Virtualization Enters the Mainstream

Once an isolated island reserved for test and development, virtualization is unlocking untapped server, storage, and networking resources. Today, standards-based server virtualization is changing the tides with efficient cost-benefit models enabled by reduced IT infrastructure costs, simplified management, and unprecedented business response.
Soaring energy prices have hit business where it hurts: in the bottom line. Because power is often the single largest data center operating expense, executives are searching for ways to increase the cost-effectiveness of IT infrastructures, often by upgrading to equipment designed for high energy efficiency. Still, unless performance per watt increases or energy prices decline, data center power and cooling costs are likely to overtake hardware costs in many organizations.

At the same time that executives are under pressure to cap data center power consumption, they are facing exponential growth in demand for processing power and data storage capacity. Exacting service-level agreements also create pressure to heighten system availability and resilience. In addition, legacy data centers usually lack the proper design, build, infrastructure, or location characteristics to support emerging regulatory and business requirements. For many organizations, these factors mean only one thing: additional data centers.

Unfortunately, additional data centers compound IT power costs and add complexity to already-complex global enterprise networks. In some cases, data center expansion follows merger or acquisition activity, which brings the extra complication of integrating heterogeneous and sometimes overlapping software environments.

Server consolidation can begin to address the problem of climbing data center power costs and complexity. But containing server sprawl is just a first step. Enterprises also need to confront the issue of efficiency within the overall IT infrastructure.\(^1\) Based on a traditional model of one application per server, up to 80 to 90 percent of x86 computing capacity may be unused at any one time—and this unused capacity needs to be managed. It takes up data center space, and it requires power and cooling.

**Exploring x86 virtualization technology**

Virtualization technologies in the x86 world, once an isolated island reserved for test and development environments, are now gaining traction as a mainstream choice for the enterprise IT infrastructure. Virtualization techniques have the potential not only to unlock underutilized server capacity, but also to expedite software deployment, reduce downtime, enhance disaster recovery, enable variable usage accounting and charge-backs, support holistic enterprise-wide capacity planning, and dampen the effects of skyrocketing energy costs.

At the heart of virtualization technology are hypervisor architectures, that is, virtualization platforms or virtual machine (VM) monitors that allow multiple occurrences of operating systems—VMs—to run on the same physical host computer at the same time (see Figure 1). Hypervisors use a thin layer of code to help achieve fine-grained, dynamic resource sharing and are generally categorized into two distinct camps:

- **Type 1 hypervisor:** The virtualization software is, in effect, a purpose-built OS that runs natively on the hardware platform for the sole purpose of hosting and managing VMs. Once the type 1 hypervisor is running on the hardware platform, multiple VMs can be hosted on top of it as guests—these may be Microsoft® Windows®, Linux®, or other standard operating systems. Type 1 hypervisors fall into two subcategories: those with hardware emulation virtualization (where the hypervisor interacts with the VM through a hardware emulation layer) and those with paravirtualization (where the hypervisor interacts with the VM through a special application programming interface). An example of a type 1 hypervisor with hardware emulation virtualization is VMware® ESX Server 3, while the XenSource XenEnterprise platform on Linux offers paravirtualization features.\(^2\)

- **Type 2 hypervisor:** The virtualization software runs as another application within a standard OS. A prominent type 2 hypervisor for server virtualization is Microsoft Virtual Server 2005 Release 2 (R2), which runs on top of the Microsoft Windows Server® 2003 OS and uses hardware emulation virtualization.

---

\(^1\)For more information, see "Data Center Efficiency in the Scalable Enterprise," by John Pflueger, Ph.D., and Sharon Hanson, in Dell Power Solutions, February 2007, www.dell.com/downloads/global/power/ps3q07-20070385-Dhawan.pdf.

\(^2\)For more information on hardware emulation versus paravirtualization, see "Using XenSource XenEnterprise with Dell Servers and Dell OpenManage," by Victor Mashayekhi, Ph.D., Puneet Dhawan; Simon Crosby; and Roger B. A. Klorese, in Dell Power Solutions, August 2007, www.dell.com/downloads/global/power/ps3q07-20070385-Dhawan.pdf.
The lineage of x86 virtualization goes back through VMware Workstation and VMware Server (formerly VMware GSX Server); this workstation virtualization software was an early example of a type 2 hypervisor. VMware workstation software gave early adopters a practical way to virtualize their desktop systems, and set in motion a rapid progression of virtualization technology.

But it was not until the advent of VMware ESX Server—a dedicated type 1 virtualization platform that evolved from a Linux kernel—that server virtualization and the concept of VMs began to make definitive strides into the mainstream. Hypervisor technology, such as that included in VMware Infrastructure 3, has advanced to the point where it can begin to deliver on the promise of virtualization by enabling highly efficient, automated resource sharing. A centralized VMware VirtualCenter Management Server console helps ensure that systems throughout the enterprise data center have the necessary computing muscle and I/O bandwidth when they need it, while features such as VMware Distributed Resource Scheduler (DRS) and VMware VMotion™ technology help distribute resources and move VMs efficiently across physical hosts. As virtualization continues to evolve, the role of the hypervisor is expected to mature to a higher level of standardization than it has right now, particularly at the VM management level.

Today, virtualization techniques have become key to building a cost-effective, highly scalable enterprise IT infrastructure, because they enable flexible resource management and automated resource allocation based on strategic business policies. Virtualization technology can benefit the bottom line in several important ways:

- **Implementing production server consolidation and containment**: Virtualization techniques help contain server sprawl by running software applications in easily relocatable VMs on highly scalable enterprise-class servers. For example, VMware Infrastructure 3 enables Dell™ PowerEdge™ servers to consolidate numerous VMs on each physical server, which can lead to dramatic increases in server utilization. Additionally, Microsoft Virtual Server and Xen virtualization on Linux offer alternative platforms for virtualization.

- **Providing cost-effective protection for business continuity**: Organizations can help ensure high availability for critical applications using industry-standard virtualization-based solutions. This approach also enables organizations to implement a unified disaster recovery platform that allows them to recover many production VMs in the event of a hardware failure without investing in costly one-to-one mapping of production and disaster recovery hardware.

---

1. For example, see “Using VMware Cluster Features on Dell PowerEdge Servers,” by Scott Hanson, in Dell Power Solutions, August 2007, [www.dell.com/downloads/global/power/ps3q07-200710562-Hanson.pdf](http://www.dell.com/downloads/global/power/ps3q07-200710562-Hanson.pdf).
Virtualization in action

Virtualized Dell server infrastructures give Mazda North American Operations and Acuity Brands Lighting the competitive edge—allowing their IT teams to spend less time putting out fires and more time launching strategic business initiatives.

In a fiercely competitive auto industry, Mazda North American Operations depends on IT to inject the same “Zoom-Zoom” agility and acceleration that characterize its cars into its business operations. Key IT initiatives include enhancing supply chain efficiency, improving the effectiveness of field managers, and helping customers learn more about Mazda cars on the Web.

As Mazda’s services grew, so did its server count—from 150 in 2003 to nearly 300 in 2007. “With a one-application-per-server approach, all we could see was never-ending server sprawl. Complexity had risen to the point where our IT staff was spending most of its time just maintaining those servers,” says Jim DiMarzio, CIO of Mazda North American Operations.

To help solve the problem of server sprawl and escalating IT complexity, Mazda turned to Dell. “Dell provided us with a proven plan for implementing virtualization,” says Kai Sookwongse, IT systems manager of Mazda North American Operations. “The Dell experts helped us assess our environment and identify applications that could be run on VMs. And when it came time to deploy the solution, the Dell team supported our IT team until our virtualized environment was up and running smoothly.”

Using the VMware Infrastructure 3 suite, which includes ESX Server software and VirtualCenter management tools, Mazda consolidated 75 servers onto 5 quad-socket Dell PowerEdge 6850 servers. “We configured our virtualized servers for 50 percent processor utilization, so we have plenty of headroom for peaks in usage,” explains Sookwongse. “We configured our virtualized servers for 50 percent processor utilization, so we have plenty of headroom for peaks in usage,” explains Sookwongse. “Two PowerEdge 2950 servers can host 20 VMs and still have plenty of capacity for peaks in demand,” says Sookwongse.

VMware VirtualCenter management software enables the IT team to move critical application instances to different physical servers to perform maintenance or to adjust the level of resources available to the application. “It used to take hours for an administrator to provision a server,” says DiMarzio. “Now, with VMware software running on Dell servers, we can remotely provision a new virtual server with just a few clicks.”

Thanks to a reduced number of physical servers, increased provisioning efficiency, and automated management and monitoring tools, Mazda’s IT budget can focus on helping improve the business rather than on IT maintenance. “Before virtualization, it took eight people to manage 280 physical servers. Now, just five people manage almost 300 physical and virtual servers,” says DiMarzio.

Lights out on server sprawl

Acuity Brands Lighting relies on rock-solid IT to provide outstanding logistics and support its sales and distribution network with advanced supply chain management and sales fulfillment processes. However, as business expanded, the company ended up with a hardware infrastructure that was distributed, costly, and difficult to manage.

To evaluate how virtualization could address the problem, Acuity deployed a consolidated, virtualized test infrastructure of 105 VMs running on approximately eight Dell PowerEdge 2950 servers. “We are getting roughly 13 VMs per physical server, which is a testament to the reliability of the Dell servers. One of the biggest benefits of this virtualized environment is ease of management,” says Jim Draughn, director of enterprise engineering at Acuity Brands Lighting. “Now, we can run far more servers on far less hardware than we could previously—which means fewer physical servers to maintain and oversee and a reduction in provisioning time from three weeks down to three hours.”

Another big advantage of the virtual pool of servers is the increase in processor utilization. “Previously, we were getting about 10 percent utilization on each server, but with virtualization, we are able to get 50 or 60 percent per server,” notes Draughn.

To manage its virtualized environment, Acuity uses VMware VirtualCenter software, which enables rapid provisioning of VMs and helps monitor the performance of both physical servers and VMs. VirtualCenter intelligently optimizes resources and helps ensure high availability for virtualized applications. “We use VirtualCenter to conduct load balancing and control resources,” notes Draughn. “The other day, we learned from VirtualCenter that one of our servers had a bit too much load on it, so we were able to move resources around to distribute the workload.”

Acuity plans to move virtualization to a production environment in 2007.

“It used to take hours for an administrator to provision a server. Now, with VMware software running on Dell servers, we can remotely provision a new virtual server with just a few clicks.”

—Jim DiMarzio
CIO, Mazda North American Operations
July 2007
The Dell virtualization strategy is grounded in simplicity: simplify the migration to and life cycle management of the virtual IT infrastructure. Based on tested, virtualization-optimized solutions and a direct, uncomplicated approach, Dell offerings enable high performance, availability, and overall value. A virtual IT infrastructure based on industry-standard Dell server and storage hardware streamlines day-to-day operations while enabling organizations to grow and evolve in cost-effective, planned phases.

The Dell virtualization offering is based on three key objectives:

- **Enabling** virtualization through software certified on key server and storage infrastructure components, integrated support offerings, specialized deployment tools, expert knowledge transfer, and performance-tuning benchmarks
- **Standardizing** virtualization implementations to help simplify deployment and management, streamline life cycle services, and broaden the choice of technology and hardware offerings that are optimized for performance, price, and manageability
- **Integrating** virtualization technology seamlessly into the IT infrastructure through unified, standards-based management and vendor-independent choices

To accomplish these objectives, Dell provides solutions based on a range of virtualization-optimized infrastructure components, focusing on simplified management for virtualized infrastructures running on multi-core Intel® or AMD® processor-based Dell PowerEdge servers as well as Dell PowerVault™ and Dell/EMC storage. For example, the Dell OpenManage™ systems management suite integrates with VMware VirtualCenter to help streamline VM management.

Dell is also helping facilitate seamless provisioning and management of virtual server resources through its partnership with Altiris and integration with Altiris® management consoles. Additional Dell and partner management tools from Nicus, PlateSpin, Symantec, Vizioncore, and VMware are offered together with hypervisor software from VMware and Microsoft as well as the Xen environment.

Dell augments these virtualization solutions with a rich set of service offerings designed to help enterprises capture the full value of virtualization. Dell Services provides broad expertise in six key areas: physical-to-virtual migration, high availability, backup and recovery, configuration management and monitoring, development and test environments, and virtualization upgrades. Modular options include validation in a test environment, ongoing configuration management and monitoring, and enhanced backup and recovery. Dell virtualization training can help enterprises increase their understanding of how to maximize their virtual IT infrastructure. Training is designed to help IT departments learn everything they need to know about load balancing, high availability, and more from the experts at Dell. In addition, Dell Services offers best practices, configuration, and implementation guides to help simplify the migration to a virtual infrastructure.*

---


---

- **Streamlining software testing and development:** Virtualization allows organizations to consolidate disparate test, development, and staging environments involving multiple operating systems and multiter applications on the same hardware. IT departments can also set up self-service developer portals to enhance developer productivity.
- **Simplifying infrastructure provisioning:** With sophisticated automation capabilities, organizations can provision new infrastructure components in minutes rather than the hours or days required for physical configurations.¹ Virtualization also allows IT organizations to centralize control and responsibility for hardware resources while giving business units and application owners control over how those resources are utilized.
- **Re-hosting legacy applications:** IT departments can migrate legacy operating systems and software applications to VMs running on upgraded hardware for enhanced reliability and resource management.

For many organizations, virtualization is expected to be the most significant factor shaping IT infrastructure and operations. Moving forward, virtualization will likely bring about fundamental changes in the way enterprises deploy and manage technology from the end user all the way to the data center—including, for example, how they plan, what they buy, how they deploy new systems, how they account for usage and charge-backs, and how licensing, pricing, and component management work. Storage has already been largely virtualized, but primarily within the scope of individual vendor architectures. Networking is already virtualized. As virtualization techniques and technologies continue to mature, the next major advancements will likely be automating the provisioning process.
Unlocking the business value of virtualization

Virtualization is now an industry-standard approach to data consolidation, which makes virtualization key to a highly scalable, highly available enterprise IT infrastructure. A virtual infrastructure can help simplify IT operations in several important ways. For example, virtualization helps shield software from hardware variability, enables secure resource sharing, and facilitates rapid software deployment and relocation. Virtualization also helps increase business agility by dynamically deploying or re-provisioning resources as needed. Advanced management tools such as VMware VirtualCenter (see Figure 2) together with shared storage can further optimize performance to help meet rigorous service-level agreements, avoid unplanned downtime, enhance the efficiency of application testing and development, and facilitate fast, cost-effective disaster recovery.

Because virtualization enables multiple applications to share physical hardware, it allows organizations to lower requirements for data center real estate, power consumption, and the volume of server hardware to be purchased and managed compared with non-virtualized configurations. Virtualization can also help reduce capital and operating expenses by creating an abstraction layer between the hardware and software stack that encapsulates the software workload in a VM. This approach helps simplify the processes of moving workloads across hardware platforms, provisioning new servers, and supporting legacy applications on updated hardware. (For more information on how Dell hardware and services can help enterprises implement virtualization, see the “Virtualization strategy: Simplify migration, simplify management” and “Virtualization in action” sidebars in this article.)

Looking ahead

Server virtualization has entered the mainstream and is fast becoming an indispensable data center technology. Today, virtualization is cost-effective and easy to implement even for small and midsize enterprises, helping expedite software deployment, accelerate disaster recovery, and dampen the impact of skyrocketing energy costs through consolidation to powerful, energy-efficient servers. As virtualization techniques and technologies mature, the next major advancements are likely to be increasingly automated provisioning and management of virtualized server, storage, and networking resources—including variable usage accounting and charge-backs.

It will likely not be long before virtualization extends past servers to the desktop. With a virtual desktop—a server-hosted approach to client virtualization designed to deliver desktop images to end users through a remote protocol—even highly mobile users would be able to access their own desktop anywhere, from any device. Moving forward, virtualization is expected to be a significant factor shaping IT infrastructure and enterprise-wide business operations from the data center to the desktop and beyond. In many organizations, the bottom line is already profiting from reduced IT infrastructure costs, simplified management, and unprecedented business response.

Jeanne Feldkamp is a business and technology writer based in San Francisco. She has worked on several publications for leading high-tech corporations.

Deb McDonald is the managing editor of Dell Power Solutions magazine. Prior to that, she served in editorial management positions for numerous computer and technology publications at Ziff Davis Media and Reed Elsevier.

Tom Kolnowski is the editor-in-chief and publisher of Dell Power Solutions magazine.