Growth in virtualization continues to reshape the data centre landscape, consolidating servers, boosting utilization and improving manageability.

**Executive Summary**

An uncertain business world still calls for reductions in total cost of ownership (TCO). Yet, today’s IT manager must also consider efficiencies and enhancing optimization. Fortunately, server virtualization can assist in each of these areas.

While increasingly gaining mainstream status in today’s data centres a proactive approach to IT management. It can help businesses minimize IT complexity. It can also increase network flexibility, and, at the same time, help lower TCO and provide a surprisingly fast ROI.

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

Dynamic in nature, the role of technology is critical in supplementing enterprise 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 centre 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.

Today, it's rare to find data centres that haven't implemented some level of virtualization. For many companies, servers are typically the first part of the data centre to be virtualized. In fact, according the financial and industry analyst firm Tier1 Research, tech maturation and market acceptance will lead to about 70 percent of organizations having virtualized data centre servers by the year 2013.

There are a number of reasons for the move to virtualization. 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 centre hardware costs, improve energy efficiency and enhance operations. Experts believe this trend will only accelerate in the years ahead, 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 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.

Still top-of-mind with IT pros, virtualization was named one of Computerworld’s 5 Significant Trends for 2011, because of its cost saving capabilities. Furthermore, the tech analyst firm Gartner named virtualization the number one technology for 2010 based on a survey of CIOs.

“I'd put it there again for 2011, followed by cloud computing, software as a service and to a lesser degree business analytics,” says Scot Finn, Computerworld editor in chief.

Gartner estimates that 39 percent of server workloads had been virtualized by the end of 2010 and forecasts that more than two-thirds will be virtualized by 2014. A recent Gartner survey indicated that virtualization raises average server utilization from 10 to 50 percent and continues to be a major initiative.

Server consolidation via virtualization offers ways to increase utilization of existing hardware.

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 centre while decreasing costs and improving service levels

Source: VMware, 2011

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 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. (ITIC) 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
Businesses develop a server virtualization and consolidation strategy with the objective of reducing hardware and better utilizing existing servers in the data centre. 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.

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.

Do the math: Server virtualization bolsters the bottom line
Server virtualization can make an enterprise 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 labour hours due to less time required for server deployment, maintenance and refresh.
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 centre 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 suppliers offer plenty of tools to perform such audits.

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. Following are the most common components to consider when planning and designing a complete server virtualization solution.

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).

Server virtualization: Smead Manufacturing saves
Following an internal audit, Albert Lui, CTO of Smead Manufacturing, 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 Lui 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 to the firm is realizing through server virtualization and the resulting consolidation are as follows:

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<th>From:</th>
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<td>Increase Server Utilization:</td>
<td>5–15%</td>
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<tr>
<td>Consolidate Hardware:</td>
<td>206 servers (5/10-to-1 ratio in production – 8/20-to-1 ratio in development and testing)</td>
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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 an entire day)

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

Hardware
Choosing the right hardware for the 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 suppliers 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 supplier 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 manufacturer actually supports virtualization and to what level.

**Power and Cooling**

Electricity used in global data centres in 2010 likely accounted for between 1.1 percent and 1.5 percent of total electricity use*, respectively.

The amount of energy used by data centres is increasing, but not as fast as previously thought. The recession, coupled with the wider use of virtualization and overall industry conservation has played a role in cutting energy demand.

Still 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 centre.

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*Source: Jonathan Koomey; 2011; Growth in Data Center Electricity Use 2005 to 2010; Oakland, Calif.; Analytics Press
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.

Cloud Computing

Today it seems almost every vendor has a cloud solution. And while many have latched on to the cloud term, care must be taken to make certain these offerings actually meet the criteria for a cloud computing model. In some cases, the question of what is and isn’t “cloud” can get confusing very quickly.

For example, some sources equate the virtualized data centre with cloud infrastructure. The two are not the same, although virtualization is considered a foundational technology for cloud computing. Nor is cloud computing the same as software as a service (SaaS), although a cloud computing platform can support this increasingly popular service model.

There’s no question that cloud computing can offer solid business value. By understanding the primary options and components of cloud computing, it becomes easier to devise and execute a successful cloud strategy. However, developing a cloud-ready enterprise requires understanding of a company’s legacy infrastructure, core business and IT processes.

Cloud Computing Defined

A widely accepted definition of cloud computing stems from early work done by the National Institute of Standards and Technology (NIST), a U.S. Department of Commerce agency that promotes innovation and industrial competitiveness via measurement science, standards and technology.

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.

In other words, cloud computing allows organizations to provide their staff with access to the applications, infrastructure or platforms they need to do their jobs — all via a simple front-end interface, such as a web browser. They might need access to these resources for a few minutes at a time or for a longer period. Depending on the deployment model in use, companies can pay on a utility basis only for what they use.

Virtualization as a First Step

Virtualization is considered a foundational technology for cloud computing. The more virtualized the infrastructure, the higher the resource utilization within the shared pool. In fact, some have even gone so far as to say that without virtualization, there would be no cloud.

Virtualization’s cloud value is found in how it abstracts and aggregates data centre resources. Along with significant cost savings, it’s the ability of virtualization to separate the OS and application from the hardware, and turning them into logical pools shared among users, that allows for optimal delivery of cloud services.

Cloud computing success also depends on the firm having full control over the number of virtual machines (VMs) that exist and the loads they carry. Keep in mind; cloud VMs consist of virtual hardware as well as operating systems. They support the economics and versatility of the cloud by allowing servers to be created on-demand. In some cases, these servers may even share the same physical hardware.

The more virtualized the infrastructure, the higher the resource utilization within the shared pool. This allows the workloads to move more fluidly across the data centre, and strongly positions the enterprise for migration to a cloud computing model.

“Legacy data centres and networks, with three-tier or four-tier architectures, might not provide the expected cloud performance,” says Raju Rajan, evangelist for global data centre networking at IBM. “You can wind up with the application tier, web tier and the data tier scattered across the data centre.

Within such a scenario, “There are simply too many hops between the tiers and the latency level is unacceptable,” he adds. Ideally, a cloud allows an organization to ignore which virtual resources can be moved around according to the logic of optimizing...
that resource rather than the logic of the application performance rate.”

In addition, adopting virtualization in all critical IT areas can help lay the groundwork for future cloud computing initiatives. Along with servers, these areas can include storage, clients and applications.

**Moving to the Private Cloud**

Businesses that aren’t in a position to pursue public cloud services need not be stuck with legacy infrastructure and outdated cost models. Rather, they can apply the same principles and make similar technology choices within their firm that a service provider would for a public cloud infrastructure.

Looking up and down their IT stacks, many firms will find that they already have some building blocks for launching an internal private cloud. Virtualization is the foundational technology. The higher the utilization within the enterprise’s shared resource pool, the more fluidly workloads can move across the data centre to support private cloud users.

Virtualization is a significant first step toward a private cloud simply because it reduces the hardware requirements needed to effectively run deployed applications. The more streamlined the IT operation, the easier it is to manage and optimize cloud service delivery and application performance.

Businesses will therefore want to consolidate servers, storage and network bandwidth. This, in effect, will enable them to build internal private clouds that provide on-demand resources, pay-as-you-go pricing and unprecedented levels of scalability.

**Private Cloud: Where to Locate**

Private cloud infrastructures can be deployed in-house or hosted with an external service provider. Deploying a hosted private cloud is a popular way for companies to instantly see the benefits of private cloud computing while avoiding pricey upfront costs of deploying resources in-house.

An IT shop can build and maintain a private cloud within its own data centre or centres. This cloud would be for the exclusive use of the firm’s staff or other privileged users.

As an alternative, a private cloud also may run externally at a hosted cloud provider’s site. In this case, the business may choose to build out the infrastructure, while allowing the provider to maintain and manage day-to-day operations. The user may also choose to utilize the service provider’s infrastructure, comprised of pooled resources dedicated to a set of defined users.

Businesses concerned with compliance, privacy, security and data availability often choose to build a private cloud rather than move processing to public services. This could also be the case if an organization intends to incorporate legacy infrastructure as part of its cloud environment.

With a private cloud, organizations will need to plan for capital expenses and define their infrastructure limitations. There is greater scalability available within a private cloud than in a legacy environment, but it isn’t limitless.

Some companies may opt for a private cloud as a step toward an eventual public cloud deployment. This positions the IT department to develop the discipline and processes required for managing cloud operations.

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**Succeeding with server virtualization**

The benefits of server virtualization have been proven. But as with every IT project, there is a right way and a wrong way to approach it. Here are some tips to make sure a company is moving in the right direction:

* It’s not a set-it-and-forget it exercise. Create a long-term roadmap for server virtualization in the infrastructure. In addition, strategically plan out a path so investments have maximum impact. And as workloads change, be prepared to reconfigure virtual servers.

* Just because servers are virtualized doesn’t automatically guarantee getting the most out of servers and apps. Even after implementing virtualization, maximizing the environment means effectively managing server performance and capacity.

* Understand current workloads and their performance and capacity needs, and use available tools to predict future workloads. Understanding which are your most mission-critical workloads and the cyclic needs of specific applications can help with better decision making.

* Before virtualizing anything, work through process detail and empower those with authority to add or change workloads. Without this plan in place, it’s all too easy to add new virtual machines too quickly, creating a new set of problems to replace the old set.

* Pair complementary applications together on a virtual server. For example, several memory-intensive servers probably don’t belong on the same virtual machine. Instead, consider pairing a processor-intensive application with a memory-intensive application, which helps avoid bottlenecks.
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Microsoft provides a 360-degree view approach to virtualization encompassing servers, applications, desktops and storage in a single, integrated environment. These virtualized environments reduce hardware, power, and support costs and improve application availability, stability, and uniformity.

VMware, the global leader in virtualization and cloud infrastructure, delivers customer-proven solutions that accelerate IT by reducing complexity and enabling more flexible, agile service delivery. VMware enables enterprises to adopt a cloud model that addresses their unique business challenges. VMware’s approach accelerates the transition to cloud computing while preserving existing investments and improving security and control. With more than 250,000 customers and 25,000 partners, VMware solutions help organizations of all sizes lower costs, increase business agility and ensure freedom of choice.

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