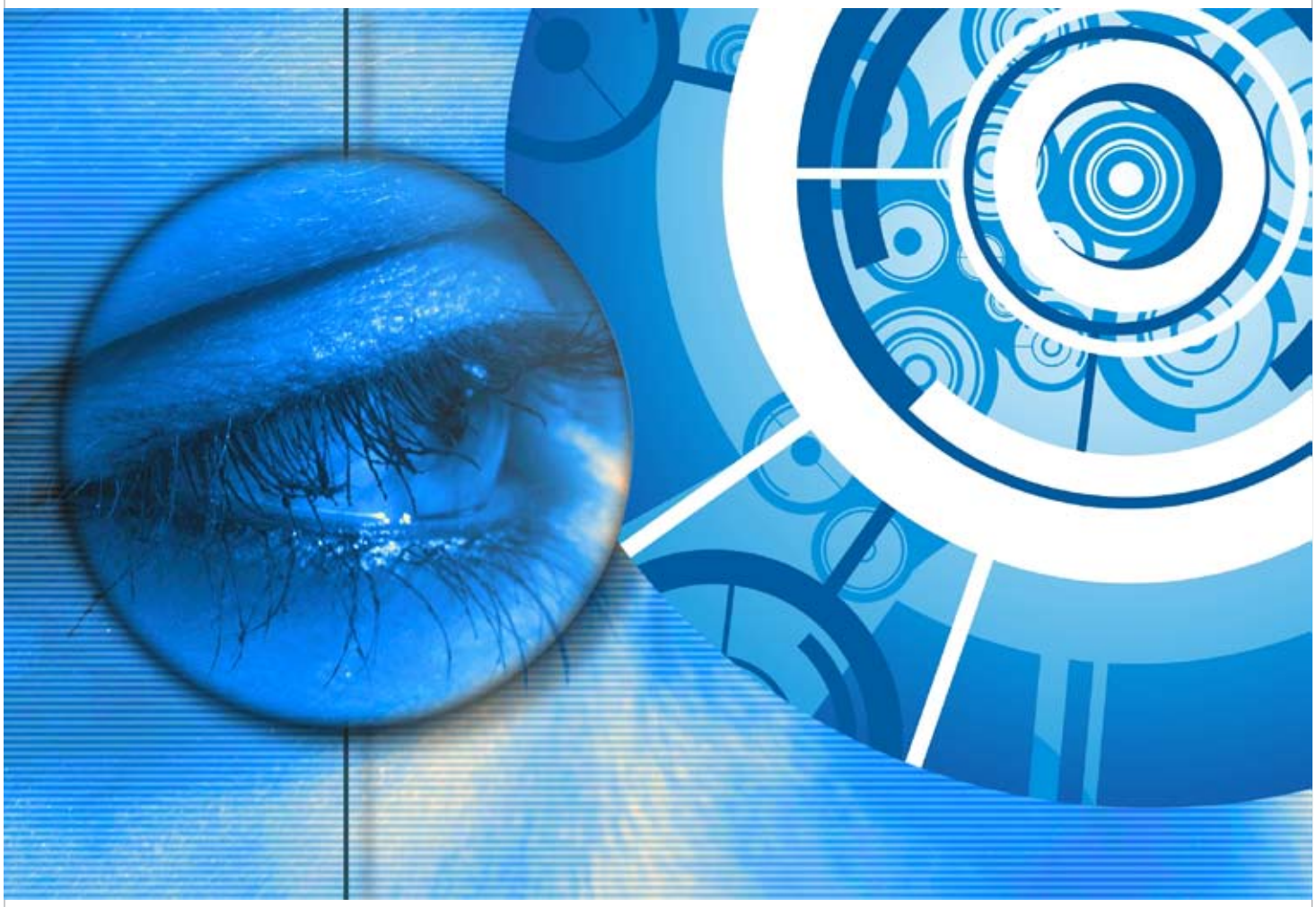
NETWORKWORLD®

EXECUTIVE GUIDE

# VIRTUALIZATION REALITY CHECK



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# Introduction

*Many large organizations are already invested in server virtualization technology and reaping the benefits of improved resource utilization and simpler management.*

Consider newspaper giant Gannett. "Our general philosophy when deploying new applications is to virtualize them unless the application owner or the vendor we purchase them from has a good reason not to," says Eric Kuzmack, IT architect at Gannett.

While other companies are encouraged by these and other success stories, they still have questions about everything from security to vendor selection. Industry watchers say organizations are wise to approach virtualization with eyes wide open, but they say the technology is going to be the way to go so you might as well get going.

Forrester Research has found that more than a third of IT shops have already implemented x86 server virtualization, though some are still at the experimental stage and many are holding back on using it for critical applications. Venture capitalists are looking for those numbers to rise and are still placing bets on start-ups building virtualization technologies.

"Virtualization is already hot and it's going to get hotter," says Paul Maeder, founding partner with Highland Capital Partners. "It's going to pop up in a lot of places, but ultimately it all amounts to the same thing; taking something that's currently uncontrollable, labor-intensive and vulnerable to security breaches and making it safe and more economical to operate."

Ryan Nelson, director of operations for professional baseball's MLB Advanced Media, is a relative newcomer to virtualization but has already seen the technology work its magic in supporting an online chat system his organization scrambled to get up and running in time for the 2007 playoff season.

Given a short deadline to get the chat system live, Nelson said he was in no position to put new servers and storage in place, turned to a hosting company called Joyent that offered virtual server zones and virtual storage. "We said to Joyent, 'We need 30 machines; 10 in a development cluster and two more gangs of 10 as big chat clusters.' And so the MLB chat client was basically turned up in a couple of days vs. a month or two that it would have taken us to get somebody to ship and install all these machines."

MLB Advanced Media is adopting virtualization in its new data center as well, and is high on its security capabilities. "If there's a security [breach], all they've broken into is one virtual machine," Nelson says. "Even if a machine has just one service running on it, say one Web server, that's running in a virtualized container. Should the day come when I need to move that service to another piece of hardware, I can just move the container. My pain point is really low."

Not that virtualization is a management or security panacea.

Gartner Vice President Neal MacDonald says "virtualization, as with any emerging technology, will be the target of new security threats."

John Debenedette, vice president of IT at e-commerce logistics provider and virtualization veteran Inttra, says hypervisors, the layer between the operating systems and hardware, could be particularly vulnerable.

"You can follow best practices on all of your virtual machines," he says. "But at the end of the day, you're putting a lot of trust in the virtual-machine platform layer itself."

About a third of 707 Network World readers asked about virtualization said they realize it comes with increased security risks. Experts say a mix of firewalls, intrusion-detection and sound thinking about policies and partitions are key to safeguarding virtualized resources.

Before virtualization can even get off the ground at an organization, certain management issues also need to be addressed. For example, companies need to figure out whether staff has the skills to run virtualized machines. What's more, political issues need to be confronted, such as whether different departments are willing to share server resources. Organizations also need to determine whether the applications they rely on most support virtualization.

Of course, not all the onus for tackling these issues falls on IT. Vendors, such as those that make management products, are upgrading their products to help simplify operation of virtual network environments. What's more, new companies and open source projects seem to be popping up daily to help address some of the shortcomings identified by early adopters.

This Executive Guide addresses basic and advanced questions about virtualization, examines the status of the market and zeroes in on security. Case studies of early adopters help put it all in perspective.

# VIRTUALIZATION REALITY CHECK

Section 1

## Exploiting Virtualization

# 10 questions to test your virtualization readiness

### Before diving into server, operating systems, application and desktop virtualization, industry analyst group suggests asking critical questions

■ *By Denise Dubie*

*Virtualization appeals to IT executives looking to maximize data-center operations, but they must ask themselves 10 difficult questions before rolling virtualization out to successfully adopt the technology, industry watchers say.*

Enterprise Management Associates has released its collection of "Top 10 questions to ask before any virtualization project." According to EMA senior analyst Andi Mann, the list starts with the basics around existing skill sets and quickly moves on to technical hurdles of which every IT organization should be aware. The benefits of abstracting software away from hardware to create a flexible, dynamic environment are compelling, but successful adoption depends on having the right skills, security and management tools and business drivers in place.

"In some cases, the technology is not ready, or the returns will not be sufficient, to embark on such a major change in technology, architecture and process," Mann writes. "Virtualization should not be rushed. It is a long-term opportunity, and enterprises that approach virtualization carefully as a strategy, not just a project, will be better positioned to benefit in the long run."

Here is a rundown of the key questions to ask before embarking on an enterprisewide virtualization project.

1. Do you have the skills to support virtualization? EMA ranks the lack of "appropriate skills" as potentially the biggest barrier to successful virtualization deployments. The research firm says about three-quarters of enterprise companies that don't yet have virtualization in place believe they don't have the skills to support the technology. EMA recommends training staff before the technology is adopted, determining requirements, documenting expected changes and performing pilots of virtualization technology in small sample environments.

2. Are you ready for the politics virtualization could introduce? The second pitfall is also related to the human element. Because IT departments have existed in siloed groups for years, IT executives could face pushback in their efforts to win mainstream

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acceptance of virtualization technology, EMA says. For instance, some groups may not wish to share server resources, and for that reason, EMA recommends organizations put in reporting tools to show how virtualization is either helping performance or at the least not hurting departments by sharing resources among them.

3. Have you considered and can you accept the risks? Virtualization technology reduces the amount of physical resources needed to support multiple systems and applications. But at the same time, it "concentrates more users and applications on fewer, more complex, shared virtual environments," the EMA report reads, and because of that, "the impact of hardware failure, human errors, security breaches, planning problems, support issues and more are vastly magnified in a virtual environment." Among its suggestions, the research group recommends enterprise companies develop detailed business continuity and disaster-recovery plans at all stages of the virtualization project.

4. How will your security systems hold up? Virtualization can introduce more security holes, more forms of malware and more vulnerabilities than many organizations are prepared to tackle – mostly because today's technology isn't yet equipped to deal with the new threats. Such security issues as hypervisor infections, rootkit viruses and malicious virtual machines can "be virtually undetectable with current tools," EMA says. IT executives must secure virtual machines as the do physical machines, and take extra steps to ensure the virtual environment is locked down. "Technology and disciplines for discovery, configuration, change management and more become critical to detecting virtual malware," the report reads.

5. Do you have compatible systems and applications? Some applications and systems do not mesh well with virtualization. For instance, EMA cites applications with "highly efficient usage, severe requirement spikes or continuously high utilization of any resource." Also applications that interact directly with hardware will also stall a virtualization project, the research firm says.

6. Do you have a capacity-planning discipline? Virtual server sprawl is a common result of virtualization deployments outgrowing their existing capacity. EMA recommends IT organizations use detailed capacity-planning measures to make sure they have sufficient hardware and software resources to support their virtualization implementation and make sure it doesn't get out of control.

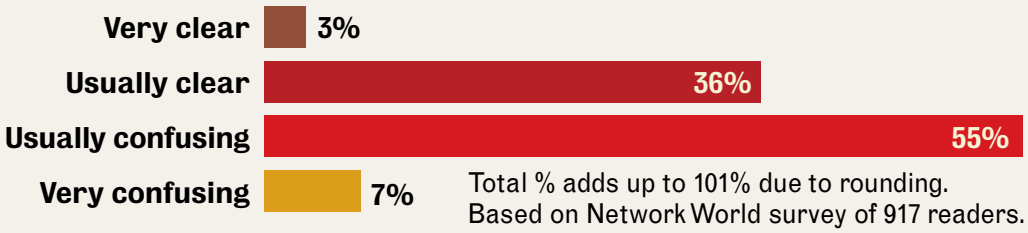
7. Is there support for your environments? While many popular, packaged applications support virtualization, many applications do not, EMA says. The research group recommends IT shops investigate which of their software and hardware platforms are supported and which might require them to upgrade before rolling out virtualization.

8. Can your network support virtualization? Network and storage can represent potential bottlenecks for virtualization in the data center. For instance, virtualization technologies that focus on the user, such as application or desktop virtualization or application streaming, don't work well over low-bandwidth connections, EMA says. Enterprise IT managers can try to address network and storage limitations with WAN-optimization technologies or by limiting the proliferation of images.

9. Can your management systems handle virtual environments? While virtualization reduces the number of physical resources to manage, it increases the complexity of the overall environment and introduces management issues that that could challenge some IT managers. For instance, the ease of deployment leads to a proliferation of virtual machines, or virtual server sprawl, which makes management exponentially more difficult. Also the added layer of software increases the complexity of managing the entire environment, EMA says. "Until management tools catch up with virtualization, the key to success is having not just tools, but also strong process disciplines for discovery, performance management, configuration management, patch management, service-level management, provisioning, disaster recovery" and more, the report reads.

### Figuring them out

How would you describe the typical pricing structures of leading enterprise network companies?




Total % adds up to 101% due to rounding.
Based on Network World survey of 917 readers.

SOURCE: NETWORK WORLD TECHNOLOGY OPINION PANEL: WWW.NWWBETOPDOG.COM

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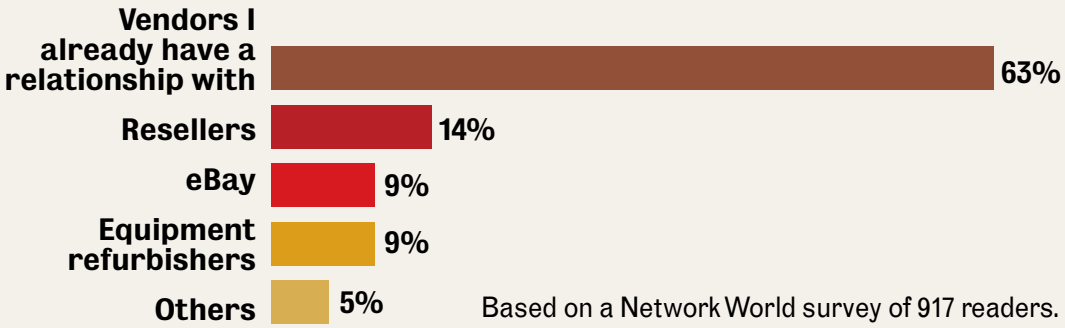
## Finding a bargain

Where do you turn first for a bargain on enterprise network products?




SOURCE: NETWORK WORLD TECHNOLOGY OPINION PANEL: WWW.NWWBETOPDOG.COM

10. Does virtualization help you address business objectives? Perhaps the "most overlooked factor in the rush to virtualization" is aligning the technology implementation with specific business goals, EMA says.

To measure the success of a virtualization rollout, enterprise IT shops must first know their desired results before deploying the technology. EMA recommends IT managers plan for long-term strategic results and not use virtualization as a quick fix for a pressing pain point. For instance, while many organizations may consider cost savings a result of virtualization, EMA reports that is not often the case.

"Overall, cost savings is not always the most likely outcome – in fact, reduced costs (software, hardware and floor space) are the least expected outcomes. Despite the touted cost benefits of server consolidation, for example, it delivers only one-off cost savings, and the additional costs – especially of software – are often considerable," the report reads.

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# How to keep virtual test environments in check

## Using virtualization for testing reduces costs and saves money, but environments need to be managed or they can run amuck

■ *By Denise Dubie*

*Virtual server technologies used in preproduction environments promise cost, time and labor savings, yet the same tools left unchecked can result in complex configurations, wasted resources and management nightmares for IT staff.*

Virtualization removes the physical server constraints of test environments and enables sharing of resources among IT staff to make test work easier, but its use needs to be carefully controlled, industry analysts and IT professionals say.

"One of the pitfalls of using virtualization in test environments is the proliferation of images, especially when testing multiple configurations across different operating systems," says Carey Schwaber, a senior analyst at Forrester Research. "There has to be a real effort around controlling this environment with policies to prevent the environment from growing too much or becoming unused resources."

### Avoiding test-server sprawl

Tim Antonowicz, systems engineer at Bowdoin College in Brunswick, Maine, says virtualization helps his team test software without requiring the build of a new operating system or cluttering a developer's workstation with another piece of software. He has 55 test stage, or sandbox, virtual machines (VM) running.

"Sandboxes are basic VMs where we test and evaluate various software offerings without expectation. If we want to try out something new, run a beta version or just play with a new idea, we roll out a sandbox VM," Antonowicz says.

Using virtualization in such a way — as a tactical tool for testing — is common. But most IT organizations haven't standardized their use of virtualization for testing across the enterprise. Different IT groups wind up operating their own pockets of virtual servers that aren't always properly managed or decommissioned. Industry watchers argue the benefits of using virtualization in test labs have yet to be fully realized because of these inconsistencies.

"It is important to have consistency when testing, and IT needs a comprehensive management approach to ensure proper coordination between physical machines and virtual resources," says Melinda Ballou, a principal analyst at IDC.

To help IT managers gain control of their testing resources, virtual test lab management vendors have been coming out with new tools.

Vendors such as Akimbi (acquired by VMware), CollabNet, VMLogix and Surgient have emerged in the past two years with products aimed squarely at those enterprise companies using virtual server tools to

### Maintaining virtual labs

Virtualization players offer tools to help enterprise companies prevent their virtual labs from becoming a test bed for chaos and unnecessary complexity.

**Vendor:** CollabNet

**Product:** CUBIT

**Features:** Provides a centralized virtualization platform that reduces build and test infrastructure costs by 50%.

**Vendor:** Surgient

**Product:** Virtual QA/Test Lab Management System (VQTS)

**Features:** Accelerates testing and application delivery by consolidating infrastructure and automating the setup of complex test environments on-demand

**Vendor:** VMLogix

**Product:** LabManager

**Features:** Allocates infrastructure, provisions operating systems, sets up software stacks and packages, installs development and testing tools, and downloads required scripts and data for automated job execution or manual testing.

**Vendor:** VMware

**Product:** Lab Manager

**Features:** Automates the setup, capture, storage and sharing of multi-machine system configurations and allows information to be shared.

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quickly build up and tear down testing environments. The products include automated features that track virtual machines and capture configuration data to be stored in libraries for future use.

For instance, Akimbi's Slingshot product, now VMware's Lab Manager, lets IT managers build a software test infrastructure to automate the setup and teardown of multiple VM environments. Surgient's Virtual QA/Test Lab Management System speeds the test process for enterprise IT managers by consolidating test infrastructure and making it possible to automate the setup and teardown of complex test configurations on demand.

IT staff at Sisters of Mercy Healthcare in St. Louis, Mo., turned to VMware and Surgient when they realized the prospect of upgrading 24,000 desktops for a workstation refresh would drain staff resources without delivering the desired results.

"We had a desktop refresh cycle that involves all the computers in the enterprise being upgrade to the same operating system and the same lockdown strategy. We had multiple environments we had to bring up to speed," says Brian Boresi, manager of client engineering. "Doing that across 24,000 workstations, to say the least, is labor- and time-intensive, too much for us because we have to follow a very rapid deployment schedule."

While the IT team realized virtualization was the only realistic option for such a large desktop rollout, Boresi says he knew they needed help managing the test lab as well. Rather than have an IT staff member physically meet with each desktop owner to determine application requirements, Boresi says Surgient enables his team to automate the process of creating multiple configurations in the test lab and change those configurations based on the user workstation environment.

"We currently support 600 applications, have a short turnaround time and aggressive rollout schedule. There is no way we could do this without an automated way to test and deploy these applications," Boresi says.

## Virtual lab limitations

Still, virtual test lab management tools won't be enough to stop the environments from going awry, some say. IT organizations need to define what can be tested, approach it with best practices and ensure anything tested on the VMs also is run in tests on physical machines before hitting production.

With that in mind, Sister's of Mercy Healthcare uses a virtual environment for one of three stages of tests and always completes a test run on physical machines before going live.

"We deploy an application package to production workstations in a pilot stage prior to going live. This way we make sure the software meets all the requirements and doesn't hit any snags specific to a physical machine and performs as expected," Neubauer says.

Edward Christensen, director of technical operations at Cars.com in Chicago, say he refrains from load or performance testing in the virtual test environment. "We limit our virtualization to functional and integration testing only. And unless your production environment is also virtualized, it shouldn't be used in performance testing," he says.

Others agree that performance testing, such as that for application load and availability, is not suited for virtual test labs.

"You can't ramp up the number of concurrent users to see how well the application will perform under of a load of say 10,000 concurrent users. Virtual machines do share some resources with the physical machine, no matter how few, that would cause those types of performance tests to be in accurate," Forrester's Schwaber says.

Gary Chen, senior analyst at Yankee Group, says he encourages clients to adopt virtualization for test environments because "if they do, their lives will get much easier and they will get more testing for less money." But he also warns IT professionals not to fall victim to the promise of virtualization without heeding some simple advice.

"No one should rely fully on a virtual environment for testing. Physical testing is still a must," Chen says.

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# Variations on a virtualization theme

## Which strategy is right for your data center: consolidation, clusters or grids?

*By Phil Hochmuth*

*To virtualize or not to virtualize -- that is no longer the question when it comes to deploying Linux in the data center. Today, the question is which virtualization approach to take.*

One option is to junk dozens, or hundreds, of stand-alone server boxes and consolidate virtualized Linux server images onto a few large hosts. Another is to buy hundreds of new Linux machines and tie them together as a single, virtual system via clustering or grid technology.

"Linux is the strongest example of an operating system that runs on almost any hardware you can think of, and almost any deployment scenario you can think of," says Jean Bozman, research vice president with IDC's Enterprise Server Group. "The style of a virtualized Linux deployment you use depends who you are and what problems you're trying to solve. Clusters, grids, virtualized servers are all possible from the basic building blocks of Linux."

### Scale up with consolidation

The trendy data-center virtualization scheme among Linux users is server consolidation, which aims to address a problem that has roots in the economic downturn of 2001 to 2003, when cash-strapped enterprises started favoring smaller servers over larger ones, Bozman says.

"Over that time, there was a proliferation of volume servers, the likes of which has never been seen," he says. Before 2001, Linux server shipments were around 3 million to 4 million units per year. Now they top 7 million. For customers who built out data centers using hundreds of machines, there is now a push to pare down the amount of "pizza box" hardware.

"Customers who run a data center with 50 or 100 physical servers may need 500 or 1,000 of those machines someday," says Kevin Lehay, director of virtualization at IBM. "How do you manage all of that environment? That's where the scale-up environment takes advantage of that."

The drivers behind the scale-up model include the ability to manage and provision servers more easily, with virtualized servers all running inside one box. Cost savings on power consumption of one large machine, vs. hundreds of single-rack-unit boxes, can be significant. A recent study by Gartner found that the cost of energy in data centers is in some cases almost equal to the cost of the server hardware itself.

For Nationwide Insurance, consolidation of 416 Linux servers onto a single Big Iron box means less walking around and pushing buttons. This is not insignificant when considering wide-scale server maintenance, such as applying Linux kernel or application software patches, according to Steve Womer, senior IT architect at Nationwide Insurance.

"Let's say it takes you 45 minutes per server to apply patches and software fixes, to reboot them and get them back up," Womer says. "Forty five minutes, with 418 servers - that's 315 man-hours. I've got eight people to do all this. That's a long time."

Womer uses a single shared-root file system, which the 418 servers share, running on top of the IBM z/VM virtualization layer of the mainframe. "If you only have one root, it's only two man-hours to patch the copy of the shared read-only root, then you start rolling it through."

### Hype over hypervisors

Several key Linux kernel and system-tool advancements over the last several years are helping these virtualized data-centers-in-a-box and grid-style deployments to evolve.

**"Forty five minutes, with 418 servers – that's 315 man-hours. I've got eight people to do all this. That's a long time."**

"The introduction of hypervisor technology you might say is the single-most important virtualization advancement over the past five years," says Justin Steinman, Novell's director of product marketing for Linux and open source.

The hypervisor is a software layer that sits between the guest operating system and the physical server. "The best way to think of it is

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as the traffic cop," Steinman says. The software controls the different operating systems that are running on a virtualized server and manages the flow of the hardware resources, such as I/O, storage, and processor use and memory access. Open source and vendor-specific products in this area include Xen's open source virtualization technology, IBM's z/VM and VMware's ESX Server.

Virtualization via a hypervisor layer is called paravirtualization, Steinman says, as opposed to standard VMware-style virtualization, in which a guest operating system runs inside a host, without any knowledge of the host system. Novell's SUSE Linux Enterprise Server 10 has a Xen hypervisor built into the Linux distribution, and Red Hat's forthcoming update to its Enterprise Linux Server also will have this virtualization piece built in.

"You need to put software drivers [in the guest Linux systems] to make them aware that they're being virtualized," he says. This enables the virtualized Linux systems to use processor resources more efficiently. Otherwise, the systems would compete for resources, with the software functioning as if running on a weak hardware system.

In clustering and distributed computing, some of the important advances have happened inside the Linux kernel, as well as with system and management tools offered by vendors to harness and control dozens, hundreds or thousands of Linux-based processors.

"That's a challenge for high-performance computing users," Steinman says. "How do you make sure all those processors are the exact same operating system with the exact same patch, with all the different tweaks there? If one box is out of sync, it could bring the whole system down."

Tweaks in the Linux kernel over the last few years also have expanded possibilities for distributed, virtualized Linux.

"Some of the advancements inside of Linux that have helped this stuff are improvement in scalability and performance," Steinman says. Linux software can now scale to 10TB of memory across a grid or cluster, and as many as 1,024 processors. "That's an advantage where the open source technology has improved to enable that. You could go out this afternoon and download the code and find the exact code tweak that was made to implement that kind of advancement."

Linux virtualization also is being used to consolidate Windows servers in some IT shops. Success Apparel, a children's clothing company in New York, has boiled down its 17 separate Windows servers to nine servers running SUSE Enterprise Linux, VMware and virtual Windows instances on top.

The move "has reduced operating expenses by 25% while allowing our IT staff to concentrate on other projects," says Steven Golub, the company's IT manager.

## Scale out with clustering

"It's funny with all the excitement about virtualization, people have sort of almost forgotten that clustering is a form of virtualization," Bozman says. "Clustering was one of the earliest forms of virtualization, in the sense that when an application is cluster-aware, it views all of the attached server nodes as being resources that it can use, as if it were on a big SMP [symmetric multiprocessing] machine."

Users of large, high-powered Linux cluster systems say the mix of proprietary virtualization management software, along with low-cost hardware and free Linux, are opening up the processing-power floodgates.

CIS Hollywood is a digital special-effects house that produced digital images for "Pirates of the Caribbean," the fantasy epic "Eragon" and the most recent "X-Men" movie sequel, among dozens of other movies. Much of CIS Hollywood's rendering work – in which large computer files are processed and crunched down into a viewable digital movie format – is done on a cluster of 40 Linux PCs, running the free 64-bit version of the CentOS Linux distribution, which are managed by software from Linux Networx.

"The big key with Linux Networx is manageability," says Matt Ashton, systems manager for CIS Hollywood. "Instead of having to maintain individual nodes – which can be done with a variety of scripts – they've got all of that all set up to go. I can update all 40 machines with a few mouse clicks without having to do it by hand."

To CIS' users – artists, graphic designers and computer technicians – the Linux cluster appears as one large virtual machine. Fronting the cluster is a scheduling application written in-house, which distributes rendering jobs to the 40 machines. "Users don't interact with individual nodes," Ashton says. "They just submit jobs, and the queue management software takes care of it."

CIS has used a clustered, virtual rendering system for more than four years as a way to process the work of its artists more quickly and inexpensively. Ashton says nodes in the cluster – dual-processor AMD Opteron boxes with 4GB of memory – cost about $4,000 each. CIS' large SMP Linux machines – four-processor, dual-core machines with 32GB of memory – cost between $30,000 and $40,000 each. The cost savings on a per-node basis is between $2,000 and $3,000 when scaling the system out, as opposed to up, he says.

PayPal, the online payment system owned by eBay, uses thousands of Linux machines to run its Web presence. The Web company replicates a single Linux/Apache image, bundled with its own transaction software, across these servers that appear as a single system to customers.

"Rather than have a monolithic box, we just have so many [nodes] that the breakages are irrelevant," says Matthew Mengerink, vice president of core technologies for PayPal.

However, few enterprises need the kind of computing power of a CIS Hollywood, or the scale of a global payment system, such as PayPal's.

Google is another example of the scale-out model, Steinman says. Its search engine runs on thousands of distributed Linux computers, which provide its

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signature fast, accurate search results. "But will an enterprise run its SAP platform on that model?" Steinman asks. "Probably not."

## Griddy up

However, this does not preclude the use of distributed, virtualized computing in enterprises.

"Businesses tend to use [a distributed Linux] model in certain specialized enterprise applications, such as actuary or risk management applications," IBM's Leahy says. "You could build a stand-alone environment, which could deliver these processes in minutes or hours, but it would be pretty expensive and dedicated to one thing." This single-purpose system also would remain idle most of the time, he adds.

This is popular in Wall Steet firms, where trading desks have very powerful workstations that often sit idle during the hours when the markets are closed.

"Some people would like to have a series of distributed resources, the kind of work you used to do on a mainframe," IDC's Bozman says. "This is a work in progress, but clearly people would like to do that."

Whether Linux users deploy virtualization in a consolidated deployment, or in clustered applications or grids, Bozman says there's a common thread shared among trends.

"It's like back to the future. What we're doing is reinventing the economics of computing, but we still want the same results that we had before" in the mainframe and large-system days – "lots of reliability and lots of availability and utilization. But we're doing it today at lower price points than we did in the early '90s."

Section 2

Market Insights

# Server virtualization in two-thirds of enterprises by '09, Forrester predicts

## IBM, HP, Microsoft urged to upgrade virtualization tools

■ *By Jon Brodkin*

*More than a third of enterprise IT shops have implemented x86 server virtualization, and nearly two-thirds expect to do so by 2009, Forrester Research finds in a survey.*

IT departments already using virtualization have virtualized 24% of servers, and that number is expected to grow to 45% by 2009.

Vendors need to get busy upgrading virtualization products, because many enterprises have been using the technology for two years or more and are ready to expand usage, Forrester reports.

"BMC Software, IBM Tivoli, HP Software, and Microsoft must repackage their offerings to create immediate tactical value by adding or buying tools for virtualization environment tasks, such as converting between physical and virtual servers and rapidly updating virtual server configurations," Forrester states.

The Forrester report – "x86 virtualization adopters hit the tipping point" – was released Friday and is based on a survey of 275 enterprise server decision-makers.

Previous Forrester research actually showed higher adoption of server virtualization, with 50% of IT shops using the technology in production and pilots in 2006.

Estimates tend to be "all over the map," and IT executives are sometimes too optimistic about predictions of future use, says report lead author Frank Gillett. But the survey results "show the power and popularity of the idea … and demonstrates there is significant intent to increase usage."

The latest report finds that 37% of IT departments have virtualized servers already, and another 13% plan to do so by July 2008. An additional 15% think they will virtualize x86 servers by 2009.

As enterprises gain a couple years experience with virtualization, they will move from tactical, experimental approaches to strategic IT infrastructure initiatives that might involve upgrading servers, storage, networks and systems management.

But virtualization isn't close to being universally adopted throughout enterprises, Gillett says. IT executives typically aren't using the technology for critical applications, or platforms like grid computing and supercomputing, he says.

"Virtualization is working its way [up] from things where people are less uptight about performance," he says.

Virtualization is primarily about sharing machines and portability, but these may not be compelling reasons to virtualize critical workloads, according to Gillett. Machine sharing isn't that necessary if a machine is already busy, and portability might not be compelling when there are few other servers a workload can be moved to.

Section 2: Market Insights

# Virtualization still hot, death of antivirus software imminent, VC says

## Highland Capital Partners founder also expects to see the ability to bypass wireless networks in 2008

■ *By Cara Garretson*

*In 2008, investments in start-ups that target consumers are expected to remain significantly hotter than those in companies building enterprise wares, as has been the case for the last few years. However, there are a few areas in corporate IT that should see some significant interest, according to Paul Maeder, founding partner with venture capital firm Highland Capital Partners.*

One of these is virtualization.

"Virtualization across the board is already hot, and it's going to get hotter," says Maeder. Once applied mainly to servers in the data center, this technique will find more applications as enterprises look to get their arms around unruly IT systems. "It's getting more segmented, it's going to pop up in a lot of places, but ultimately it all amounts to the same thing; taking something that's currently uncontrollable, labor-intensive and vulnerable to security breaches and making it safe and more economical to operate."

Another trend Maeder predicts for 2008 is, at long last, the death of antivirus software and other security products that allow employees to install and download any programs they'd like onto their PCs, and then attempt to weed out the malicious code. Instead, products that protect endpoints by only allowing IT-approved code to be installed will become the norm.

"There are much better approaches to dealing with external threats, and those approaches are going to take over," he says.

Antivirus products won't disappear overnight, Maeder adds, but will slowly fade into the background as enterprises embrace this new model. "Ultimately it's the enterprise buyers who are going to decide what the structure of the industry is, and they decide that through their buying habits," he says.

A third trend predicted for 2008 by Maeder is the ability to work around closed wireless networks, much like Skype opened up the opportunity to bypass wired networks.

"Carriers so far have a hegemony of closed systems; they decide what applications go on a phone and what comes over the airwaves. That has resulted in very slow innovation, versus the rate of innovation on the open Internet," he says. "I think entrepreneurs are going to find ways to bypass that, and once they do there's going to be enormous innovation."

# Data center managers see green, battle virtualization hangovers in '08

## It's time to face the challenges of managing virtual environments and adopting green computing practices

■ *By Denise Dubie*

*Data center managers who championed virtualization and green computing in 2007 now face the task of delivering the benefits they promised -- something industry watchers say will be no small feat.*

As projects move beyond the planning phase in 2008 into broader deployment, data centers managers will need to evaluate how they're going to manage and support the

# Section 2: Market Insights

new technologies without overhauling their entire infrastructure.

"Virtualization and green computing will flip-flop for a while, because they represent challenges beyond what they are said to do," says Robert Whiteley, senior analyst at Forrester Research. "We will see a bit of a virtualization hangover at first because while a lot of people have embraced the technology and seen some success on x86 servers, virtualization forces IT to look differently at managing an environment. And the greening of IT, that is going to be a challenge because a lot of companies don't have a full grasp on what it is yet."

## Managing more than VMware

To start, virtual server management technology will become more critical as VMware faces competition in the hypervisor market that until now included few players.

With Citrix (considering its XenSource buy), Microsoft, Oracle and Sun all having plans for virtualization, data center managers will for the first time "face islands of hypervisors within their IT shops," which will have to be managed as a cohesive whole to truly cash in on the benefits of the technology, says James Staten, principal analyst at Forrester Research. Hypervisor providers and management vendors alike will be working to deliver the platform on which multivendor virtual servers can be managed. For instance, VMware acquired virtual server management software maker Dunes Technologies in 2007.

"The market is going to see the need for a heterogeneous virtualization management platform that we haven't seen up until this point," Staten says. "It will cause a significant shake-up in the management space when start-ups pop up, and bigger players that haven't been doing a very good job will look to acquire them."

In addition, data center managers are considering virtualizing not only server resources, but also storage, network, desktop and application resources – – which will drive a need for more comprehensive management tools. But data center managers aren't about to replace their existing management tools, so industry watchers say vendors will have to work to cover more platforms and develop standards to help customers manage heterogeneous environments.

"A big debate in 2008 will be around how to put hooks into management tools from the multiple virtual resources, and data center automation will become even more critical," Whiteley adds.

Indeed, data center managers are looking for vendors to provide more automation capabilities to their tools. With the volume of servers increasing exponentially due to virtualization, systems administrators will not be able to keep up-to-date server and application configuration records or track change manually. Acquisitions such as HP's Opsware buy and BMC's RealOps purchase could help these vendors get ahead of competition looking to not only manage but also provide automation in virtual data center environments.

"The noise I am hearing the most around data centers involves managing virtual servers and automation. IT has gotten to the point where it absolutely needs to control the configurations of multiple systems and has no reasonable means to do so without considerable automation," says Jasmine Noel, a principal analyst at Ptak, Noel and Associates.

## It's not easy going green

Just as virtualization is no slam dunk, neither is green computing. Industry watchers say that working toward a greener computing environment isn't going to be easy for most data center managers due to technical, political and other reasons outside the control of IT.

"Legislation is coming about putting corporate responsibility programs in place, but in a lot of cases IT doesn't fall under the umbrella of corporate responsibility," says Zeus Kerravala, senior vice president of global enterprise research at the Yankee Group. "IT needs to start understanding more about data center facilities and find ways to design data centers to eat up less power."

According to Steven Harris, director of data center planning and design at consultancy Forsythe Technology, the amount of power that data centers consume has doubled in the past five years and it is projected to double again in five years. Because the data center consumes a significant amount of the resources from facilities, many will be looking to IT to be more cost-effective and conserve energy.

"When people think about how they can save money and lower operating costs, unfortunately the big changes from the facilities side – such as replacing an electrical or mechanical system – are extremely expensive and introduce significantly more risk," Harris says. "So companies will be looking to IT to make changes such as consolidation, virtualization and optimization to lower costs and do so without causing major outages."

For IT, that means finding ways to reduce their power consumption – but not necessarily because they care about the environment. Forrester's Staten says in 2008 data center managers will be tasked with "energy auditing," which involves understanding the entire power path from the utility to the CPU. While vendors will paint such efforts as green computing, companies are more looking to cut costs.

"Being green is not the main driver for trying to conserve power. It's a cost-driven measure for IT," he says.

One way to start cutting costs is with products that shut off unused workstations or limit power consumed by servers. For instance, companies such as Partners Healthcare and many others tapping Energy Star initiatives have already reported millions in savings.

Still, the disconnect between the premise of green computing and the IT drivers could cause confusion among data center managers lacking clear direction from corporate management.

"There isn't anything you will be doing when you won't hear about green IT," but without more knowledge of the subject and technologies relating to green IT, "the whole argument could blow up in IT's face," says Rich Ptak, founder and principal analyst at Ptak, Noel and Associates.

Section 2: Market Insights

# IT managers stymied by limits of x86 virtualization

## X86 virtualization lacks maturity of mainframe virtualization, analyst firm says

By Jon Brodkin

*IT managers well-versed in mainframe virtualization might expect smooth sailing when implementing virtualization tools for x86-based servers. But they're quickly finding unexpected challenges because x86 virtualization is nowhere near as mature as the mainframe virtualization tools that evolved over the past four decades, says a Saugatuck Technology analyst who is researching virtualization.*

"The large shops start with the impression that it will be easy, because they think they know what they're doing," says Charlie Burns, author of the report "The Many Faces of Virtualization: Understanding a New IT Reality". "The problem is it's different. They start to find out pretty quick that the things handled automatically by the virtualization mechanisms in the mainframe either aren't there, or are less mature and robust."

Virtualized servers are in some ways harder to manage than the traditional environment in which each server hosts a single application, because they contain a layer of abstraction between the operating system and hardware. When something goes wrong, this layer of abstraction makes it difficult to identify malfunctioning devices, according to Burns.

Beyond troubleshooting limitations, Burns says IT departments will run into difficult management challenges if they attempt to run more than about five operating system images on a single server. Mainframe virtualization tools can comfortably run hundreds of virtual servers on a single piece of hardware, Burns says.

But hypervisor software used for x86 servers today falls short of mainframe virtualization when it comes to balancing the requirements of workloads vs. performance, he says.

IT managers Burns interviewed while doing his research have discovered that there are different rules and best practices for operating virtualized x86-based servers compared to "real" physical servers. If you want a physical server to run faster, you give it more memory, Burns says. But this isn't always the right move with virtual servers.

"In a virtualized environment, you might get the exact opposite effect," Burns says. "If you increase the size of the virtual storage amount in that virtual image, you might cause the whole thing to slow down. There are things you relearn for a new server environment."

The popularity of server virtualization has increased dramatically over the past few years as IT executives place a bigger focus on increasing server utilization rates. The tools have gotten better, too, but Burns thinks it will take another three to five years to sort out the problems in today's technology.

Intel and AMD are building virtualization into the chip level, and customers can expect software improvements from hypervisor makers such as VMware, the Citrix-owned XenSource, and SWsoft (now Parallels), he says. Virtualization will be mature and robust enough within a few years to greatly increase the utilization rates of non-mainframe servers, he says.

For now, he says customers should stick with the basics: create a plan that meets clearly defined objectives, research existing tools and use the best, most updated virtualization technology available.

Burns's report covered the whole realm of IT virtualization - including virtualization of applications, desktops and storage - to identify the impacts today and the future of these technologies.

By the end of 2010, at least 30% of non-desktop IT infrastructure pieces will be virtualized, up from 5% today, Saugatuck found. Cisco, VMware and XenSource will dominate IT virtualization, providing the tools for 60% of new deployments through 2010, the report predicts.

But use of virtualization will be limited over the next half-decade by several key factors, such as IT processes and expertise, and the services and management tools available to customers, Saugatuck states.

Server virtualization is actually maturing faster than mainframe virtualization did in its infancy 40 years ago, Burns's Saugatuck report states. But there's another key factor that could impede the growth of x86 server virtualization. With the mainframe, most system components came from the same vendor (IBM). With x86 server virtualization, the microprocessor, server platform, storage, hypervisor and operating systems typically come from multiple vendors.

"These vendors may have conflicting objectives," Burns writes.

Section 3

Security Spotlight

# Virtualization security needed — now!

## Experts say it's only a matter of time before malware writers weasel their way into the core of a virtual server platform. Here's how to stop them

■ *By Deb Radcliff*

*For years, Inttra, an e-commerce logistics provider to the world's largest cargo-shipping organizations, has been using virtualization on its back-end IBM mainframe and Citrix Systems servers in a secure environment. Now the Parsippany, N.J., company primarily uses IBM blade servers running virtual Linux machines. VMware's virtualization technology on an Intel platform powers this New Data Center infrastructure.*

John Debenedette, Inttra's vice president of IT, says he believed he could keep a virtualized data-center environment secure while emulating established best practices. He's not ready, however, to risk running virtual Web servers outside his DMZ. Nor is he ready to allow virtual machines on the endpoints, which are harder to control.

"You can follow best practices on all of your virtual machines. But at the end of the day, you're putting a lot of trust in the virtual-machine platform layer itself," Debenedette says. "This layer — also called the hypervisor, the virtual kernel or virtual-machine monitor — sits between the hardware and all its device drivers, including the operating system, which puts it in a very authoritative position."

Security watchers have not confirmed any exploits at this layer; but virtual-machine-aware malware, such as RedPill, and virtual-machine rootkits, such as BluePill, are common. Debenedette rightfully frets about this new platform layer: It's a vector into which virtual-machine malware writers are trying to break, experts say.

In this virtual environment, effective security best practices are sorely needed. In addition to physical machines, virtual machines must be managed and secured. Network defenses must be tuned to watch for rogue traffic on them. And the virtual-machine layer must be built safely and defended from up-and-coming forms of attackware.

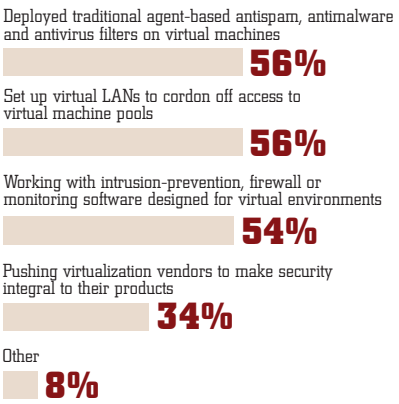
### Virtual-machine best practices

In a survey of 707 Network World readers, 36% of respondents — 250 respondents — said they realize virtualization has increased security risk. Of those, slightly more than half had deployed firewalls and segmented critical networks into virtual LANs, and another half had included virtual-machine traffic-awareness in their intrusion-detection sensors.

One-third of respondents seemed to grasp that the virtualization platform layer itself is vulnerable. The others did not believe virtual-machine platform vendors need to make security integral to their products (see graphic, below):

### Virtualization, security and you

In a recent survey of 707 *Network World* readers conducted by Research Concepts, approximately two-thirds of respondents said virtualization has not increased their security risk. The 250 respondents who do consider virtualization an added security threat tackle the problem in various ways. Here's the breakdown (multiple answers allowed):




Clearly, many enterprises are failing to apply even the most basic security policies for protecting their virtual servers.

Topping off that dangerous misstep,

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organizations are experiencing rogue and unmanaged virtual-machine creep — the very thing virtualization tries to relieve in the hardware realm, consultants to Fortune 500 companies say.

"The problem is collectively known as virtual-machine sprawl," says Anil Desai, consultant and author of The Definitive Guide to Virtual Platform Management. "If virtual machines are built without IT's knowledge, it's tough even to know they exist on the network," he says.

Consultants report a widespread problem at client sites: "Software developers, intranet users, even users on data-center servers with too much privilege, are setting up virtual machines [without IT's knowledge] because they're easy to deploy and help get certain jobs done," Desai says.

Inttra's Debenedette says he doesn't understand this phenomenon. Any organization worth its salt should have locked down its data centers according to best practices, which would make actions such as launching a new virtual server something that would trigger alarms, he says. Enforcement of those best practices is what ultimately cuts down on scope creep.

Debenedette's team uses VMware's Virtual Center management software, which contains an autodiscovery feature that locates rogue builds. Novell's ZenWorks, Microsoft's System Center Virtual Machine Manager and other virtual-machine-specific management tools also are available with discovery features. For those who don't want to integrate such tools into their management consoles, CA, HP, Network General, and other management and monitoring vendors over the past year have added varying degrees of virtual-machine-awareness to their suites.

Being able to locate virtual machines also helps with licensing and product support, says Richard Whitehead, a product director at Novell. "If you're running virtual servers, and they're not licensed, they're not supported," he says. "That means they're not patched and updated. And that makes them a security risk."

ROGER HAGADONE

Other discovery-related features of management tools that help with security include terminating unnecessary virtual machines and failing over to other secure systems if a load balance, infection or attack makes that necessary, Whitehead and others say.

## Best practices in securing virtual machines

In a virtualized New Data Center infrastructure, every virtual device and its systems and network segments must be controlled and managed according to best practices, experts say. These practices should include:

- Standard-gold builds, security, and version- and patch-management controls for every application running on every virtual machine and every virtual-machine type.
- Policy enforced by virtual firewalls, anti-malware and virtual-device management.
- Appropriate logical and physical separation of virtual-machine types; for example, virtual Web servers should be separate from virtual database servers.
- A network intrusion-detection system or monitoring finely tuned to rogue or malicious virtual-machine traffic.

## Partition like the real world

Where and how virtual machines failover is important, says Tom Parker, executive consultant at Verizon Business. Enterprise IT executives are all over the map in how they set up their failover processes, he says.

For example, failover could occur from one virtual machine to another or to a different virtual subnet. Best practices might dictate that the failover transfers to a separate physical server. This would be particularly important in the case of total system failure.

In a virtual environment, separation and partitioning of systems are important, not only for backup but also to create a DMZ. IT often overlooks this separation, Parker says. "What happens when the database servers are virtualized alongside, say, a farm of virtual Web servers on the same computer? I see that all the time," he says. "You're increasing the risk that attackers and malware can get from the Web server to the database server."

Best practices dictate that these types of systems be separated by a DMZ, which can be accomplished virtually, physically or through a combination of virtual and physical elements.

In a virtual DMZ, virtual switches and firewalls virtually separate a cluster of virtual data-center servers from a cluster of virtual Web servers, experts say. This can get as

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elaborate as you want — with virtual firewalls and switches separating subnets everywhere — as long as the virtual network devices and firewalls also are managed according to best practices.

Parker, however, has concluded that it's best also to separate these server farms logistically — with Web servers on one physical server and databases on another. "This removes the risk of anything malicious spreading between the [virtual machine] server farms themselves," he explains.

## Lock the lowest layers

The VMware platform, with its rights and privileges to the host operating system and hardware, makes a tempting target for malware writers, consultant and author Desai says. "From a technical standpoint, the virtualization layer has to run with either direct access to hardware or a hardware abstraction layer — meaning it's running with a high level of permissions to the physical machine," he says. "Any application with that level of access would be a target."

That makes it a question of when — not if — virtual-machine-specific malware will start jumping between virtual machines, down the stack to the host operating system or even to the virtual-machine monitor layer. Parker and other malware researchers say they have seen all these attack scenarios under development.

"They're looking for ways to attack the sandboxes and virtual machines by their kernels," says John Safa, CTO of DriveSentry, which makes firewalls for hard drives.

Patrick Lin, VMware's senior director of product management, recites a list of tests and certifications through which the company runs its products to prevent security failures. But security problems still come down to users having too much trust in the vendor; that's why Paul Smith, server security strategist at Intel, says he thinks virtual machinery will drive authentication to the chip.

Smith is referring to the "root of trust" components within the Trust Computing Group's (TCG) Trusted Platform Module (TPM), which stores a key containing the hash value of a system's approved configuration on the chip. When the system boots, the root of trust compares the hash values on the key and the chip, and prevents anything from running if the chip's hash has changed.

Specific to virtual machines, Intel and Advanced Micro Devices support TPM's root of trust, which checks the hash of the virtual-machine monitor, or hypervisor. If that hash has changed and the system attempts a reboot, the root of trust will revert to the original hash or not allow the boot. Developers also are working to address virtual TPMs. In this way, the trust-certification process would extend to virtual guests, says Larry Russon, a Novell product manager.

This would ensure the integrity of the virtual-machine platform, as well as — by virtue of its integrity — its safety, because any malicious or unauthorized changes to the platform (and ultimately the virtual machines themselves) are not allowed, Intel's Smith says. Configuration changes and patches are difficult using the Trusted Computing Group's model, Russon counters. This is because every change for every virtual device in the trust-certification process must be replicated and rehashed again at the chip.

Not to mention that management calls to the chip open a whole new layer, some say. "Flash programming to the chip for updates: Can this be cracked?" Inttra's Debenedette asks. "I'll bet we'll have to worry about that in the future."

Section 3: Security Spotlight

# Virtualization security risks being overlooked, Gartner warns

## Gartner raises warning on virtualization and security

■ *By Ellen Messmer*

*Companies in a rush to deploy virtualization technologies for server consolidation efforts could wind up overlooking many security issues and exposing themselves to risks, warns research firm Gartner.*

"Virtualization, as with any emerging technology, will be the target of new security threats," said Neil MacDonald, a vice president at Gartner, in a published statement.

Virtualization software offers the ability to run multiple operating systems, or multiple sessions of a single operating system, on a single physical machine, whether server or desktop. But virtualization software, such as hypervisors, present a layer that will be attacked and security strategies need to be put in place in advance, Gartner warns.

"Many organizations mistakenly assume that their approach for securing virtual machines will be the same as securing any OS and thus plan to apply their existing configuration guidelines, standards and tools," MacDonald said. While this is a start, a closer look at securing virtual machines is required, especially since needed tools may be "immature or non-existent," according to Gartner.

Among the specific points about virtualization and security addressed by Gartner:

- Loss of separation of duties for administrative tasks.
- Patching and signature updates and protection from tampering.
- Limited visibility into the host OS and virtual network to find vulnerabilities and correct configuration.
- Restricted views into "inter-VM traffic" for inspection by intrusion prevention systems.
- Mobile VMs and security policy.
- Immature and incomplete security and management tools.

Gartner speculates that the "rush to adopt virtualization for server consolidation efforts" will result in many security issues being overlooked. That, in combination with the lack of available security tools for virtualization, will mean "as a result, through 2009, 60% of production [virtual machines] will be less secure than their physical counterparts."

# VIRTUALIZATION REALITY CHECK

Section 4

## Case Studies

# EBay's computing guru gives behind-the-scenes peek

## Shares eBay's views on the next-generation data center, virtualization

■ *By Beth Schultz*

*Today on eBay, you just might find that absolute perfect mantelpiece you've been looking for, at a great price. It's there, nestled among some 100 million other items, placed for sale by one of the online auctioneer's 233 million registered users. Now think about the back-end infrastructure that enables you to find, and then buy, that object of your delight, and you do have to wonder how it ever happens. Contemplating the database environment alone — 600 production database instances spread across hundreds of medium-sized servers — is enough to give even the most stalwart IT executive a case of the shakes.*

But Paul Strong, distinguished research scientist at eBay, doesn't faze easily.

"You just can't get all the details for 100 million items on a single machine," he said in an interview, during which he described eBay's IT infrastructure, discussed next-generation trends, and shared how any enterprise, large or small, could benefit from the lessons the online auctioneer has learned along the way.

### The next-generation data center today ...

When we look at the data center, we don't see silos and silos of applications on islands and silos of infrastructure because those have proven to be expensive and not particularly efficient, and they tend to be very static. We need to move toward [something] more dynamic, and that means really viewing applications and business services as being network-distributed. And the platform on which they run is the data center. The data center is a system and should be treated as such. The application components are distributed across the entire system. How your application behaves depends on where your load-balancers direct traffic, the number of application instances behind them, how you connect to your databases. Your applications and services don't run on a single server. They run on a collection of resources that range from servers to firewalls, load-balancers and such.

### Where the next-generation data center is headed ...

One of the real trends in the next-gen data center is that it's all about interconnectedness. It's about the fact that all value is delivered by connecting sets of things together and agility is achieved by reconnecting the same sets. So it's all about relationships and how you manage them. It's the relationships that deliver value and how you cable together your infrastructure, how you make your applications and services communicate, and the patterns you use to drive the value it delivers for the business.

### Managing the next-generation infrastructure ...

We're using some technologies, for

## Section 4: Case Studies • • •

example semantic Web technologies, to allow us to have an ontology that describes our infrastructure and allows us to ask questions of it. We want to be in a position where we can ask our management framework, 'If a user presses this button, show me the things in the path.' And if they have a problem with it, 'Show me everything in the path that could be broken.' Or if, say, a load-balancer in our infrastructure breaks, 'Show me which business process is impacted so I can understand the financial impact on our business.' Things like that.

We have a good start, but we expect that we won't be able to capture all of these relationships. So we're trying to build a system that if we don't know everything, at least it captures what we do know so we can learn or infer the things that we don't know. For example, if we know there's a relationship between two application components, and they exchange a message, then we can infer – even if it's not explicitly stated that that's a SOAP message over HTTP – they must be able to exchange HTTP messages between them. That means there must be the ability to create TCP/IP connections between them, which means there must be a physical link that connects them because you know the application which is exchanging SOAP messages depends on the operating system to have a TCP connection between them that depends on physical servers that have bits of wire connecting them together. So by knowing the high-level thing, you know that somewhere there's a relationship and you can go away and search for it and understand and see if you can see how it's doing, what its properties are. Because if the SOAP message is running slowly, you can say, 'OK, well what are the physical cables this is running over? Is there a problem with a port in the line?' And things like that. It's all about the relationships.

### Server virtualization's role at eBay ...

If you think of server virtualization, like VMware and Xen and a whole slew of others, we don't use a lot of that in production. The main reason is that one of our main constraints on deploying things is really around performance and on latency, very specifically. Many virtualization products have carried a latency penalty because obviously if you're going to do something that goes through the I/O stack then it's going to have to go through not only the I/O stack of the operating system but the virtual machine that sits under it. However, we have used those in environments like test and [quality assurance] where we want to rapidly provision stacks of software for testing purposes.

### Database virtualization at eBay ...

By using database virtualization, we're able to scale. We used to run on the largest computers money could buy with the most memory you could fit in them. And it didn't matter how big of a machine we got, we couldn't fit our databases onto them. So initially we started partitioning those databases in a traditional sense by having discrete instances. And then we discovered that you can't get all the details for 100 million items on a single machine either. So you had to start splitting them. We moved a very large chunk of database functionality out of the traditional database tier and into the middle tier. We heavily customized it so we were able to basically scale the database across hundreds of … medium-sized servers by essentially virtualizing the database. So for an application on our infrastructure that uses the database, the coder doesn't need to know anything about the database vendor, what the table spaces look like, where they data is physically located or anything else. We built an abstraction layer into our application layer stack that allows us to virtualize the underlying database. So again, we get the same benefits in general of virtualization, which is essentially efficiency improvement, scalability improvements and flexibility, because we can change things behind the scenes without impacting the application that depends on it. And for us, and I believe many users, because data is exploding in terms of its quantity, that how you manage data and how you make it accessible by very large distributed applica-

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tions is becoming a very big problem. And it's probably one of the hardest places to actually scale.

### What others can learn from eBay's IT experiences ...

In the early days, it was easy to say, 'We're very different. We can achieve this by spending money on very heavily specialized equipment that an average IT person might not require in the data center.' At one point, we had a very large number of the largest computer systems you could buy. What we ended up doing is what everybody else will have to do but we had to do it sooner. Because our database wouldn't fit inside one large box, we had to split it across 10 or 20 large boxes. And if you can split it across 20, then why can't you split it across 1,000? This reduces your dependency on a specialized vendor, perhaps, and gives you freedom of choice and things like that. We were pushed to it by the scale and the way in which we were growing. But many other users are seeing these trends. They're not driven to solve the problems as much as eBay was because our entire survival depended on us solving these problems very, very quickly. We solved the database scale-out problem to some greater or lesser degree in 2000-2001 and now we're beginning to see the products that will allow people who don't have the skills and can't afford the burden of paying for people to develop their own software to do it.

### The ultimate next-generation goal ...

We really should be recognizing that we never build to an endpoint. We're building for constant change and agility and responsiveness to the business. Anything static possibly ends up being a constraint on the business in terms of agility and capabilities of delivering shareholder value.

# A virtual hit for MLB Advanced Media

## Virtualization helps MLB Advanced Media get a new application up in midseason and promises to play a big role in its new data center and beyond

■ *By Paul Desmond*

*December is a relatively slow time of year at MLB Advanced Media, the company that brings you the official Major League Baseball Web sites. From pitch-by-pitch accounts of games to streaming audio and video -- plus news, schedules, statistics and more -- it has baseball covered. Doing so requires serious horsepower, so much so that the company's Manhattan data center is pretty much tapped out in terms of space and power, according to Ryan Nelson, director of operations for the firm. Strategic use of virtualization technology enabled him nevertheless to forge ahead with implementing new products during the 2007 season, and promises to smooth a shift to a new data center in Chicago in time for the 2008 season.*

How long have you been using virtualization technology?

It's all pretty new. We are a homogeneous Sun shop, so we're not really touching a lot of the VMwares of the world. One of the big features of Solaris 10 is Solaris Containers and Zones. We started using Solaris Zones in the last year to actually split off server environments, development environments and [quality assurance] environments.

During the 2007 season we got hit with a big new challenge we didn't find out about until the All-Star break, which was to add a chat product. There was pressure to get it lit up before September so fans could chat about the playoff races and use it during the playoffs. But it was a big, ambitious project and I didn't have any rack space or spare power and [there was] no time to order new machines. So, we worked with a company called Joyent in California that provides hosting using virtual zones and virtual storage.

We said to Joyent, 'We need 30 machines; 10 in a development cluster and two more gangs of 10 as big chat clusters.' And so the MLB chat client was basically turned up in a couple of days vs. a month or two that it would have taken us to get somebody to ship and install all these machines. And then we developed like crazy for about a month, tested for another three weeks, then launched it.

At launch time we asked for another 16G

## Section 4: Case Studies • • •

bytes of RAM in each server. It scaled very well. When the playoffs and World Series came around, we ordered up 15 more machines and got twice as much memory and processors installed on them, as well as on the ones we already had. Joyent dials all this up and down. As soon as the World Series is over, we call and say, 'Thanks, that was great. Let's scale down to a skeleton crew of these machines.' So, when I have a need for it, we pay for the utilization. When we don't, we don't. We can turn it up and down as we need to.

We can respond to new projects really quickly, and it also lets us try out new products. If our chat product had been a huge failure, we could've turned the whole thing off and it wouldn't have been a big deal. It makes it easy to try new things. We don't have to sign a contract, get approvals and all that.

We can also respond to the seasonal load changes. And we can also respond to differences in the season that we know are coming. In April, we're focusing on registering new users and selling new products. On draft day, I might need to really beef up my stat resources because people are querying our minor-league stats engine to see who this guy is they just drafted. In the middle of July I may need an additional 10 machines to be generating the CAPTCHA images and processing All-Star balloting. All-Star balloting is about four days of crazy database load, and then it goes back to nothing.

### Getting personal: Ryan Nelson

| | |
|---|---|
| **Title:** | Director of operations |
| **Organization:** | MLB Advanced Media |
| **Responsibilities:** | All server infrastructure for the Web sites and streaming media of 30 Major League Baseball teams, 150 Minor League Baseball teams, various Major League Soccer clubs, and many other entertainment and sports properties. |
| **Number of IT staff:** | 15, as well as about 120 developers |
| **Education:** | University of Iowa, electrical and computer engineering |
| **Previous jobs:** | Chief systems architect of StarMedia, a Latin-American-centric portal site; lead systems engineer for Netcast Communications, an early streaming-audio technology company; broadcast engineer in Iowa City, building and maintaining several FM radio stations. |
| **First PC:** | Timex-Sinclair 1000 at age 14, followed a couple years later by an Atari 800 ("The first computer I hooked a modem to.") |
| **Home network:** | Macs in a home office and a media server in the living room connected via wireless; 15Mbps cable modem connected to a wireless router and to powerline Ethernet adapters to reach such places as the garage and basement; and a FreeBSD mail server in the garage. |
| **First Internet experience:** | "The U. of Iowa had connections to BITNET and CSNET when I got there in 1987. I mostly used Usenet and FTP freeware archives, until I discovered Mosaic on the HP-UX workstations at school. I showed Mosaic to my college buddy Scott Heiferman, now CEO of Meetup.com, in 1994. He returned the favor by helping me make the jump to NYC a few years later." |

### Give us a sense of the MLB.com infrastructure.

In terms of Web servers, we have roughly 100 at our New York data center, and we have a second data center in Chicago that is just about to go online that has 130 servers. So, by the time we get cooking on the 2008 season, we'll have in production about 180 of those.

### So you're just wrapping up the new center?

We've had it for about a year, but it's been in build-out phase. Part of the reason we're interested in virtualization is because of the power, space and data-center-capacity pain — we've certainly felt that. We were actually in a facility in Chicago and outgrew it before we got in production, and so moved to another facility from the same company. We knew we would need more floor space and more power. We're finishing it during the off-season. Once Chicago comes online, we're going to take much of the New York data center offline and rebuild it.

### I can't resist — so this is a rebuilding year?

Right. We'll upgrade servers to Solaris 10, upgrade our [storage-area network] infrastructure and replace some older hardware with newer, thinner models that use less power and generate less heat. That data center is in Manhattan, where the cost per square foot is just ridiculous. So, driving up utilization and squeezing everything you can out of every last square inch of rack space is important to us.

We'll move all the services we have running in New York to our data center in Chicago. Migration services is one of the features of virtualization in general, but Solaris Zones specifically. You can do things like clone a zone or migrate a zone. We can move a virtual machine from rack to rack around a single data center, and actually move these services to a virtual

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machine in a different city.

Also, in addition to seasonal traffic shifts, our load characteristics change drastically during the day. If I have 10 games starting at 7 p.m., there's a huge influx of traffic right at 7 p.m. If we have a bunch of day games, people use their high-speed Internet connections at work, reloading the scoreboard page a lot or watching our flash Gameday product, which has [pitch by pitch updates], or watching the streaming video online. So the ability to slide computing resources around is pretty handy for us.

### How else are you using virtualization?

All the services in our new data center will be put into containers, to get the manageability and security benefits — if there's a security issue, all they've broken into is one virtual machine. Even if a machine has just one service running on it, say one Web server, that's running in a virtualized container. Should the day come when I need to move that service to another piece of hardware, I can just move the virtualized container. My pain-point is really low.

It also lets us accommodate developers who are in a pinch because our season starts this year on March 25 — the [2007 World Series Champion Boston] Red Sox are opening in Japan against Oakland. That day is hard and fast. Previously, as a security guy, it was my job to say no to developers who wanted to log into a production machine and look at something because they were trying to debug a problem. Especially in the age of [Payment Card Industry] compliance and all that, we need to secure operational access to production machines. But now I can snap off an exact copy of the production machine and hand that to the developer, or I can give him access to a different Solaris Zone running on the same machine. So it let's us draw interesting security lines.

### What were the biggest challenges when you were implementing virtualization technology initially?

For every application we run, you end up with some assumptions, such as it will always use this IP address or this much memory. We need to make sure these assumptions are kept to a minimum or at least abstracted out into a different layer or into config files that can be then transformed as part of the virtualized-host boot scripts.

Wrapping our heads around this extra layer of abstraction from an administration perspective is a challenge. If I've got 100 hosts, that's an administration challenge already. If each of those hosts has one or two or three virtual hosts running inside of them, I need to keep track of those as well. And they move around a lot, so you need to be very careful. It seems like we've had to buy three times the number of white boards we use just to keep track of all this stuff.

Right now we're doing most of the management by hand with scripts that we've written ourselves because we've only got, not a toe but maybe most of a foot into the virtualization pool. But we need to get a handle on it before it gets out of control. We're quickly going to outgrow the point where we can manage an army of virtual machines like we can manage a smaller army of hardware because we're doubling our data center capacity on real physical hardware in a couple of months.

In the off-season we also have regular employee turnover, and it's interesting trying to hire people who have virtualization experience, especially big-enterprise virtualization experience. You can't really go out and say, 'I need to hire three guys who have been using iSCSI and Solaris Zones for large scale Web infrastructure' because they're just not out there. So, we're learning on our own, basically, and we're working with Sun Professional Services quite a bit. I can imagine if this had happened five years ago, the Zones feature in Solaris would have been an extra license. Now it's all free, and it's really cool, but where they really want to make their money is helping us on the services side.

### What other applications do you see for the technology?

We're tasked with transcoding a huge library of archived ball games. I can see where we would take a rack of machines that are used during the season to serve up files and reconfigure them to run a virtual instance of Windows to become a Windows Media encoder. We can take those servers and say, 'Today you're going to be 20 Windows machines,' and throw batch jobs at them and have them transcode stuff as fast as possible. The Sun server has an Intel chip inside and can be a Windows machine when it needs to be. And if you have a good management console, you can just say, 'Install Windows on these 30 machines or boot Windows on these 30 machines.' That's pretty interesting. Virtualization lets us slosh resources around seasonally.

Sun also just announced xVM based on Xen. So Sun's got Solaris Zones, which is kind of a virtualized user environment — one kernel with a bunch of virtual computing environments underneath it — and then there's the Xen piece, which is actually booting multiple kernels on big-enterprise hardware. That's in partnership with Microsoft, so it supports things like Windows. I would imagine that that's the technology we would end up using to do projects like I just described.

### Have you found any sorts of applications that do not lend themselves well to virtualization?

We haven't even considered running our database stuff on a virtualized host. For all of our databases, we really need high-performance storage and lots of dedicated hardware. That database includes our Major League Baseball stats, fantasy-team data, all the newsletters customers subscribe to, and what subscription audio products they've purchased, and so on. With virtualization, you do add a lot of extra abstraction. The big challenge for people who are inventing these new virtualization technologies is

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to make the overhead as low as possible, but it's still there. For really high-performance computing, if you need one big monolithic machine, virtualization doesn't help.

### Have you been able to determine your ROI on these virtualization efforts?

Not really, but I know it's very good. It's nice when someone comes up with an ambitious new project and my default answer isn't 'no.' It used to be, 'You'd like to give a free taco to everybody in the country? That's going to take X number of servers. And you need them up by Friday? I just can't do it.' Now I can say, 'Yes, you can do that and here's what it will cost. And if you have a big surge in traffic, I can double the number of your servers and it's going to cost this much.' And if they're going to make three times that much on the product, they'll say, 'That's fine.' So it lets us get to yes very easily. And the time from a decision to delivery is very fast.

### What have been the most pleasant surprises about virtualization?

I'd say it's not as hard as we once thought. If you think back to the days of mainframes, you actually had to write [code] for a compute grid or to spread your application around. When the developers use their instances of applications or of servers, they don't necessarily know that they're even running on virtual machines. They just ask for access to a machine to test something and we give them logon information and ask if they need root access on the box, which blows their minds sometimes. But once you're in a virtualized environment, it's very familiar to people. It's more administration work on the outside, but we don't have to train people much to use the resources that are presented to them in a virtual way.

### Any big disappointments with the technology?

Not yet. But we're just getting into it.

# Gannett's virtualization veteran lets us pick his brains

## Having gone virtual in 2002, Gannett's Eric Kuzmack knows what the technology does well and where it still needs work — and there's plenty of bothtion up in midseason and promises to play a big role in its new data center and beyond

■ *By Paul Desmond*

Gannett Co. is the largest newspaper publisher in the United States, with 85 daily papers including USA Today and nearly 1,000 non-daily publications. The company also operates 23 U.S. television stations and a large number of Web sites affiliated with its various properties. As you might expect, all that content creates a rather heavy demand on the company's IT infrastructure, which supports nearly 50,000 employees at about 200 locations. To help it keep up with demand without breaking the bank, in 2002 the company began exploring virtualization technology. It hoped to improve its x86 servers' utilization rates, which at the time averaged no more than 10%. Today the company has well over 1,000 virtual machines running on more than 50 VMware hosts, says Eric Kuzmack, IT architect at Gannett. Virtualization has been a big success, delivering ROI numbers that 'nobody would believe,' Kuzmack says, but adding that it's not for every application and there is no shortage of enhancements he'd like to see, especially in terms of management and accounting tools.

What kinds of applications are you supporting using virtualization?

All kinds. Our general philosophy when deploying new applications is to virtualize them unless the application owner or the vendor we purchase from has a good reason not to. We've come across a few application types that tend not to be great candidates for virtualization, such as large databases and those that do a lot of polling, like network monitoring applications. But we're virtualizing most other kinds of workloads, whether it's intranet Web servers, database servers, various application servers, Active Directory and portions of Exchange, although Microsoft has taken a very hard stance against virtualizing Exchange 2007. So, we're not

virtualizing our Exchange 2007 mailbox servers, but we are using virtualization for some of the other components of Exchange, as well as for disaster-recovery components. And for the most part, we really haven't had problems at all.

**You set out to improve server utilization rates. What have you achieved?**

When we start approaching 60% to 70% process utilization we'll add servers to our farms. We like to leave some headroom to handle spikes. Generally we'll go up to eight physical servers and then start a new farm. Or when there's a generation change in the processor, we're essentially forced to start a new farm because you can't use VMware's VMotion technology across two Intel processors of different families. [Ed. note: VMotion makes it possible to move a running virtual machine from one physical server to another without disruption.] Intel is introducing some features in its new chips that are supposed to help moving [virtual machines] between processor families so that won't be as big of a deal.

**Management was a big concern for you early on. How would you assess the general state of the tech today?**

There's still a wide disparity between what the various vendors offer. There's lot of talk. Microsoft, XenSource [acquired by Citrix Systems], Virtual Iron and everybody else is coming up with their own management tools. What we don't really have yet is a good, proven story on taking a Xen virtual machine from anybody's hypervisor and running it on somebody else's hypervisor. Or having a Microsoft hypervisor in the same pool as a Virtual Iron server and being able to move a [virtual machine] from one to the other. So, at the industry level, there's still a long way to go. VMware is certainly well beyond anybody else in the market [in terms of] management.

**What kinds of things can you do with VMware that you can't with some of the others?**

At a very basic level, it's easy and flawless with VMotion. I right-click on a server, click migrate, hit enter a couple of times and I'm done. The other vendors in the market are coming out with [similar technology], but it's still a ways away. And once they do come out with it, how stable is it going to be? We've been using VMotion since 2003, which is a very long time.

**Why is that capability so important to you?**

VMotion was really the feature that cemented our decision to go down the virtualization road. The biggest concern management had when we started looking at virtualization was the 'too many eggs in one basket' problem [and VMotion solves that]. We didn't want to have 10, 15 or 20 applications go down because of a hardware problem or because we needed to do maintenance. So, when VMotion came out and we started working with it — we were one of the two non-VMware entities that beta-tested VMotion — it dawned on us how important VMotion was. Other vendors have kind of dismissed VMotion as a curiosity, but they're plainly wrong. Very shortly after we set it up, we had several cases where we used it to the company's benefit. And it's very easy to set up.

**Are there other virtualization management challenges that have not yet been met?**

How much time do you have? For one, no one's quite gotten to cost accounting yet. There are two pieces to this. We don't do internal chargebacks, but in general it's important for us to understand [virtual machines] aren't free. One of the downsides of virtualization is a lot of folks say, 'Oh, we'll just spin up another [virtual machine].' So having tools to identify how much a particular farm costs, including the servers and the disks and everything, and how it's being utilized and at what percentages, would enable you to come up with a cost of ownership for a

## Getting personal: Eric Kuzmack

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|---|---|
| **Title:** | IT architect |
| **Organization:** | Gannett Co. |
| **Responsibilities:** | Providing strategies for aligning technology with business goals. Responsible for server, storage, directory-services and identity-management architectures. |
| **Education:** | Bachelor of Science, Emergency Health Services, University of Maryland |
| **Previous jobs:** | Paramedic for Sussex County, Del. |
| **First PC:** | "The first PC I ever used was an Altair 8800 my uncle built with a cannibalized IBM Selectric typewriter as the keyboard and a 5-inch black-and-white TV tube as the monitor. The first PC I ever owned was an Osborne I." |
| **Home network:** | Gigabit Ethernet with two laptops, four desktops and a dozen virtual machines. |
| **First Internet experience:** | "Tinkering with Mosaic and realizing there were only a few hundred Web pages, of which only a small percentage was interesting. Some things don't change over time." |
| **Words to live by:** | Unique solutions have the virtue of never having been tried. |

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particular [virtual machine].

And another challenge is growth prediction, where if you've got a set number of [virtual machines], being able to look at how those are being utilized and, based on that, project how many additional [virtual machines] of similar characteristics you could put in a given environment before you'll run out of resources. Those kinds of things are critical. Today a new application comes in, and it's purely a guess as to whether or not the amount of virtual resources you have will fit the application, which in a sense is similar to the physical world. Except people are a lot more comfortable with the physical world and, generally speaking, you either pick a two-, four- or eight-processor box. You don't have a whole lot of tiers in there. But in the virtual world, we're able to nuance our resources much more efficiently than in the physical world. The downside of that is you don't necessarily fix everything using brute-force performance: 'Oh, this application is slow. Instead of troubleshooting the application, just put it on a faster box.'

Also, the management tools out there are great at managing two, three or four host servers, but when you start getting into 50 or 100 hosts spread across multiple divisions or subsidiaries, all of the tools still have a fairly long way to go. So our subsidiaries that have a large number of hosts have their own instance of the management tools. Some of the smaller environments that have two, four or five servers are on our central management system. But the management software is fairly pricy, and we prefer not to have to buy multiple instances of it.

### What have been the biggest challenges to implementing virtualization?

Honestly, there really weren't many. We've only run into one or two bugs of any substance since we started. And the issues we had weren't technical. They were what we like to call the 'eighth layer' of the OSI model, the political layer. People want to have their own servers. Or if you're sharing a resource and you run out, then some little application may come along that has to bear the expense of a new physical piece of hardware. So, how do you account for the fact that one little application costs the company $1,000 and another little application costs the company $12,000? So, things related to capital allocations were sticking points.

Another issue was trusting that the environment works — the issue of all my eggs in one basket. On the technical side we had training issues involved with troubleshooting performance problems. It's different in a virtual environment. Understanding that hitting the old power switch has a very different meaning when you've got 25 virtual servers running on a box.

And you can get yourself into trouble if you don't pay attention to the infrastructure you're running on. If you typically buy very inexpensive servers without a lot of redundancy, that may be okay for an environment where, if you lose a server, you lose one application. But if you use the same kind of servers in a virtual environment and you lose that server, maybe you take down 10 applications. It's a much larger business impact. So early on we made sure we bought Tier 1 vendor hardware, with all the right redundancy components built in, fully redundant storage networks and that sort of thing, because we do run mission-critical applications on virtual infrastructure.

### Has there been any user reaction to virtualization?

The end-users have no concept of virtualization. But the business owners of the application have seen our ability to deploy more quickly, whether test, development or production servers. Our ability to react to change is faster. When all of a sudden we need four more Web servers to do X, we can deploy them in minutes instead of days or weeks. Business owners also see substantially reduced costs because they don't need to purchase test and development hardware. They may need to contribute some capital funding to the overall virtual hardware, but typically it tends to be much less expensive than having to buy individual servers for all the components of their various applications.

### Have you tried to calculate your ROI?

When we started our virtualization efforts back in 2002, we built a very strong ROI purely on the reduced number of servers that we had to purchase. We came up with an ROI that was so high we knew nobody would believe it. We had to cut things back, but we know it's saving the company hard dollars. It's the soft dollars that are much harder to quantify. We know we're saving a lot of time and effort in terms of deploying applications, as well as in the overall flexibility and time to market for various applications. Time equals money.

### Aside from savings, what other kinds of benefits have you realized?

A couple of years ago we did some testing where we VMotion-ed a virtual machine from one location to another 100 miles away. We lost just one packet. Now, the plumbing required to actually do that for real wasn't there yet. But as pipes get bigger, as VMware and other companies continue to build in disaster recovery, we're going to see the capability to do things like VMotion-ing between data centers. A variety of people have already done it in one way or another. With things like that, virtualization is going to change the way we do things on a large scale. Disaster recovery, business continuity — those kinds of things are pretty key in our virtualization strategy. We don't have to do cold spares anymore for most kinds of environments. If we're having problems with a particular virtual server, we just take a snapshot of it. We let the production system continue to run and we can give the actual server that's having trouble over to the developer to troubleshoot what the problem is.

Also, building a development lab is never easy, and they are never anything like real life. Well, in our environment they are. We take a snapshot of real life [virtual machines] and pull them off into an isolated environment. Then we have a

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development environment that actually matches production — because it was production an hour earlier.

### What does that do for you?

The first thing to get cut when doing development projects are test and development environments because generally speaking, you can't afford to buy three of the same system. In a virtual environment, we don't have to worry about that as much. And when you want to roll out a new version of the application a year later, you can just take another copy of the current production environment to create a fresh development environment, as opposed to using the year-old one.

### So, would you say you're getting better applications as a result?

Yes. And we also get better deployments of things like patches. There have been cases where we deployed patches but were unsure of exactly what was going to happen. Now we can take a snapshot of the [virtual machine], deploy the patch and, if things go poorly, just revert back with a couple of mouse clicks.

### What would you say has been the most pleasant surprise for you with respect to virtualization?

From a VMware perspective, how easy it's been. Generally speaking, the virtual-infrastructure stuff is pretty easy to install, especially if it's a small environment with two or three hosts. It's easy to install, easy to run and it's rock-solid, very much one of those things you just don't need to worry about.

### What's your biggest disappointment?

'Disappointment' may not be the right word, but the software vendors have been slow to adopt a support policy for virtual environments; licensing policies for virtual environments are all over the place. Be it Microsoft, Oracle, IBM, whoever — they're all over the map. Even the vendors themselves don't have consistent policies, and when they do, their salesforces don't necessarily know what they are. One salesperson will say, 'Oh, yes, sure, you can do it that way.' And then you actually go and look at the license and find, no, you can't. We're large enough that if a salesperson makes a promise, we're generally able to get the vendor to live up to that promise. But for your average [small-to-midsize] business, they don't have that kind of dollar baseball bat to go after a vendor.