop virtualization

Unlike application virtualization where one or more applications are displayed or streamed from a central server, in *desktop virtualization* a user's entire PC executes on a central server, with the graphical display output to a client device. You'll often hear this form of client virtualization referred to as VDI, which stands for Virtual Desktop Infrastructure.

The advantage of this approach is that it's easier to keep client systems updated with patches and so on. This is because instead of managing individual systems that are located hither and yon, IT groups can manage them in a centralized location.

New developments in desktop virtualization have optimized this form of virtualization. Instead of needing to store one desktop image for each user — in other words, for 4,000 users you need 4,000 disk images, thus necessitating lots (and lots) of storage, even though much of each image is identical — this latest form uses one single image that's cloned as required. This cloning cuts down enormously on the amount of needed storage and makes the economics of desktop virtualization even more attractive.

What's that you say — if my desktop is cloned each time, what happens to my favorite app that I use every day? Is that going to disappear with desktop virtualization? Have no fear; individual options and data can be kept separately and applied to the cloned image to ensure that you have your favorite apps and data when you bring up your desktop.

Desktop virtualization often uses an inexpensive client device for the end-user display and interaction. These *thin clients*, as they're known, can be cheap devices with little computing power and no local disk storage. This can reduce the cost per employee end-user device significantly — the hardware is less expensive, but they typically use less energy, take up less space, and require less help desk support.

Desktop streaming

A variant of desktop virtualization is *client check-in, check-out*. In this form, the ongoing storage of the client system is centralized, but when the end-user is ready to begin work, the client system is transferred down to the client device, where it is used like a traditional PC. When the session is over, the user closes the system down, the PC image is written back to the central repository, and nothing remains on the end-user hardware.



This check-in, check-out form of client virtualization is just getting going, but it holds great promise for environments where the availability of high-speed network connectivity is uncertain. For example, when someone is working remotely from home, it may not be clear if their connection is robust enough to allow application virtualization or traditional desktop virtualization; in these cases, a one-time download of the desktop to a client device may be a good option.

Chapter 3

Understanding Virtualization Use Cases

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In This Chapter

- ▶ Looking at server consolidation
 - ▶ Using virtualization in system development and testing
 - ▶ Understanding failover
 - ▶ Pooling your servers
 - ▶ Discovering disaster recovery
-

Virtualization is useful in a number of scenarios. They range from simple and straightforward to complex and transformational. Understanding how you want to use virtualization will dictate which virtualization solution is most appropriate for you. This chapter goes over some of the main uses of virtualization.

Studying Server Consolidation

The first application of virtualization is usually server consolidation. In fact, server consolidation is what most people think of when they consider virtualization. *Server consolidation* refers to taking separate server instances and migrating them into virtual machines running on a single server. To be technically correct, consolidation is also the act of taking a number of separate servers and migrating them onto fewer servers, with multiple virtual machines running on each server.

Companies implementing server consolidation often move from running 150 physical servers to running 150 virtual machines on only 15 servers, with a corresponding reduction in hardware investment, power and cooling, employee time, and, in many cases, software licensing costs. This kind of consolidation can offer up to 60 to 80 percent utilization improvement. Please see Figure 3-1 for an example of how virtualization helps consolidate servers.

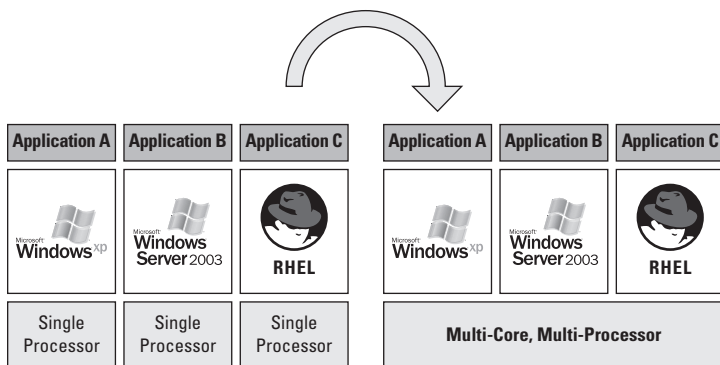


Figure 3-1: Consolidating servers with virtualization.

Development and Test Environments

Imagine, if you will, a typical challenge in the software development world. An engineer builds some software to implement certain functionality. To fully develop it, the software must be run and tested on a variety of systems (for instance, Windows and Linux) as well as various versions of those products.

So a quality group takes the software and tests it in all the various configurations to ensure it meets applicable requirements for functionality, scalability, robustness, and ability to withstand incorrect use.

By using virtualization, a developer or tester can replicate a distributed environment containing several systems on a single piece of hardware. This negates having a bunch of servers sitting around for the occasional use of developers or testers.

Virtualization is also useful in test and development environments in another way. One of the side effects of exercising software is that early versions often crash and damage not only the application, but also the underlying operating system as well as other applications in the software stack. To recover, it's necessary to reinstall all the software. Again, this is a real drag on productivity. With virtualization, only the application under test and its associated virtual machine and related software are impacted. Please see Figures 3-2 and 3-3 for examples of how virtualization can be applied in development and test environments.

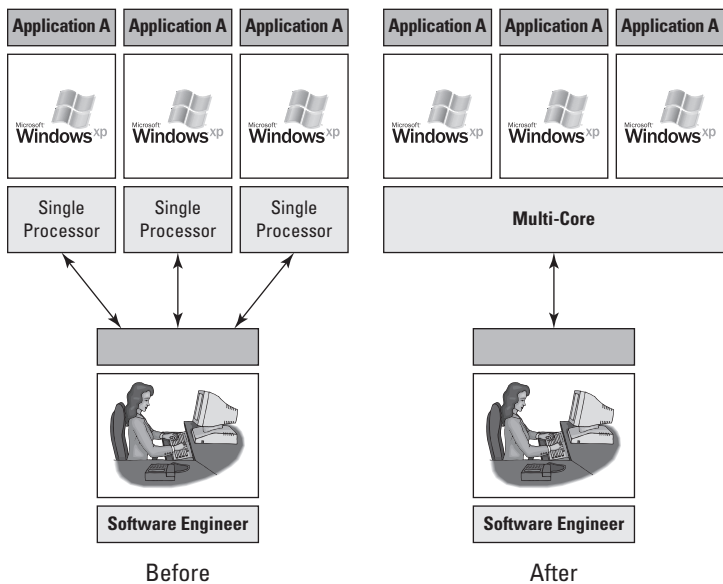


Figure 3-2: Using virtualization for development.

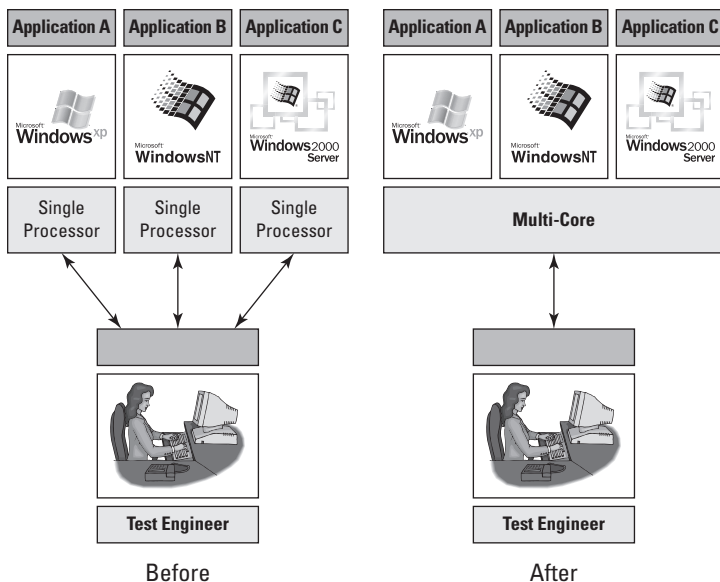


Figure 3-3: Using virtualization for testing.

Private Cloud Computing

Simply put, cloud computing is a means of providing on-demand technology services over the Internet. A *private cloud* is an environment where these services are operated solely for a single organization. Many IT organizations are exploring how to build their own private clouds to increase agility and lower costs. Virtualization is a key component of private clouds because it allows for rapid provisioning and de-provisioning of on-demand services.

Quality of Service

IT organizations must focus on the quality of service they deliver — how well they keep applications and their underlying infrastructure available and performing well.

Fortunately, virtualization, when properly managed, can help improve quality of service because it removes hardware

dependence. By virtualizing systems, you can more quickly respond to failures of all types: hardware, network, even virtualization software itself. It can also be used to pre-emptively avoid failure by moving workloads off a system that is showing signs of problems (memory, disk, and so on).

Given the demands on IT organizations to continuously improve their operations in order to achieve business goals, it's incumbent upon them to explore how virtualization can help improve quality of service.

Companies run many applications that they consider *mission-critical*, which is a fancy term meaning that the company relies on these applications for a fundamental part of their business.

Simple failover

The hypervisor is constantly monitoring each virtual machine's status, so it's relatively straightforward to configure it to start a new instance of a virtual machine should it notice a previously running virtual machine is no longer present. Because all the hypervisor has to do is start a new virtual machine based on the VM's image, the outage duration of a virtual machine may be mere seconds. Obviously, this is a huge improvement over the minutes-to-days durations typical of non-virtualized system restores.

High availability

High availability (HA) extends the concept of simple failover to incorporate an additional hardware server. Instead of a crashed virtual machine being started on the same piece of hardware, it is started on a different server, thereby avoiding the problem of a hardware-precluding virtualization failover.

But how does HA work? After all, how can a hypervisor on one physical server start a VM on another hypervisor? The answer is, it can't.

HA relies on overarching virtualization software that coordinates the efforts of multiple hypervisors. When a VM on one hardware server crashes, the coordinating software starts another VM on a separate hardware server.



Actually, it's a bit more complex than that. The coordinating virtualization software is constantly monitoring all the hypervisors and their VMs. If the coordinating software sees that the hypervisor on one server is no longer responding, the software then arranges to restart the VMs that were on the failed hardware on other hardware.

So HA addresses the issue of hardware failure by using higher-level virtualization software to coordinate the hypervisors on two or more machines, constantly monitoring them, and restarting VMs on other machines if necessary.

This certainly addresses the issue of hardware failure and makes failover more robust. It should be noted that moving to this multi-machine virtualization is more complex than the single-machine situation. Part of the state of a virtual machine is its network address and its storage resources. If you move a VM to another piece of hardware, these bits of its state need to move as well or the new VM won't be able to locate its storage nor connect to the networks. So HA requires the virtualization software to be able to migrate these parts of the VM's state to another physical server and configure that server's hypervisor to use the VM's state from the original, failed hardware. See, I told you HA is complex.

Some HA software can even watch what's happening within a virtual machine and restart the application it was running in a different virtual machine. So it addresses questions of application software failure, too.

HA provides an extra layer of failover protection at the cost of additional virtualization software complexity. You may have noticed, though, that even HA doesn't provide for the ability to migrate current VM memory state to the second machine; put another way, even though you gain the ability to begin executing a VM on a second machine, users working on the original VM will lose the state of their work. Depending on the application's value, even that bit of lost work might be unacceptable; after all, if your application is processing multi-million U.S. dollar underwriting transactions (or, just as bad, hundreds of multi-thousand U.S. dollar underwriting transactions), losing even a bit of work might be significant.

Clustering

Clustering is designed to ensure that no data is lost in the event of a software or hardware failure. Clustering has typically been offered by application vendors as an add-on to their base product, with some attendant drawbacks like extra expense, redundant solutions, and infrastructure complexity. Part of the extra expense reflects the fact that you need extra hardware, with the mirrored system on standby, ready to take over should the primary system fail. You don't need to be a genius to recognize that buying a second set of hardware makes clustering a significant expense. However, if you've got millions of U.S. dollars worth of transactions occurring on your system, keeping a redundant server ready may be a worthwhile investment. And techniques exist that can allow you to run other work on the stand-by server until it is needed.

How does clustering work? Essentially, the coordinating virtualization software runs two VMs on separate machines. The VMs are identical in terms of the OS and application configuration, but differ, naturally, in the details of their network connections and local hardware. The virtualization supervisor constantly communicates with the clustered VMs to confirm they are working (this is usually referred to as a *heartbeat*, signifying the continued existence of the entity).

One VM is the primary server and is the system that users interact with, and the second VM serves in a backup capacity, ready to stand in should the primary server go down. The primary server constantly sends any changes to the secondary server so that its state reflects that of the primary VM at all times. If the primary VM goes down, the virtualization supervisor notes its unavailability and transparently switches users to the backup server. New users connecting after the switch don't see anything different — they're just connecting to what looks like the same application and are unaware it's running on a different VM. Users that have been connected to the original VM that is no longer available also are unaware of the switch, because the virtualization software has been sending their state to the secondary machine all along. They may notice a short break in responsiveness while the switch is made, but it's usually so quick that no one notices.



You may have noticed that one drawback still remains in virtualization clustering: You still have redundant, unused backup capacity in the form of a VM that is kept up to date but performs no work. Although running a VM on a virtualized server is certainly less expensive than dedicating an entire server to acting as a hot backup, there is still some cost to running a mirrored VM. One alternative is HP's PolyServe software, which works with industry-standard hardware such as HP ProLiant servers and HP's portfolio of storage arrays to consolidate and virtualize NAS in Linux or Windows environments. With the software, information from file or database servers can be consolidated into a single, shared pool of storage that is highly available and can scale to match business demands.

Data mirroring

All of the quality of service mechanisms I've discussed thus far address how to keep virtual machines up and running. But what about data? After all, applications inside virtual machines are useless without data — so clearly it's important to ensure data availability as part of an overall quality of service strategy.

One way of keeping data available is to *mirror* it. As the name implies, mirroring data means that data in one place is reflected to another, ensuring that they're exact copies of one another.

Mirroring enables real-time consistency between two data stores. This makes it possible to immediately shift between one system and another by attaching the second system to the mirrored data.

Mirroring achieves this real-time consistency by feeding a constant stream of data changes — whether additions, updates, or deletions — from one location to another.

To do its job well, mirroring needs to be very efficient. If too much data is forwarded, the traffic would make it difficult to keep updates from occurring in real-time. On the other hand, it's important that every bit of important data is sent to the mirror so that quality of service can be achieved. Therefore, as you can imagine, mirroring software is very savvy stuff, indeed.

Data replication

Data replication is a second service oriented toward improving data quality of service. Unlike mirroring, which focuses on keeping copies of data consistent in real-time, replication addresses the need to keep complete copies of data available so that they can be used for system rebuild purposes.

Replication is typically accomplished by sending copies of data to a centralized storage location, enabling an organization to be certain that it has copies of critical data securely stored in case of a need to recover some specific data assets.

Again, efficiency in operation is vital for replication — just because the data is being moved to a storage location doesn't mean that keeping the data flowing efficiently isn't important.

Smart replication software keeps up-to-the-minute changes flowing to the central location, thereby ensuring that an IT organization can quickly locate data assets and use them to rebuild a failed system.

IT Operational Flexibility

IT organizations need to be ready to respond to changing business conditions. The one-word term for this is *agile*. When you think of an agile athlete, you probably envision someone who can quickly change course, can stop on a dime, and — very important — can change action according to what happens in the external environment.



These are the requirements for today's IT organization. It must be ready to grow or shrink the computing resources devoted to particular applications. It must implement infrastructure and processes that reduce the amount of manual intervention required to change the computing resources used. In short, today's IT organization must be ready to speedily move in any direction to respond to internal or external environment changes.

Load balancing

Load balancing protects against a system being vulnerable to any given error condition by implementing redundancy — in the case of load balancing, redundancy is achieved by running more than one copy of a virtual machine on separate servers. When you run two instances of the virtual machine and one VM crashes, the other continues to operate. If the hardware underneath one of the VMs fails, the other keeps working. In this way, the application never suffers an outage.

Load balancing also makes better use of machine resources. Rather than the second VM sitting idly by, being updated by the primary machine, but performing no useful work, with load balancing, the second VM carries half the load, thereby ensuring that its resources aren't going unused.

The use of duplicate resources can extend beyond the VMs themselves. Companies concerned with achieving high levels of availability often implement duplicate networks with each physical server cross-connected to the rest of the network, which ensures that the VMs will continue to be able to communicate even if part of the network goes down.

Moving to virtualized storage can help with load balancing — combining storage and server virtualization gives maximum flexibility, improved utilization, and easier administration. Networked storage is required if the VMs are running on different servers.

Load balanced VMs may also be configured to act as clustered VMs and share state between them. That way, if a VM crashes, its work can be picked up and continued by the other VM.

Server pooling

With *server pooling*, your virtualization software manages a group (or pool) of virtualized servers. Instead of installing a VM on a particular server, you merely point the virtualization software at the VM image, and the virtualization software figures out which physical server is best suited to run the VM.

The server pooling software also keeps track of every VM and server to determine how resources are being allocated. If a VM needs to be relocated to better use the available resources, the virtualization software automatically migrates it to a better suited server.

You manage the pool through a management console, and, should you notice that the overall pool of servers is getting near to your defined maximum utilization rate, you can transparently add another server into the pool. The virtualization software then rebalances the loads to make the most effective use of all the server resources.

Naturally, because you have no awareness of which physical server will be running a virtual machine, your storage must be networked so that a VM on any server can get access to its data.

In my view, this is the future of virtualization. In the near future, IT departments will look back on manually installing operating systems on individual servers, or even on managing groups of virtual machines on individual servers, as a crude, inefficient practice.

Helping with Disaster Recovery

Disaster recovery refers to products and processes that help IT organizations respond to catastrophic situations, ones far worse than a single VM crashing or a piece of hardware failing. Disaster recovery comes into play when an entire data center is temporarily or permanently lost. In complete data center loss, IT organizations need to scramble to keep the computing infrastructure of the entire company operating. Think Hurricane Katrina: When it struck, many IT shops lost all processing capability because their entire data centers were inundated. As if that weren't enough, Internet connectivity was lost as well due to telecommunications centers being flooded. Spare capacity inside your data center when a catastrophe strikes won't help. To protect yourself from truly awful weather, earthquake, or man-made disasters, you need disaster recovery capability.

Discussing the overall requirements for disaster recovery is too large a subject to be addressed in this book, but suffice it to say that you need spare data center capacity, the ability to bring OSs and applications back up, and a way to manage the migrated infrastructure. In addition, you need a well-considered disaster recovery process, so that if a disaster occurs, the IT staff can execute a documented — and rehearsed — plan.

Virtualization can help with the application recovery and ongoing management tasks. Any of the failover, HA, clustering, load balancing, or server pooling virtualization capabilities may be applied in a disaster recovery scenario (see the preceding sections on these topics for more information). It just depends how much you want to physically manage during the disaster recovery process.



Because VM images can be captured in files and then started by the hypervisor, virtualization is an ideal technology for disaster recovery scenarios. As you can imagine, in a time of disaster, needing to locate physical servers, configure them, install applications, configure them, and then feed in backup tapes to get the system up to date is a nightmare. And keeping spare computing capacity in a remote data center that completely mirrors your primary computing infrastructure is extremely expensive.

With virtualization, a much smaller set of machines can be kept available in a remote data center, with virtualization software preinstalled and ready to accept VM images. In the case of a disaster, VM images can be transferred from the production data center to the backup data center. These VM images can be started by the preinstalled virtualization software, and can be up and running in just a few minutes.



If you're uncomfortable with the risk that some transactions might be lost in the case of a disaster that strikes suddenly, leaving no time to migrate VM images, you can run clustering or load balancing virtualization configurations, enabling the two data centers to remain consistent.

With this set up, you get the peace of mind of knowing that if you did lose access to data in one location, you don't lose one of your most valuable assets — your data.

Chapter 4

Game-Changing Results from Virtualization

In This Chapter

- ▶ Looking at infrastructure from a virtualization perspective
 - ▶ Finding out how virtualization can help applications and IT operations management
 - ▶ Knowing what to keep in mind with client virtualization
-

Traditional data centers, although offering excellent data processing capabilities, suffer from limitations that make them less than satisfactory for the IT needs of tomorrow. They're made up of isolated systems, each providing specific functionality, but also unable to cooperatively work with other systems. The traditional "one application, one server" model, typical of many data centers, strands applications on physical servers, unable to share data, limited in the ability to fully utilize hardware, and, due to fixed infrastructure architectures, severely limited in the ability to rapidly respond to changing business conditions.

Virtualization provides real benefits in terms of business performance: lower energy costs, better hardware utilization, and more robust IT infrastructures.

However, you may feel a little overwhelmed by the range of choices facing you and not sure how to move forward with virtualization; in other words, you may be asking yourself: "How do I get from where I am today to where I want to go with virtualization?"

Hewlett-Packard can help. The following section explains how virtualization fits into HP's overall view of how data

centers can be better managed and created, which HP calls the Converged Infrastructure. HP offers solution-oriented hardware, software, consulting, and outsourcing services. HP Enterprise Services offers a large presence and track record in server management and virtualization outsourcing expertise. The rest of the chapter explains how easy virtualization is with HP to help you and how HP virtualization can help you save money and increase agility through hardware, software, consulting, and outsourcing services.

Converged Infrastructure

If one thing should be clear from this book, it's that virtualization is changing the way IT does business. And when you change the way you do business, you need to examine all your pre-existing assumptions and practices to make them align with the new reality.

Trying to graft virtualization onto existing infrastructure will hinder you from realizing all the benefits the technology offers. A better approach is to rethink your infrastructure with an eye toward how it must change to incorporate virtualization.

Here are some areas to take a look at:

✔ **Take a comprehensive view of your infrastructure:**

Rather than approach virtualization as a piecemeal effort, review your overall infrastructure and plan how you can apply virtualization throughout your entire data center. Ask yourself these kinds of questions: What servers can be virtualized? What applications should remain on stand-alone systems? What storage and networking systems do you need to support a highly virtualized environment that enables the easy movement of virtual machines and their application workloads? With answers to these questions, you're prepared to move forward with your virtualization strategy.

✔ **Refresh with technology designed and optimized for virtualization:** When it comes time to replace existing hardware or add capacity, make sure that the new products are virtualization-ready. Servers, storage, and blade systems are being designed with virtualization in mind, including increased memory, automated load balancing, more network connections, and even embedded

virtualization software. Be sure that your new infrastructure equipment can support your virtualization plans.

✓ **Create a networked or shared storage environment:**

While direct-attached storage was fine for the “one application, one server” world of the past, for today’s agile IT organization, storage that can’t be shared is a handicap, keeping systems isolated and unable to respond to changing business conditions. A shared storage system (SAN or NAS) is required to take advantage of the advanced capabilities of server virtualization such as migrating live virtual machines, high availability, fault tolerance, and disaster recovery. And by the way, your storage itself should be virtualized, so that it meets the performance, availability, utilization, and management requirements of virtualized server and desktop environments.

✓ **Virtualize your network connections:** The connections that link servers to storage area networks (SANs) and local area networks (LANs) can be a major infrastructure barrier. Every change requires manual intervention, slowing down your agile IT organization. Virtualized network connections allow these potential choke points to be managed remotely, thereby removing bottlenecks.

✓ **Manage virtual and physical resources with the same tools:** Too many IT organizations install a virtualization management solution next to their existing resource management solution — and then they wonder why workload has gone up, not down. A better approach is to use tools that let you manage physical and virtual devices in the same way, from the same interface.

The goal of this effort is to realize the maximum benefits possible in terms of meeting business service needs: gaining the maximum payoff while reducing costs to the lowest possible level. Virtualization can help you on both the business outcome and the cost reduction sides. But the overarching goal that drives the virtualization effort should be meeting business service needs.

Here are some products from HP that can help in efforts to rethink your infrastructure:

✓ **HP Virtual Connect:** Insulating server hardware from I/O connections by putting a virtualization layer in between physical servers and the network they connect to, HP

Virtual Connect makes it possible to define a server/network and storage configuration once. Any subsequent changes to the physical servers are managed by Virtual Connect via the Virtual Connect management tools by the system administrator. This means that the tedious work of coordinating system, network, and storage administrators necessary to manage physical equipment changes are no longer necessary. Servers can be changed at will without affecting the network or storage infrastructure.

- ✓ **HP BladeSystem Matrix:** HP BladeSystem Matrix is a converged infrastructure solution delivering the benefits of shared services — an ideal foundation for a private cloud. It provisions complex infrastructure and applications in minutes rather than months and reduces total cost of ownership significantly versus traditional infrastructure. HP's Server Management Services offering from HP Enterprise Services supports a converged infrastructure architecture. HP Services combine design, implementation, and ongoing hosting and management of the HP BladeSystem Matrix infrastructure to help IT organizations accelerate complex IT projects, management tasks, and lower costs across the data center.
- ✓ **HP Matrix Operating Environment:** Part of the Insight software portfolio, HP Matrix Operating Environment is advanced infrastructure management for the x86 architecture that lets you continuously analyze and optimize your physical and virtual resources in exactly the same way. This powerful tool makes your infrastructure more efficient and agile, with built-in capacity planning functionality and integration of the physical and virtual management functions. The Insight software portfolio also includes HP Systems Insight Manager and HP Insight Control for essential infrastructure lifecycle management. The Matrix Operating Environment is the set of integrated software components that power the BladeSystem Matrix solution. The components of the Matrix Operating Environment are:
 - The capability to design and define service templates, the ability to initiate the deployment via a self-service interface, to quickly build service catalogs, and to manage the pool of resources before and after the deployment

- The ability to do ongoing capacity planning and workload visualization
- The capability to failover and recover workload resources over distances up to continental in distance (for ProLiant only)

The Matrix Operating Environment (OE) capabilities are integrated with key Insight Control components to provide virtual and physical management of a BladeSystem Matrix environment, which enable the deployment and management of workloads within a private cloud environment. The Matrix OE also enables the creation of service catalogs and customization of services to a client's specific requirements.

✓ **HP Virtual Server Environment:** HP Virtual Server Environment (VSE) for HP Integrity Servers provides an automated virtual infrastructure that can adapt in seconds with mission-critical reliability. HP VSE allows you to optimize server utilization in real time by creating virtual servers that can automatically grow and shrink based on business priorities and service-level objectives. HP VSE works in tandem with high-availability operating systems, such as HP-UX, to enable the virtualization of mission-critical environments. The virtualization capabilities are highly integrated into these mission-critical operating systems, making virtualization on HP Integrity servers powerful and seamless. See Figure 4-1.

✓ **HP ProLiant BL495c virtualization blade:** The BL495c is designed specifically to host virtual machines. It includes:

- Up to two AMD Opteron 2300 Series processors with AMD Virtualization technology to improve performance in a virtual environment.
- 16 DIMM slots, supporting up to 128GB of memory, that deliver outstanding memory-per-core and memory-per-VM ratios among half-height blades.
- Integrated dual-port 10 GbE server adapter with Flex-10 technology that lets you cut network connection costs up to 75 percent per VM.
- Dual-link HyperTransport connections between processors that provide additional performance gains over traditional single-link connections.

- ✓ **HP Enterprise Services: Server Management Services:** Offers services that keep clients' business applications and databases running reliably, securely, and cost-effectively. This service includes the planning, deployment, configuring, hosting, and ongoing support of server environments that are hosted at HP Enterprise Server Management Services or client data centers. The service employs standardization, virtualization, automation, and ITIL-based best practices. Since clients' applications and databases are critical to their success, the offering is an ideal solution for the enterprise that needs to focus on its core business. Server Management will streamline their server environments, improve their total cost of ownership, ensure global service delivery excellence, and secure their logical and physical resources.
- ✓ **HP P4000 G2 SAN Systems:** HP StorageWorks P4000 G2 SAN Solutions deliver enterprise functionality that enhances virtual environments, simplifies management, and reduces costs. Easy to deploy, scale, and maintain, HP P4000 SANs ensure that crucial business data remains available. HP StorageWorks P4000 G2 SAN Solutions are great for virtual servers, client virtualization, database, e-mail, and business applications.

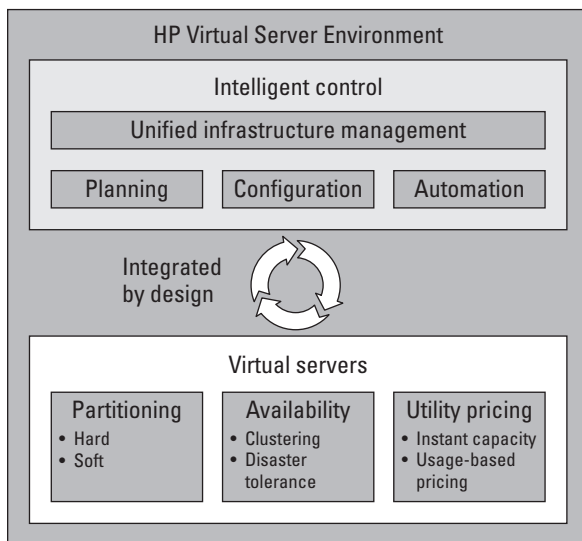


Figure 4-1: HP VSE for HP Integrity.

- ✓ **HP 3PAR Utility Storage:** HP 3PAR Utility Storage is the next generation of Tier 1 storage. HP 3PAR Utility Storage delivers the agility and efficiency demanded by the virtual data center and cloud computing environments. Exclusive virtualization features such as wide striping, thin persistence, and autonomic management capabilities built into HP 3PAR Storage Systems deliver unique benefits that take server virtualization to the next level.
- ✓ **HP StorageWorks EVA:** This product offers system-wide virtualization of all disk resources managed by the EVA controllers. Whereas other systems group disk drives into discrete physical RAID groups that increase management burden by having multiple physically distinct RAID groups, the HP StorageWorks EVA uniquely binds a physical disk into groups of blocks and distributes all resulting RAID groups across all disk drives. The result: automatic workload (capacity and performance) distribution to all disks in the array, while delivering one of the easiest arrays to configure in the industry. In fact, EVA takes up to 50 percent less time to manage compared to traditional disk arrays.
- ✓ **HP ProCurve Data Center Networking Solutions:** With ProCurve 6600 switches and Data Center Connection Manager (DCM), your data center network integrates into the HP Converged Infrastructure to streamline IT workflows, deliver faster time to service, and increase utilization. DCM works with HP Network Automation Software to automate network provisioning workflows between network and server IT teams in virtual environments.

First American: One out of many

In 2007, First American Corporation standardized on virtualization. Using VMware on HP BladeSystem c-Class server blades, it virtualized 50 percent of its servers. The 4,500 open systems run on 2,250 physical machines. That means First American has been able to avoid

buying, maintaining, and feeding electricity to 2,250 physical systems. Yet, it gets essentially all the benefits of their capabilities.

Moving ahead, the company plans to virtualize more and more of its servers when they're scheduled to be refreshed. First American

(continued)

(continued)

is a textbook example of the benefits possible from extensive virtualization.

"Consolidation let us experience firsthand the value of virtualization, VMware, and HP BladeSystem," says Jake Seitz, an enterprise architect at First American. "We're now able to on-board new business much faster than before," adds Aaron Andrews, director of distributed systems. "If we were physically moving server hardware, it would be much more difficult. But by virtualizing servers, we can bring the acquired servers as images into our lab, test applications, and easily move them onto the production floor. On-boarding that would have taken a year before now takes two months."

First American has chosen to standardize on the HP ProLiant BL680c G5 Server Blades. "Our objective is getting the maximum density of virtual machines (VMs) on each server," Andrews says. "We chose these servers because in our benchmark tests, they really were twice as fast as models that had dual core chips."

The company currently has 300 HP c-Class server blades and 270 HP p-Class blades. The latter will be upgraded to c-Class when it's time to refresh them. The c-Class server blades are in 25 HP BladeSystem c7000 Enclosures. Ten of those

enclosures contain virtualized servers.

More are on the way. "We're about to virtualize another 600 servers onto 30 to 40 more server blades," Andrews says. "We're fitting what would be ten racks of traditional servers into one 10U HP BladeSystem enclosure."

The IT team found that eight HP server blades inside an HP BladeSystem c7000 Enclosure can accommodate 180 VMs. That means the space required by 180 servers is reduced by 98 percent. "We're going from ten racks to 10U," Andrews says.

Power requirements also drop by 90 percent. The 180 rackmounted servers would consume 450 watts each, totaling 81 kilowatts, Andrews notes. Running 180 VMs on ten server blades consumes 6.7 kilowatts. The result is that 74.3 kilowatt-hours are saved for each enclosure. Multiply this savings by ten enclosures over a year, and the result is a projected annual power savings of \$714,000.

Additional energy savings will come from a desktop virtualization project the company will host in its HP BladeSystem environment. The team is rolling out VMware Virtual Desktop Infrastructure, which will convert existing desktops to thin clients. Watts per hour for each endpoint will drop 93 percent from 118 to 9.

Consolidated IT Operations Management

The key to matching business requirements to IT operations is to create a link between business service requirements and the physical and virtual resources required to deliver those services. Furthermore, those resources must be managed in real-time to ensure that applications and infrastructure are always ready to meet their service requirements.

Here are some areas that you should think about in your efforts to “real-timeify” your operations management:

- ✓ **Think of virtualization in the context of a business service:** By using a business service perspective, you’re driven toward managing virtualization as part of an overall effort of meeting business service requirements.
- ✓ **Monitor business services across physical and virtualization infrastructures:** Today’s complex business processes are driven by multiple applications, which can sit on physical or virtual infrastructures. Managing from a business services perspective enables you to track IT operations across the spectrum of IT resources and optimize holistically rather than separately among physical and virtual systems. Using a unified approach toward physical and virtual management will avoid things falling through the cracks between two different management approaches.
- ✓ **Incorporate virtualization into service management processes:** Service management solutions provide consolidated processes, such as incident, problem, and change management for the distributed enterprise. They also enable consistent processes for managing and enforcing license compliance across virtual and physical environments. Moreover, you can align all resources and processes during your service level optimization initiatives.
- ✓ **Integrate virtualization into quality management:** One of the highest payoff areas where virtualization can be applied is in quality assurance and testing efforts. Using virtualization in these areas can speed them up by orders of magnitude by removing repetitive manual efforts.

Virtualization also helps implement consistency, because identical resources can be used throughout the quality lifecycle, thereby removing intermittent errors due to misconfiguration or inconsistent installation.

Here are some products from HP that can help in efforts to rethink your applications and IT operations management:

- ✔ **HP Performance Management software:** Provide end-to-end application stress testing across physical and virtual environments. You can quickly and accurately pinpoint the root cause of application performance problems.
- ✔ **HP Business Service Management solutions:** Link business services to underlying physical and virtual infrastructures to provide insight into the health of IT services. HP BSM provides the tools required to identify performance problems before end-users are affected, optimize the performance of virtual infrastructures, and provide accurate decision support data for automating changes to the environment.
- ✔ **HP Operations Orchestration software:** Increase common orchestration and automation of workflows across physical and virtual infrastructures to improve management and maintain the availability of business services.
- ✔ **HP Client Automation software:** Manage a complete spectrum of virtual client solutions, including both end-user devices such as thin clients and PCs, as well as virtual applications and images located on servers in the data center.
- ✔ **HP Server Automation software:** Manage heterogeneous physical and virtual servers. Administrators can create and configure VMs on existing servers, run audits of configurations and interconnections, enforce compliance for virtual environments, and show inventory of VMs and their storage/cluster configurations.
- ✔ **HP Network Automation:** Deliver real-time visibility, automation, and control of your ever-changing network, allowing you to improve security, achieve network compliance, and save money. It supports both physical and virtual network switches.

- ✓ **HP Storage Essentials software:** Get a comprehensive storage resource management and storage automation for physical and virtual infrastructures.
- ✓ **HP Discovery and Dependency Mapping software and the HP Universal CMDB software:** Achieve consolidated views of physical and virtual IT infrastructure and services. HP Discovery and Dependency Mapping software natively discovers deployed hypervisors and maps the relationship of these logical elements to the overall business services they support.
- ✓ **HP Service Manager software:** Leverage discovery data and service dependency maps of virtual and physical resources to provide consolidated management of incident, problem, and change processes across heterogeneous environments.
- ✓ **HP Data Protector software:** Assure business continuity in virtualized environments by providing zero downtime backup of application data and images that span virtual and physical servers.

Client Virtualization from Desktop to Data Center

Client virtualization is the newest frontier in virtualization technology, but one that pays enormous benefits to organizations going forward (for more on the topic, see Chapter 2). Although server virtualization improves data center operations, client virtualization can improve results for every other part of the organization — in other words, for the vast majority of the employee base.

There are several approaches to client virtualization. Each has value, and should be applied in the right circumstances to ensure maximum value is obtained. To that end, here are some things to keep in mind when thinking about client virtualization:

✓ **Keep your business service requirements in mind:** The traditional desktop PC provides tremendous productivity to workers, but may not fulfill all your business goals. For example, it may be important to centralize company data so that important laws or regulations are followed. Another example is that disaster recovery needs may dictate that applications and data be kept inside data centers, where they can be rapidly moved via virtualization to other data centers.

✓ **Target the right technology to the right end-user group:** The varieties of client virtualization mean that different types of employees may be best served by different solutions. Here are some examples:

- Server-based computing solutions provide remote application access to a shared, centralized desktop operating environment. It can be a cost effective means to increase client security and to enhance data protection and manageability for light-usage, task-based workers.
- Virtual Desktop Infrastructure (VDI) provides fully functional and personalized desktops delivered across the network from a shared server. Each virtual desktop is isolated and secure in the data center, sharing physical data center resources for optimal resource allocation through virtualization. It is ideal for basic office productivity applications and allows IT to maximize utilization, lower costs, and increase reliability.
- Blade workstations provide data center and remote access capabilities for workstation-class users. Ideal for specialized applications with heavy graphics, blade workstations deliver seamless workstation performance for a rich end-user experience along with centralized control and security in the data center.

✓ **Keep storage needs in mind:** Pretty much every client virtualization solution requires moving data off the local device and into a centralized storage solution. Be sure to incorporate storage requirements and options into your client virtualization planning so that you implement a storage approach that can support each type of client solution you implement.

- ✓ **Take a consistent approach to your client virtualization effort:** Because you can implement a number of different client virtualization technologies, they need to all work well together. Obtaining different solutions from different vendors may cause your overall client effort to be harmed — and certainly will hinder your ability to meet business service requirements. Find a way to ensure that all your client virtualization products cooperate; it may be desirable to look to a single vendor to provide the portfolio of client solutions.

HP Network Automation delivers to Terremark Worldwide Inc.

As a leading global provider of IT infrastructure services, Terremark Worldwide Inc. faces the constant challenge of managing a multi-tenant environment of shared systems and multiple devices while engaging staff efficiently and meeting its Service Level Agreements. A key tool in this effort is HP Network Automation software. Using the HP solution to automate network change, configuration, and compliance management, Terremark meets its aggressive goals for activation speed, process accuracy, network availability, and security. To its customers, that means reliable, cost-efficient access to advanced network technologies. To Terremark, it means high quality customer service and accelerated revenue generation.

At Terremark, HP Network Automation replaces time-consuming and complicated processes. Before adopting this HP solution, in order to program an automation, Terremark

had to write code to specific vendor application programming interfaces. "We'd have to learn or relearn a new API for each vendor of network gear and then write code specific to that," says Howard Grodin, Terremark's Senior Director of Program Management. "We wanted to consolidate into a single tool offering multi-vendor support and high availability."

To find the optimal solution, Terremark conducted an extensive evaluation of vendor software offerings. HP Network Automation came out on top. "It performed in every scenario we threw at it in a proof of concept, including things like setting up a highly available environment, the ability to support multiple device vendors, and the robustness of the APIs," Grodin says. Network device drivers within HP Network Automation software enable the interfacing between the Network Automation core and unique

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vendor devices. This delivered the broad vendor device coverage that Terremark needed and that HP competitors could not match. "Those drivers differentiated HP Network Automation from the others," Grodin says.

Terremark used HP Software Professional Services during the initial design and implementation. This included on-site HP Software and IT Service Management training for roughly 40 end-users and administrators at Terremark's Dallas and Miami data centers. Because Terremark runs 24/7 with multiple shifts, HP also offered the option of online coursework. "It was nice that HP had that flexibility," says David Newton, Terremark's Vice President of Operational Support Systems and Development. "It wouldn't have been practical to send that many people to HP sites. Instead, HP came to us, and we were able to focus more clearly on the problems we were trying to solve."

HP Network Automation is a key enabler of creative innovation at Terremark, Newton says. Managed networks and managed hosting are different in nature, yet each uses the software for its own ends. "We have different groups that leverage the software in completely different ways; it's flexible enough to allow that kind of culture while bringing consistency across multiple product

lines, multiple locations, and different engineering organizations."

Terremark's leading-edge Enterprise Cloud, for example, lets customers deploy server capacity on demand by controlling a resource pool of processing, storage, and networking resources — without buying costly, cumbersome servers. HP Network Automation has cut the service setup time from 24-to-36 hours to minutes — getting the customer functional faster and accelerating revenue generation for Terremark. "When we set up Version 1.0 of The Enterprise Cloud, firewall configurations were manual and took at least a day," Newton says. "Now deployment of firewalls is reduced to minutes and is done in real time, when the customer is activated."

Working with HP, he adds, has been highly satisfying. HP representatives' product knowledge and responsiveness is outstanding. However, the relationship goes beyond that. HP has proved itself a true partner in envisioning and building toward the future. "We need a vendor that understands innovation," Newton says. "Working with HP has really opened my eyes as to HP's capabilities as a software as well as a hardware provider. It goes beyond point solutions. There is a strategy to HP's software suites and the interrelationships between them — a road map to the workflow and data sharing capabilities of tomorrow."

Here are some tested and proven interoperable products from HP that can help in efforts to rethink your client virtualization:

- ✓ **Thin clients:** Get the highest return on your investment in client virtualization with highly secure, affordable, and reliable HP thin clients. HP's thin client technology leadership has built an industry-leading portfolio that offers maximum flexibility through industry-standard hardware, open software platforms, and simple management integration to support any client virtualization infrastructure and most any user — from the basic task worker to the most demanding power user.
- ✓ **Session-based computing:** HP provides one of the most complete solutions for your session-based computing environment, including servers, clients, and printers designed and tested to support Citrix and Microsoft.
- ✓ **Virtual desktop infrastructure (VDI):** This integrated virtualization solution of hardware, software, and management tools replaces the traditional desktop configuration model and is delivered with industry-leading partners: Citrix, Microsoft, and VMware. Built on proven and trusted HP ProLiant and BladeSystem servers, HP VDI reference architectures were designed for business size and usage patterns to simplify adoption, leveraging real-life implementation experience and HP engineering and testing.
- ✓ **Blade Workstations:** HP Blade Workstations portfolio includes the affordable HP ProLiant xw2x220c and powerful HP ProLiant xw460c Blade Workstation as two options for helping businesses combine the centralized security and control of a data center with just-like-local workstation performance. In addition, both blade workstations support HP Remote Graphics Software, an advanced utility that compresses streaming video, high-end graphics, audio, and USB redirection for seamless delivery over a standard Internet connection, along with real-time 2D and 3D multimedia collaboration between professionals in multiple locations.
- ✓ **HP StorageWorks:** HP's StorageWorks portfolio provides scalable storage options and solutions with a choice of arrays to support the data needs of the clients while delivering higher levels of data protection and information security. This includes the HP P4800 BladeSystem SAN, which was purpose-built for client virtualization and is a cornerstone of the HP Client Virtualization Reference Architectures.

Client virtualization for Deloitte Netherlands

Deloitte Netherlands is the country's largest firm offering accountancy, tax, consultancy, and financial advice. It is part of the Deloitte Touche Tohmatsu group, which has offices in over 128 countries and employs 140,000 people worldwide.

While Deloitte Netherlands employs the equivalent of 6,500 full-time workers, the headcount is actually 8,300 people because of the popularity of part-time working in the Netherlands. Because it is an accounting and auditing firm, it also has a high percentage of mobile staff using notebook computers.

"Unfortunately, while part-time work is big in the Netherlands, we do not have part-time computers," says Erik Ubels, chief information officer for Deloitte ICT Solutions, the division responsible for business technology in Deloitte Netherlands' 40 offices. "A desktop or notebook is given to a person for 100 percent of the time so while we may be providing 1,000 computers, it may only equate to 700 full-time positions, which means we have a relatively high cost."

Deloitte wanted to find a solution for this problem and it also wanted to extend its strong standardization policy. This had already covered notebook computers, smartphones, and printers but not its 1,400 varied desktops which had been acquired

at different times and for many different requirements.

There was an obvious answer and it was HP's client virtualization. Client virtualization shifts desktop computers and storage out of the work environment and into the data center. Users then seamlessly connect either to traditional servers or server blades using desk mounted thin clients or mobile devices.

An important part of HP's solution is the software that manages virtualization from the data center to the desktop. HP Session Allocation Manager (SAM) software allows Deloitte to increase efficiency by giving priority to certain groups of people. Also available is HP Remote Graphics Software (RGS), which allows you to remotely access and share the graphics workstation desktop, allowing remote employees to collaborate on projects digitally, in real time.

"While we are absolutely confident of significant savings, we only recently deployed HP client virtualization, and since we are accountants, we are awaiting real figures," says Ubels. "However, from an investment perspective, instead of having 1,400 desktops we can run on 700 to 800 blades, so we have already saved half the cost and I think I can double that with other things that HP is enabling us to do."

Chapter 5

When to Ask for Expert Help

In This Chapter

- ▶ Understanding when to look for help
- ▶ Mitigating project and support risk
- ▶ Asking for right skills

This chapter gives you some expert tips on when to call in the cavalry. While you're moving your virtualization solution to the next level, you will begin to appreciate the benefits that virtualization brings if planned, designed, and implemented successfully. You want to make sure your virtualization initiative is a success story, and sometimes you need help to make sure that's the case.

Mitigating Enterprise-Wide Deployment Risks

Virtualization is a journey, not a product. Just as any lengthy journey requires preparation, multiple steps, and ongoing oversight to ensure a happy outcome, so too does virtualization. A successful virtualization journey requires astute planning, careful implementation, and use of appropriate outside expertise. As you move your virtualization initiative to the next phase with broader enterprise scope, you will need to think about data center performance, integration needs, virtualization management, and process best practices.

A good source for outside expertise is an organization like HP Technology Services or HP Enterprise Services. HP Technology Services understands end-to-end strategy, design, implementation, operation, and support aspects of virtualization while

providing technical depth for heterogeneous environments. Additionally, HP Enterprise Services brings 45 years of expertise as an industry leader providing virtualization outsourcing solutions.

Making Smart Technology Decisions

Are you looking at different technology options and don't know how to start comparing them in an objective way? You can start by making a business case comparing the costs and benefits of your virtualization alternatives. Then test your most likely scenario with a proof-of-concept or pilot. There are many considerations to take into account before investing in a particular technology. Plan for expert help upfront to bring in objective analysis. Look for a partner that has strong VMware, Microsoft, and Citrix partnerships, as well as applications expertise and solid infrastructure skills. HP's workshop, business value, and proof-of-concept services are designed to help you with a strong start to your virtualization journey.

Remembering Skill Mix and Re-Skilling Needed

Another potential area for consideration in a virtualized environment is finding the right skills to successfully implement virtualization inside your enterprise. Implementing virtualization in a small, pre-production environment is relatively easy and usually doesn't require outside help. However, the impact of virtualization (architecture, people, and processes) is much more complicated on a bigger scale. Bigger projects require strong project management, plus architectural, technical, methodology, and life-cycle skills along with understanding of support for virtualized environments. Plan for additional help upfront and understand the skills needed. More than likely you will need training for your internal staff, who will need to work across boundaries and new technologies. HP Education services offers training for virtualization. Or, if you don't have the time to invest in internal skills, HP can help you with outsourcing solutions.

Chapter 6

Ten Steps to Your Next Virtualization Project

In This Chapter

- ▶ Making virtualization a journey
 - ▶ Finding ways to make your virtualization journey an easy one
-

If you're raring to go with virtualization, but want to approach your first virtualization project methodically, this chapter covers ten steps to keep in mind as you create your project plan.

Remember That Virtualization Is a Journey, Not a Product

Any significant project requires careful planning and monitoring. You should move through the planning, implementation, and operations stages deliberately, with careful project tracking and milestone evaluation.

Virtualization makes the process of project planning even more important because after IT organizations start to get some of the benefits of moving to a virtualized environment, they start to consider whether there are other areas where they could apply virtualization. Truthfully, virtualization can be extremely seductive — after you start to get the hang of it, you look for additional applications of the technology.

Evaluate Your Use Cases

What is a use case? Simply put, it is a definition of how you will — or might in the future — apply virtualization. Where a use case becomes extremely important is in helping you identify virtualization capabilities that you may not need today, but that could become important in the future.

Because there are a number of different ways to use virtualization technology, you should think through how you are likely to apply it. Moreover, some thought should go into how virtualization might be used in the future. This is because the range of products that can be used for virtualization tends to narrow as you move to more complex applications of the technology.

Here's a great way to get started:

- ✔ **Virtualization Workshop:** Two-day intensive workshop delivered by HP Technology Services consultants who will cover a 360 degree overview of virtualization. The focus will be on the server, management, and security aspects of a virtual environment. The customer will then be equipped with the general knowledge of how virtualization will aid them and better able to determine their next steps in approaching a virtualization environment.
- ✔ **Virtualization Proof of Concept:** The recommended next step is the Virtualization Proof of Concept (POC) service. This is a three-week intensive engagement delivered by HP Technology Services consultants who will lead a set of activities on the following topics: management, continuity, failover, disaster recovery, and high availability as prioritized by the customer. As each topic can be very consuming, the customer and the consulting team will agree on a subset to focus on prior to the start of the POC service. An assessment will follow this engagement, citing areas for further investigation, improvement, and next steps.

Review Your Operations Organization Structure

It's tempting to treat virtualization as a purely technical matter, but that would be a huge mistake. It's a fact that humans are political (or, at least, social) animals. That means that decisions, even technology decisions, confront the fact that people have emotional biases that affect their acceptance of new initiatives.



Many IT operations groups are organized along functional groupings. In other words, one group manages servers, another manages the network, and yet another manages storage. Virtualization, however, integrates these different functions into a single unit — so these autonomous groups need to collaborate and cooperate. Therefore, examine the human side of your IT operations to ensure smooth virtualization sailing.

Define Your Architecture

Defining your virtualization architecture is a fancy way of saying that you must take your use cases and insights gleaned from your organizational structure and define your virtualization infrastructure design.

This design is absolutely critical and should definitely be reviewed with all interested parties. This review process serves two purposes:

- ✓ **It ensures that you have captured everyone's needs.** If you review the architecture with someone and you hear that the operations groups would like to implement a more automated management capability, that conversation may steer you toward a certain set of products.
- ✓ **It tends to generate awareness and commitment from the different groups for your virtualization project.** By building a sense of inevitability, you will generate momentum for your project, which is important.

Select Virtualization Software

Now that you've defined your virtualization architecture, you can select the product or products you will use in your virtualization project. By this time, selection should be a relatively straightforward exercise, since you've identified what functionality must be present in the virtualization architecture.

In the past year, your options have become much more numerous and diverse. On the server side, products from VMware, Citrix, and Microsoft are available. A number of storage virtualization products are in the market. And, of course, virtualization is being extended into new areas like networking. It's a far richer portfolio, but with such a plethora of potential solutions, you need to carefully select products that meet your use case requirements.

Select Virtualization Hardware

A key thing is to ensure your hardware is virtualization-ready. Many organizations try to repurpose old hardware and find it doesn't scale or fully support the desired use cases. So, during this step, look for virtualization-ready hardware. HP's ProLiant BL495c and Flex-10 are examples of hardware that come prepared for virtualization. Whenever you virtualize servers, you should also evaluate your storage infrastructure. The HP StorageWorks P4000, 3PAR, and EVA are all shared storage systems that meet the demands of server and client virtualization deployments and are tightly integrated with the virtualization software platforms.

Perform a Pilot Implementation

Confirming that your project assumptions and choices will actually work in production is vital. Unfortunately, many people wait to find out until they actually go into production with their new system, which is obviously the wrong way to go about this.

The way to avoid these gotchas is to try out your selected virtualization solution in a controlled test environment — in other words, do a pilot implementation to ensure that everything works properly.

Implement Your Production Environment

This is the stage in which you order software and hardware, install any necessary data center equipment (for instance, power connections and so on), install the virtualization software and hardware, and confirm that you're ready to move forward with migration to your new virtualized architecture.

This step has to be executed flawlessly, because if the infrastructure's not right, the production systems won't work properly. So install everything, make sure it boots up properly, and do some initial testing to ensure everything is working as it should.

Put Governance and Policy in Place

Virtualization greatly reduces the effort to implement new systems. That can cause problems as new systems are spawned with little oversight — so-called virtual server sprawl.

Avoid this sprawl by putting processes and policies in place. This goes by the term *governance*, which, as you might expect, implies structure and formal rules by which the use of IT resources are governed.

Manage Your Virtualized Infrastructure

Finally, you've implemented your virtualization infrastructure and gotten your physical servers migrated to it. You've had the party and handed out the T-shirts. Do you think you can rest now?

Not a chance. You need to manage (or, you might say, administer) your new environment. Furthermore, to get the maximum benefit from your new virtualization capabilities, you need to integrate them into your overall management process, so that you can manage physical and virtual systems with the same tools, the same processes, and the same people. This is particularly important because organizations are changing the way they implement systems today — they may keep them virtual throughout the development and rollout phases, or may develop virtually and roll out physically. For this reason, using a management process and product suite that can easily manage both physical and virtual is important. HP Software's automation and management products and services are designed for the new world of mixed environments, so look for solutions like these to manage your environment.

If you want to focus on your core business and not worry about managing the virtualized environment, HP can do that for you. To better align your systems with enhanced IT services, HP provides you with multiple sourcing options — including full outsourcing to meet your rapidly changing requirements. Consumption-based utility services delivery is available with their Standard and Select Services. By managing servers better, you gain the efficiencies, economies of scale, and capabilities to align your technology with your business. That means you maximize your server return on investment (ROI) and can focus on strategic priorities.

Chapter 7

Ten Virtualization Pitfalls to Avoid

In This Chapter

- ▶ Remembering to train
 - ▶ Keeping the future in mind
 - ▶ Being organized
-

This chapter discusses ten pitfalls to avoid in your virtualization project. They're drawn from both personal experience as well as observations of how other organizations have suffered as they moved forward with virtualization.

Don't Wait for Perfection

The virtualization field is in a great deal of flux because so many exciting things are going on; sometimes it seems like a new product or service is available every day. Some people embrace a rapidly changing field because they expect it offers tremendous potential. Others hang back, with the thought that they'd prefer to defer taking action until things are more stable.

Don't Skimp on Training

One of the most bewildering things about IT organizations is that they will invest huge sums in new hardware and software, but skimp on ensuring their employees know how to use their new systems.

Don't Expose Yourself to Legal Issues: Compliance

Another potential area for consideration in a virtualized environment is software licensing. When single physical systems are provisioned and presented as multiple systems, and virtual systems usage is variable, historical licensing agreements and assumptions can change.

Furthermore, with the rise of virtual appliances and the vastly larger number of systems possible because of virtualization, keeping track of software licenses is both more important and more difficult. So be sure to put processes into place as part of your overall IT governance to ensure you keep track of licenses and maintain compliance with all your responsibilities. Solutions like HP Asset Manager can help track software licenses across virtual and physical environments while HP Business Service Automation solutions can automate compliance across physical and virtual infrastructures.

Don't Imagine That Virtualization Is Static

Not only will your business conditions dictate that you continually evaluate how well your virtualization infrastructure meets current business realities, but virtualization itself is constantly changing. This means that your state-of-the-art virtualization solution implemented 18 months ago may need to be examined in light of new virtualization developments.

Don't Skip the "Boring Stuff"

It's fun to install software and see new things come up and run. It's not nearly as much fun to do use case interviews or design reviews. But keep in mind that those "boring" tasks make the fun stuff possible. In fact, unless you complete these boring tasks, you probably won't get the go-ahead to move forward with the project and have fun doing the interesting stuff.

Don't Overlook a Business Case

In these times of short rations for IT organizations, there's no surer way to get your project shot down than by ignoring the business case for it. On the other hand, there's no surer way to ensure your project gains executive support and sails through the approval process than by demonstrating the impressive financial benefits available by moving forward with the project.



This means it's incumbent on you to evaluate the financial impact of moving to virtualization and to present that information as part of the project approval process.

Don't Overlook the Organization

Because virtualization affects so many groups, it's important that you work with each of them and convince them that virtualization will make their work lives better and easier. This includes not only technical groups, but business sponsors as well as senior management. When you change infrastructure, you affect lots of groups, so be sure you include all of them in your project planning.



The key is to make your organizational work models and flows explicit and track their lifecycles as they move through the various groups in your organization. Put a tracking mechanism in place so that nothing falls between the cracks.

Don't Overlook the Hardware

Virtualization is software that enables other software resources to take better advantage of underlying hardware. But don't imagine that the hardware itself has no effect on virtualization. Far from it. The type and capability of the hardware you use to host your virtualization solution can dramatically impact the virtualization density you achieve, as well as the performance levels available for your virtual machines or blade clients. Whether the target hardware is blades, a large server or storage arrays in a SAN, or the SAN itself, make sure it is capable of supporting the type of solution you are implementing.

Don't Overlook Service Management

Most virtualization platforms come with their own set of management tools. Although many of these tools work well within their own domains, they're not mature or robust enough to manage beyond their intended platforms. They also tend to require additional training to run and maintain and produce management information that resides outside of accepted standard operations procedures. Rather than adopt one set of tools and procedures for virtualization and another for physical environments, look for management solutions that manage both physical and virtual environments in common. Also work to ensure the virtual environment is managed as part of an overall service framework rather than as a separate parallel infrastructure. HP offers management and service solutions to meet both of these requirements. HP also provides full outsourcing if you prefer to have your environment managed so you can focus on your core business. HP will host your data within their secure data centers or provide highly trained personnel to manage your on-site centers.

Be Prepared for Even More Virtualization in Your Future

Virtualization makes it easy to create new systems — reducing the effort from days or weeks to mere minutes. Likewise, the cost can be reduced by an order of magnitude.

Given this ease of system creation, some organizations find that they suddenly have a surfeit of systems — they're sprawling all over the place! And while the cost and effort of creating one virtual system is low, if you begin to suffer from a surfeit — well, watch out! So be sure to keep an eye on the total number and growth trends of your virtual machines. You'll be glad you did.

You may wonder, "When will this virtualization effort be finished?" The short answer is: never. Virtualization is being applied to new areas of the technology infrastructure, and it seems like every day brings a new product to the market. So get used to the process of ever more virtualization in your infrastructure — it's not likely to end for the foreseeable future.

Get the lowdown on virtualization

If you think virtualization deserves a closer look, and you want to know how to implement it in your organization, *Virtualization For Dummies*, 3rd HP Special Edition, can help you out. This newly updated edition gives you an introduction to the subject so that you can understand its promise and perils — and create an action plan to decide whether virtualization is right for you. This book helps you sort out the hope from the hype and gives you tools to feel confident in making your virtualization decisions.

- **Tackle virtualization basics** — *from emerging trends to reasons why virtualization is hot today*
- **Sort out virtualization technology** — *several different “flavors” of virtualization exist*
- **Figure out how to use it** — *certain environments are better for virtualization than others*
- **Understand some HP technology** — *HP is here to help you out with virtualization and some of their technology is particularly suited to it*
- **Get the help you need** — *how to know when to call in the pros*



Open the book and find:

- **Helpful case studies**
- **Explanations of common virtualization technologies and applications**
- **How to optimize quality of service**
- **Great ways to get virtualization rolling**
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