

Server Virtualization: Decrease IT Cost and Data Center Space

Decoupling hardware from software reduces complexity, adds flexibility.

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Executive Summary

An uncertain business world still calls for reductions in Total Cost of Ownership (TCO). Yet, today's IT manager must also focus on expanding efficiencies and enhancing optimization. Fortunately, server virtualization can assist in each of these areas.

This game-changing technology offers a proactive approach to IT management. It can help businesses minimize IT complexity. Server virtualization can increase network flexibility. And at the same time it can help lower TCO and provide a surprisingly fast ROI.

The technology can be viewed as part of an overall virtualization strategy that includes client virtualization along with storage optimization. It also supplements infrastructure optimization, thereby making IT more of a strategic asset and business enabler.

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Data Center: Situation Analysis

Dynamic in nature, the role of technology is critical in supplementing organizational initiatives. Innovation in hardware and software often helps facilitate the tactics required to meet business strategy deemed essential to success. The adoption of virtualization is a current, prominent example of how such innovation is occurring.

With the explosive growth of data center use in the 1990s and after, challenges emerged. The cost to support a sprawling physical infrastructure increased dramatically. With server sprawl, up to 85 percent of each server's resources can go unused. The resulting excesses in hardware, power, cooling and management can lead to infrastructure instability and excess spending.

A less than robust economy is putting greater pressure on IT organizations to cut costs. Capital Expenditures (CAPEX) and Operating Expenditures (OPEX) have come under the axe. Budgets are also being reduced based on future uncertainties.

Subsequent reductions in IT staffing are also requiring greater efficiencies. Increased productivity is seen through improving server uptime and flexibility. The same can be said for speeding the availability of new servers and improving disaster recovery (DR) processes.

It's evident there has been a rapid adoption of virtual environments as a way to reduce data center hardware costs, improve energy efficiency and enhance operations. Experts believe this trend will only accelerate in 2010, increasing the deployment of server and client virtual machines.

Server Virtualization: The Basics

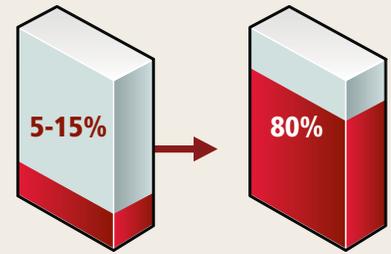
In its most basic sense, server virtualization removes physical barriers and decouples one technology from another, thereby removing intricate dependencies. From a practical standpoint, it allows running multiple independent virtual operating systems (OSs) and applications on a single physical computer.

The technology permits combining and consolidating workloads on a smaller number of physical servers to maximize the investment in hardware. It separates the physical resources from the applications that use them. The main goal is to reduce costs and increase hardware utilization.

In addition, the technology offers solutions to many of the challenges that IT departments face today. In fact, according to "Computerworld's 2010 Forecast" survey, 64 percent of the 312 professionals polled stated that

SERVER VIRTUALIZATION AND THE CURRENT SERVER FLEET — With advances in hardware and software over the past two years, businesses are finding that 60 to 80 percent (or more) of their current servers are good candidates for virtualization.

Consolidating server hardware via virtualization offers ways to increase utilization of existing hardware from 5-15% up to 80%



It can also serve to:

- Reduce hardware requirements by a 10-to-1 ratio or better
- Accelerate server provisioning time by 50-70%
- Reduce energy costs by 80%
- Power down servers without affecting applications or users
- "Green" the data center while decreasing costs and improving service levels

their organizations are likely or very likely to virtualize more servers in 2010.

What's more, the tech research firm Gartner estimates that 55 percent of all new workloads will be deployed on virtual servers this year. This is up from 40 percent in 2009.

IT Challenges

It doesn't take much to realize the IT industry landscape has dramatically evolved over the last decade. Businesses have gained access to greater technological capabilities through inexpensive x86 server systems as well as the applications and operating systems that run on this platform.

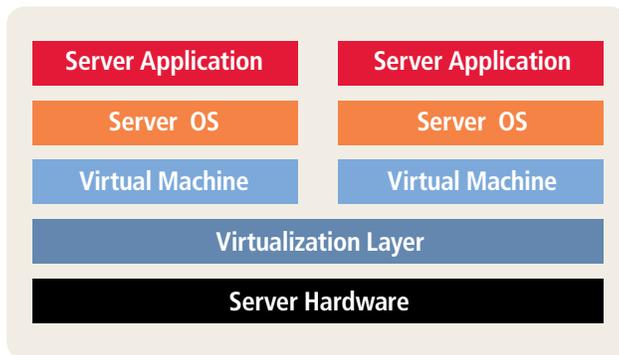
However, adoption rates increased so rapidly that many businesses today now face a myriad of difficulties. Fortunately, server virtualization can serve as a potential remedy. These issues include:

- Low server utilization
- Complex server-storage migration
- Inefficient server deployment
- High-availability/disaster recovery complexity
- Power and cooling costs

Server Virtualization 101

As noted earlier, server virtualization technologies enable the separation of the operating system and applications from the physical hardware through the presentation of virtualized hardware. This decoupling creates not only separation but also isolation from other operating systems. For example,

Windows Server, Linux, NetWare, etc. can now run side by side on the same physical hardware. Previously, each operating system demanded its own physical server.



Solution Benefits

Cost of ownership acts as a major driver behind the adoption of server virtualization. According to the Information Technology Intelligence Corp. (ITC) 2009/2010 Global Virtualization Deployment Trends Survey, almost 50 percent of respondents reported that server virtualization helps them lower their TCO and achieve faster ROI. The most common benefits realized include:

- Reduced cost
 - Server/storage hardware
 - Rack space
 - Power/cooling
 - Network, storage area network (SAN), keyboard/video/mouse (KVM) ports
 - Increased productivity
- IT responsiveness
 - Increased system utilization
 - Easier testing and development
 - Simplified migrations
 - Predictable high availability (HA) and disaster recovery

Reducing CAPEX, OPEX and TCO

Organizations develop a server virtualization and consolidation strategy with the objective of reducing hardware and better utilizing existing servers in the data center. The process offers the potential for substantial cost savings — sometimes within a short period of time.

CAPEX savings are realized as multiple machines are consolidated onto one host. This reduces the need to purchase additional servers. When companies virtualize the entire IT infrastructure, savings can add up quickly. In fact, firms can often expect at least 50 percent CAPEX savings following server consolidation.

Do the Math

Server virtualization bolsters the bottom line

Server virtualization can make an organization really see green — and not just via the technology's impressive energy savings. Significant cost savings can be achieved by reducing server numbers, maintenance and floor space as well.

A major hardware manufacturer compared the cost of maintaining an infrastructure of 20 physical servers with the cost required to consolidate the same environment with three servers running 20 virtual machines.

The company found that over a three-year period, a firm deploying a completely physical environment would have to spend an average of \$57,640 on new servers, plus \$8,000 in provisioning costs, and around \$48,000 in power and cooling charges.

Conversely, an organization that consolidated through virtualization would spend \$25,566 on the new servers, \$1,500 on virtualization software, \$800 on provisioning, and \$20,000 on power and cooling over the same three-year cycle.

The end result? The firm that chose server virtualization would pocket \$65,774 over three years. While not part of the study, additional cost savings can likely be gleaned via reduced labor hours due to less time required for server deployment, maintenance and refresh.

And there's more good news regarding costs. According to a recent IDC survey, respondents not only validated a strong trend toward virtualization, but moreover, 62 percent cited lower TCO as a key benefit to adopt the technology.

Following server virtualization, firms still have to manage the virtual environment. Therefore, a substantial OPEX decrease, over the short run, may be hard to come by. However, businesses are realizing that the number of workloads that an administrator can manage increases — in some cases up to hundreds of machines per administrator.

This can help to facilitate OPEX savings over a longer period of time. While maybe a little less than capital expense savings, these can be ongoing cost reductions that can accrue year after year — possibly reaching into the 30- to 40-percent range.

Server Virtualization Components

First Steps

Identifying candidates for server virtualization can be as much art as it is science. However, it's best to start with some hard facts — how many servers the data center has, how efficiently they are being utilized, the age and health of the machines, and future application usage.

The best way to get a handle on those statistics is through an audit. Audit logs can offer a great deal of information regarding activities that have taken place on servers. The major virtualization vendors offer plenty of tools to perform such audits.

Server Virtualization: Smead Manufacturing Saves

Following an internal audit, Albert Lui, CTO of Smead Manufacturing in Hastings, Minn., discovered that 85 percent of the company's servers were underutilized — running at an average of only 15- to 20-percent capacity.

The analysis allowed him to make a business case for server virtualization. By consolidating underutilized servers into virtual machines, the company could effectively increase server utilization, support multiple applications on unused server capacity with fewer machines, defer capital expenses on new servers and reduce operational costs.

The direct cost savings and tangible benefits the firm is realizing through server virtualization and the resulting consolidation are as follows:

	From:	To:
Increase Server Utilization:	5-15%	60-80%
Consolidate Hardware:	206 servers	107 servers
	(5/10-to-1 ratio in production)	
	(8/20-to-1 ratio in development and testing)	

Incremental Savings:

- CAPEX: Approximately \$915,000 in commodity servers (within the first four or five months)
- OPEX: Approximately \$3,000 (per year)
- Energy Savings: Dropped 10kVA (over 12 months)
- \$3.2 million over the next five years (based on business expansion and application requirements)
- Project came in under budget by \$380,000

Incremental Efficiencies:

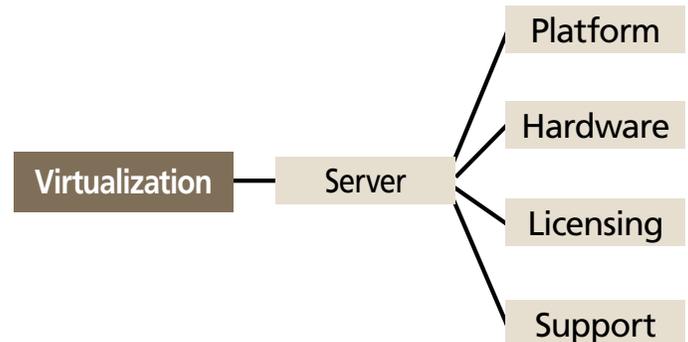
- Virtualized disaster recovery site
- Recovery process is streamlined and faster to implement
- Recovery site serves to facilitate application development
- Can provision new server in 15 to 20 minutes (previously took one day)

Note: The use of a storage area network (SAN), combined with server virtualization, will likely result in ever greater cost savings and efficiencies.

The audit will help to make it clear which servers are candidates for replacement, and which are candidates for virtualization. In general, older servers, nearing end of life, are better candidates for replacement, experts say. And newer servers can be repurposed to maximize their lifespan.

Common Components

A server virtualization solution may contain a number of components depending on business requirements. The following diagram groups the most common components to consider when planning and designing a complete server virtualization solution. This section will briefly discuss each component.



Platform

Two basic server virtualization platforms exist today:

HOSTED VIRTUALIZATION — requires a general-purpose operating system, such as Windows Server or Red Hat Enterprise Linux, underneath the virtualization layer. Examples of such platforms include Microsoft Virtual Server and VMware Server.

HYPERVERSOR-BASED VIRTUALIZATION — the most popular virtualization platform runs without the use of any general-purpose operating system. Examples include VMware ESX Server, Citrix XenServer and Microsoft Hyper-V (standalone version).

Hardware

Choosing the right hardware for your virtualization platform can be a project in itself. Let's start with server hardware.

Though existing servers could potentially be used, some businesses purchase new servers due to the increased processing and memory capacity as well as the reduced power consumption.

Since the majority of server virtualization solutions are deployed using shared storage, a number of variables require consideration before making a storage platform choice. First, choosing a storage protocol becomes important since not all storage vendors support all currently available protocols (e.g., Fibre Channel, iSCSI, NFS, etc.). The drive technology demands consideration for the same reason. Today's options include Serial ATA (SATA), Serial Attached SCSI (SAS) drives and interconnect technology, which includes SAS and Fibre Channel.

Finally, it may prove important to evaluate the network hardware during virtualization design, since certain features now require gigabit and in some cases 10-gigabit connectivity. Don't forget to consider new technologies to reduce the number of Ethernet connections per server, including 10Gb and Fibre Channel over Ethernet (FCoE).

Licensing

This probably remains the most misunderstood component of both server and client virtualization technologies. Each virtualization platform licenses its software very differently, so each option requires independent evaluation.

Each operating system and application vendor also has its own licensing rules and provisions for virtualization that need investigation. Microsoft, for example, allows server processors licensed for Windows Server Datacenter Edition to run an unlimited number of Windows Server virtual machines. The licensing also removes mobility restrictions on their migration between physical server hosts.

Support

When developing a virtualization solution, the plan should include a means of support for every component working together.

Virtualization solution providers usually require the purchase of some level of support with every license. Options usually include four-hour or faster incident response.

Keep in mind, this support doesn't include troubleshooting of the operating system or the apps running inside a virtual machine. At a minimum, OS and application server support should thus be obtained. This is in addition to determining that the software vendor actually supports virtualization and to what level.

Server Refresh

Running virtualized servers can put an extra strain on present computing power. In some cases, it's a good idea to consider a server refresh along with an initial virtualization strategy.

According to a report from the research firm IDC, studies show that the aggregate installed server base has aged, while virtual machine densities on those systems have increased sharply. Therefore, new infrastructure is sometimes needed to handle those increased loads.

Some IT organizations have used virtualization as a tactic to postpone server hardware upgrades during the economic downturn. But as aging equipment comes under the pressure of increased workloads, it may be time to consider upgrades across the board.

One of the major reasons for data center server refresh is the technology leap in server processors. Today's server chips provide enhanced scalability, power and performance. What's more, they are much more environmentally friendly.

Cost savings can also be gained from server refresh. HP, for example, recently completed a study showing that simply replacing two older HP ProLiant G4 servers with a single ProLiant G6 server provided power and cooling efficiencies to break even within a few months.

Additionally, most of the modern hypervisors require relatively recent processors with Intel VT or AMD-V technology to have full functionality.

What's more, an older server might have less memory expandability, making it a poorer choice for virtualization.

It's also important to keep in mind that virtualization is generally licensed at either a per-processor or a per-server basis and some vendors have processor core restrictions. Putting a new virtualization license on an older, less-capable server may not be as attractive a target as utilizing a newer server for a virtualization initiative.

Intel Server Upgrade Center (ROI calculator for new servers)

Looking for a quantitative way to discover the value of a server upgrade? Developed by Intel's Server Product Group and Total Cost of Ownership (TCO) consultant Alinean Inc., this online calculator generates a full report defining the benefits of a server refresh.

Based on the advantages of replacing older servers with the latest generation of Intel-based servers, the tool allows the opportunity to specify input assumptions. It then offers an optimal report geared to a specific organization.

<http://upgradecentral.ihvweb8.com/server/>

Business Continuity/ Disaster Recovery Processes

Another area where server virtualization is quickly gaining appeal is its contribution to disaster recovery projects. These typically carry a hefty price tag and level of complexity, not to mention extensive idle hardware.

With conventional solutions, the ability to execute the fastest and most reliable recovery requires the duplication of the entire production infrastructure. Using virtualization, an organization is able to gain rapid and reliable failover and recovery without requiring identical hardware.

Through consolidation, businesses can slash the cost of the server infrastructure needed, both for production and disaster recovery. For example, it is not out of the ordinary to find 20 servers at the disaster recovery site consolidated into three virtual machines.

Even more, the expense associated with traditional disaster recovery efforts often forces businesses to only protect the most critical applications. This may leave a number of other areas vulnerable. Server virtualization allows businesses to expand the scope of their disaster recovery and at the same time simplify the process.

Server virtualization can also help to ease the data-recovery process. Because traditional solutions tend to entail numerous steps that can be difficult to automate, the practice tends to be slow, complex and prone to human error. Virtualization, on the other hand, opens the door to automated disaster recovery, subsequently increasing reliability and availability.

What's more, even if a business hasn't virtualized its production servers, assigning virtualized target servers for disaster recovery can provide greater simplicity, reliability and cost savings. And improving the recovery time of the applications can be one of the real payoffs of server virtualization.

Virtualization and Disaster Recovery

Virtualization technology can assist disaster recovery in a number of ways including:

- Allowing for dissimilar and less hardware at the disaster recovery site
- Facilitating easier failover and recovery
- "Snapshot" technology can be used to capture "point-in-time," making for easier replication
- Allowing firms to expand the scope of availability/disaster recovery to all applications and data and not just those deemed mission critical

Power and Cooling

According to the U.S. Environmental Protection Agency, energy use at U.S. data centers more than doubled from 2000 to 2006. For every dollar spent on new server hardware in 2007, more than 50 cents was spent on power and cooling costs, according to IDC.

There's no question that rising electricity costs, shrinking power supplies, and mounting social and economic pressure to "go green" are forcing companies to rethink their IT strategies. And for a growing number, server virtualization holds the key to effectively meeting these challenges.

Recent research from the tech analyst firm Enterprise Strategy Group (ESG) underscores that fact. The firm found that organizations resoundingly believe server virtualization will have the single greatest impact on reducing power consumption in the data center.

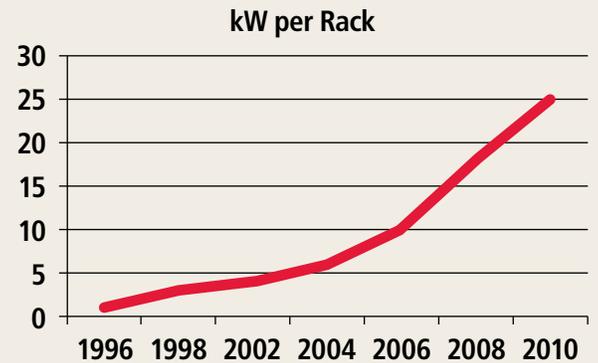
Virtualization and Disaster Recovery Software

Recent analysis indicates that as many as half of medium-sized businesses do not have a disaster recovery plan. While most companies agree a DR plan is important, many ignore it because it can be labor intensive and expensive.

The good news is there are now software products that orchestrate all disaster recovery in a server virtualization environment. They basically make disaster recovery something that most companies can do without the overwhelming cost and complexity.

VMware's vCenter Site Recovery Manager, for example, allows for automating the entire workflow of setting up, testing and implementing disaster recovery plans for the entire virtualization layer. It sets up how the failover should happen, which applications get the highest level of protection and which applications get recovered first.

Rising Energy Consumption in the Data Center



Source: VMware

In fact, they say it will have twice the impact of developing more energy-efficient physical server technologies. Not surprising, consolidating the number of hardware devices required to run the same number of applications can lead to appreciably lower power and cooling requirements.

While the ratio of virtual machines to physical servers will vary depending on the virtualization technology used, the type and scalability of deployed physical servers, and user-defined Service Level Agreements (SLAs), a 25-to-1 reduction is considered typical.

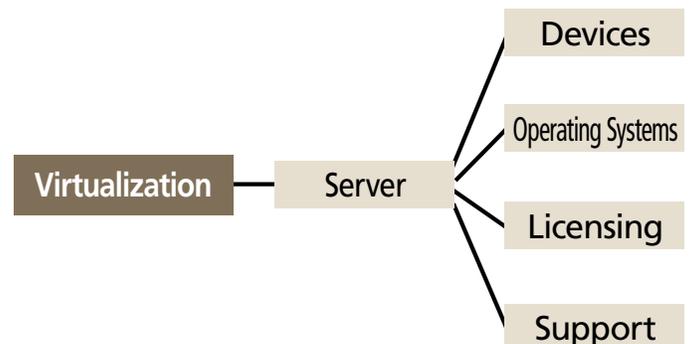
Powering and cooling as many as 80 percent fewer physical servers can translate to potentially hefty savings to the bottom line. According to the experts, businesses can save up to 60 percent in power and cooling costs.

Client Virtualization

Organizations are struggling to manage and maintain the proliferation of desktops, notebook PCs and other client devices. At the same time, they must reduce costs and increase end-user productivity.

Wide adoption of server virtualization in the data center has led to renewed interest in client virtualization (also known as Virtual Desktop Infrastructure or VDI). The technology can simplify IT management and lower costs.

Unlike server virtualization, a number of additional components comprise the client virtualization makeup including devices, operating systems, applications, licensing and support.



Virtualization: Implementation Pitfalls

Businesses are required to show a positive and quick ROI for almost every IT initiative. Both total cost of ownership (TCO) and ROI analysis have been used for the last few years to prove the value of virtualization projects. However, not every firm recovers their investment in the time originally anticipated.

For example, in some cases, businesses are only able to virtualize 20 percent of their infrastructure, even though 85 percent was originally estimated. One reason for this is the availability of personnel as well as financial resources.

While this type of situation isn't typical, it can happen. Here are some ways to avoid it:

1. Commit to not only the hardware/software investments, but also the resources required to execute the project.
2. Commit to a reasonable timeframe for implementation and conversion. Also, consider scheduled downtime windows, which can limit your conversion timeframe.
3. Scrutinize the ROI analysis thoroughly. Some corporations may find later on that they cannot convert physical servers to virtual machines due to I/O or other hardware dependencies, lack of vendor support, unanticipated virtual licensing models, etc.
4. Develop a migration plan for Physical-to-Virtual (P2V) migration. A P2V project can affect multiple application groups, so put effective communications, logistics and fallback plans in place.
5. If internal resources are not available, consider outsourcing design, implementation and P2V work to an experienced partner.

Devices

When building a client virtualization solution, an important factor is the end-user experience. Start by analyzing your audience and how they will be using the client devices.

For example, consider your end users not only in terms of what devices they will employ — such as notebook PCs, desktops, tablet PCs and mobile devices — but also in light of the locations from which they will connect.

Your analysis should likewise account for the types and numbers of displays users need and connections to peripherals, such as printers. Additionally, evaluate the required bandwidth.

Finally, determine which users require stringent security such as smart-card readers, biometric scanners, two-factor authentication tokens, etc. Identifying device types and user needs well ahead of implementing a client virtualization solution can eliminate some potential options that might otherwise be incorrectly chosen for your business.

Operating Systems

There are many ways to present an operating system to devices. In a hosted model, Windows can run on blade PCs, workstations in the data center or in virtual machines on a virtual platform.

Either way, a display protocol, such as Remote Desktop Protocol (RDP), Independent Computing Architecture (ICA) or Remote Graphics Software (RGS), generally delivers the operating system to the particular device for presentation to the user.

In both models, the processing actually occurs on blades or the hosted platform. For this reason, it doesn't matter whether your client devices are thin or thick, since connecting to the remote systems requires minimal client-side hardware.

Another possible solution involves hosting Windows images on a server, then streaming the operating system to existing desktops. This option works extremely well for firms looking to extend the lifecycle of existing desktops.

Applications

Microsoft Terminal Services and Citrix XenApp technology, also known as server-based computing, hosts desktop applications on a Windows server and then delivers them to users via sessions (called Published Applications). This approach enables all the processing to occur at the server itself.

A newer technology available from a number of vendors, application streaming, focuses on isolation and streaming. Isolation refers to technology that installs the application locally on a desktop in a separate container, thereby isolating it from other applications.

In addition, installing software locally, either manually or with a software delivery solution, offers yet another option.

Management

While determining what devices, operating systems and applications make up a client virtualization solution, you'll also need to think about a number of important components related to management.

The following list contains some of the components that should be evaluated end-to-end:

- Printing
- Security
- User Profiles
- Imaging (Operating System, Thin Client)
- Updating (Operating System Patches and Thin Client Firmware Updates)

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