What to expect with virtualization

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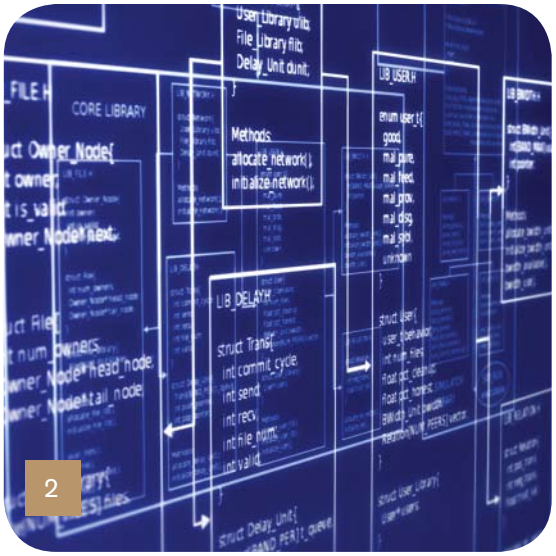


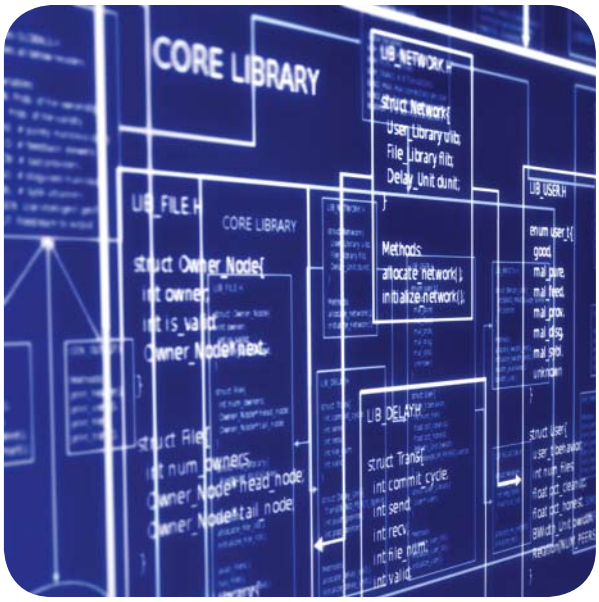
This content was adapted from Internet.com's Datamation, Enterprise Storage Forum Web sites. Contributors: Mike Scheurman, Drew Robb, Paul Rubens, Scott Alan Miller, David Strom, and Kenneth Hess.

Virtualization: An In-Depth Overview

By Mike Scheuerman

In the last year or two we have seen virtualization go from a poorly understood concept to a much-hyped industry buzzword being bantered about constantly in every conversation involving technology. There is no doubt that virtualization is playing an important role in today's IT landscape, and it even applies to the small and medium business markets

Unlike many technologies that provide a great degree of technological risk and expense and may not be appropriate for a small business, virtualization is a mature technology (IBM CP/CMS circa 1968) that is well understood. In short, it provides a layer of hardware abstraction that can benefit an IT organization of any size. It may possibly apply even more to small business IT departments than to the enterprise space.



Virtualization: Seriously, What is It?

In today's IT landscape it has become popular to re-label many common technologies as "virtualization" for marketing reasons, unnecessarily complicating the issue.

True virtualization refers to the virtualizing of entire operating systems. Wikipedia uses the term platform virtualization and I will as well. Technically we could refer to this as "System Virtualization" or "Operating System Virtualization" to distinguish it from loosely-related technologies.

The basic concept of platform virtualization involves running an abstraction layer on a computer that emulates the hardware itself. Through the combination of abstraction and emulation we get what is known as a virtual machine. This virtual machine is a completely working "computer" onto which we can install an operating system just as if we were installing onto the bare metal of a dedicated machine.

Instead of being limited to only installing one operating system image per computer we can now – with platform virtualization – install many copies of the same or disparate operating systems onto the same piece of hardware. A powerful concept indeed.

Why Has it Taken So Long?

The obviousness of the utility of this technology begs the obvious question: "If platform virtualization has been available since 1968, why is it only becoming popular and important recently?" This is an excellent question. The answer is actually quite simple.

Traditional platform virtualization technologies require a lot of support within the computer hardware itself. IBM has been building this type of support into its mainframe systems for decades. Large UNIX vendors like Sun have been providing

"In today's IT landscape it has become popular to re-label many common technologies as "virtualization" for marketing reasons, unnecessarily complicating the issue."

this in their high-end UNIX servers for years as well.

These systems are highly specialized and typically run their own custom operating system(s). Generally only large IT shops could afford servers of this magnitude. Small shops did not have ready access to these technologies.

For those IT professionals who have worked with this type of equipment in the past the idea of virtualization was often so ingrained into the platform that it was often discussed very little. It was seen as simply an aspect of these high-end server systems and not necessarily a concept in its own right.

What has changed recently is the move to bring platform virtualization to the commodity hardware space occupied by the AMD and Intel (x86_64).

The first move was to use software alone to make this possible on the x86 processor family. The early players in this space were VMWare and Microsoft, with products like VMWare Workstation, Virtual PC, VMWare GSX and MS Virtual Server.

These products showed that no special hardware was needed to effectively virtualize whole operating systems. Companies of all sizes began to experiment with the concept of virtualizing their existing commodity platforms. This form of virtualization is known as "host-based virtualization" as it requires a host operating system on which the virtualization environment will run.

Following on the tail of these software-only solutions, the big processor vendors in the commodity space, AMD and Intel, began building virtualization capabilities into the processor. This allowed for more flexibility, security and performance. It brought the commodity x64 hardware market much more in line with the traditional offerings from the other processor families common in big iron servers.

By doing so, the virtualization market has really exploded. This is true both from the vendor side, as more and more vendors begin offering virtualization related products, and from the customer side, as virtualization begins to be better understood and its use becomes more commonplace.

With the latest rounds of purchasing, most IT shops have purchased servers, and often desktops, that support hardware-level virtualization even without intending to prepare themselves for a move to virtualization, making the equation often tip in that direction naturally. This hardware-supported virtualization model is called "hypervisor-based virtualization" as all operating systems run on top of a tiny kernel called the hypervisor and no traditional operating system runs directly on the hardware.

Why is Virtualization Beneficial?

There are two things that we can readily virtualize (without getting esoteric or starting to virtualize our routing and switching infrastructure): servers and desktops. By far the easier and more obvious choice is the virtualization of servers.

> "It is not uncommon for a small business to easily virtualize half a dozen servers on a single piece of hardware at a minimum. And 20 or more is not an unreasonable number to hope to achieve."

Virtualizing the server infrastructure, or part of it, is the first place that most IT shops look today. Most companies find that the majority of their servers are extremely underutilized with excess CPU, memory and drive capacity sitting idle. Meanwhile, additional workloads fail to find a home due to budget constraints, space or implementation time. Virtualization to the rescue.

Through virtualization we have the opportunity to run several virtual servers on a single piece of server hardware. We could virtualize just a single server system but this would not gain us any utilization advantages. Or, in theory we could virtualize hundreds of servers if our hardware could handle it.

Typically, businesses can virtualize several typical servers roles onto a single physical server. Virtual machine density is, of course, determined by load characteristics as well as by the available hardware. Virtualization uses a lot of memory and storage, obviously, and so careful planning must be made.

Memory and storage are relatively inexpensive today and are certainly vastly less expensive than purchasing additional server hardware and paying to support it. It is not uncommon for a small business to easily virtualize half a dozen servers on a single piece of hardware at a minimum. And 20 or more is not an unreasonable number to hope to achieve.

Many small shops instantly jump to the conclusion that virtualization requires expensive SAN storage. This is not the case at all. Virtualization provides a range of benefits even without using a SAN storage infrastructure.

There are, of course, some significant advantages available by using SAN in conjunction with virtualization and high availability or load balancing technologies. Often, though, these high availability and load balancing capabilities are additional features that did not exist prior to virtualization and are not necessary in order for a shop to see significant benefits from virtualization. But they do present an opportunity for future improvement when and if budgets allow.

Three Advantages

Businesses, even small businesses, will immediately see many advantages from virtualization, even doing so on a small scale. Some of these benefits are obvious and some are less so.

- **Cost:** Our first advantage is hardware cost. By eliminating the need to purchase and support expensive server hardware on a per operating system basis we can now deploy more systems at lower cost per system. In many cases this is not only a cost savings but will also provide greater funds necessary to move from more Spartan servers into fewer – but more enterprise class – offerings with important performance, stability and support features. These features may include integrated power management and KVM over IP from an out-of-band management console.

- **Reducing power consumption:** It is very trendy, and for good reason, for companies to be concerned with how "green" they are today and IT virtualization plays a key role in the greenification of the department.

  The addition of virtual machines onto a single physical server typically represents a trivial, if even measurable, increase in power draw. Adding additional physical servers, of course, adds a significant amount of power consumption even for systems that are lightly used or used only occasionally.

- **Reducing backup complexity:** Virtualized servers can be backed up using completely traditional methods such as file system level backups from the operating system itself as made popular by traditional backup systems like NetBackup, BackupExec, Amanda, Bacula, and others.

  So if we desire to stick with current backup strategies we can without any additional complexity, but if we want to move to image-based backups we can do so quite easily. Using system images as backups is not necessarily new or unique to virtualization but virtualization makes this far more obvious and accessible for many users.

  In fact, with virtualization system images (a copy of the entire system, not just of its individual files) can be taken using nothing but the regular filesystem - no special software needed. A complete system backup can be taken by simply shutting down the virtual server, making a copy of its virtual filesystem - often a single, large file, and starting the system up again.

> "Using system images as backups is not necessarily new or unique to virtualization but virtualization makes this far more obvious and accessible for many users."

  Restoring a system can be a simple as copying an image file from a backup storage device to the virtual server and starting it back up. Restore done. System back online.

  This is as simple as it gets.

- **Ease of provisioning:** Building a new server operating system directly on hardware is a time consuming venture for most shops.

  This is especially true if there are any surprises with new hardware type that has not been used previously. There may be missing drivers or special operating system settings and parameters needed to support the hardware. With virtualization the target platform is always identical, removing many surprises from this process. This makes it both faster and more reliable.

  In many cases deployment is also faster simply because the process of preparing the base machine is so much faster. To kick off a manual install of Linux on a traditional

physical server I must purchase the server, install into rack, connect power and networking, provision networking, turn on server, update firmware, configure out of band management system, burn in hardware, install installation media and begin installing.

Or from some virtualization environments I can simply kick off the entire process with a single command at the command line. Deploying a new server could go from hours or days to minutes. This does not even begin to address the simplicity of cloning existing systems within a virtual environment.

- **Significant software cost savings:** Some vendors, like Novell with SUSE Linux, allow you to virtualize as many servers as you want on a single physical machine while paying for only a single machine license. Red Hat gives you multiple installs but not unlimited like Novell. Microsoft has a range of virtualization pricing options depending on your needs, including an unlimited per processor deployment license.

  In a worst case scenario you will need to pay for additional operating system and other software licenses exactly as if you were running the same machines physically but in almost all cases there is more pricing flexibility and often dramatic cost reductions for multiple virtualized hosts.

- **The ability to "roll back" an entire operating system:** Most virtualization platforms allow for a concept of taking a system snapshot, making changes to the active system and then restoring the system back to its original state when done. This is great for software testing. It's especially good for testing operating system patches or any critical update process where, if something went wrong, it could cause your system to become unresponsive and potentially not repairable.

  The ability to go "back in time" to the latest snapshot, taken seconds before the patch application or risky configuration change can be a lifesaver. Of course taking an image backup could be used in the same way but snapshots allow for even more rapid recovery due to their "proximity" to the original file system.

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No Extra Software/Hardware Costs

All the benefits mentioned above come with a move to virtualization and do not require additional cost for software or hardware.

If our budget allows and the need exists there is also the option of adding one of more virtualization servers and having these servers share a SAN for storage of virtual machine images. At a minimum this will roughly triple the hardware cost but provides double the processing power and some really amazing features.

The main feature that really makes this solution impressive is the concept of live migration. Live migration is when a virtual operating system can be moved, while running, from one physical virtualization server to another. This can be done for purposes of load balancing, disaster testing or to survive a disaster itself. With some live migration solutions, generally sold as high availability, this migration can happen so quickly that it provides effectively "zero downtime." And even heavily used Web servers could survive the loss of a physical server without customers ever knowing that a physical server had gone down. The transition between virtual machine host nodes is completely transparent to the end users.

There is one major caveat. Relying upon a SAN in a disaster recovery scenario, of course, creates another point of failure: the SAN system. So when planning to use a SAN to increase the reliability of your virtual machines, be sure not to use a SAN that is not as redundant as or more so than your servers themselves. Otherwise you may increase cost while accidentally lowering reliability and performance.

For the average business it is not unlikely that it will make sense to not only virtualize some of the server infrastructure but virtualize all or nearly all of it. Virtualization's advantages are so many and its downsides so few and minor that it is a rare workload in the small business space that would justify dedicated hardware servers.

Desktop Virtualization

Unlike real desktops and servers, virtualized desktops often

add a bit of complexity due to licensing requirements, especially with Microsoft Windows desktops.

Virtualizing desktops is also somewhat complicated because there are many modes for physically providing desktops. Obviously once we begin talking about virtualizing the desktop infrastructure we are actually talking about a range of solutions. This is because some device must always exist "on the desktop," providing a keyboard, mouse and monitor which cannot be virtualized. And the desktop operating system itself must be running elsewhere.

Even without virtualization this is done (and sometimes marketed as virtualization when, in fact it is simply remote access) very commonly through desktop blades, rackmount desktops or terminal servers. All these solutions move the desktop into the datacenter and provide access to it either from thin client front ends or simply via software to remote users' existing machines (such as users at home logging in to the office).

We will start with the concept of the terminal server, as this is the most easily virtualized and the most straightforward. Whether we are talking about virtualizing the server on which we run Microsoft Terminal Server (now known as Remote Desktop Services), Citrix XenApp or simply a standard Linux remote desktop terminal server, we need do nothing more than install that server into a virtual environment rather than into a physical one. It is really a question of server virtualization, not of desktop virtualization – it is only perceived by the end user as being related to their desktops.

The other method of desktop virtualization, "true desktop virtualization" as I will refer to it, is to actually run desktop operating system images on a virtual server just as if they were normal desktops dedicated to a user.

This means virtualizing operating systems like Windows XP, Windows Vista, or Windows 7 with each image being dedicated to a single user just as if it was a physical desktop.

We could, theoretically, do the same thing with Linux or some other flavor of Unix. But since those systems do not have per user licensing or desktop specific versions and since they always run their desktops in a server mode, we can only differentiate between a true virtualized desktop and a Unix-based terminal server in its usage –- not by any strict technological means, as they are one and the same.

Only Windows truly offers a dedicated desktop model that allows this to happen in this particular manner without the concept of shared access to a single image simultaneously.

Due to licensing restrictions from Microsoft, Windows desktops must be installed one image per user, even if technologies exist to make this technologically unnecessary. But still there are benefits to this model. The big benefits to virtualized desktops definitely go to companies who have employees who roam either internally or even externally.

Using virtualized desktops provides far more control to the company than does providing laptops. Laptops can be stolen, lost or damaged. Laptops wear out and need to be replaced regularly. A virtual desktop that is made accessible from the outside of the company can be secured and protected in ways that a laptop cannot be. Upgrades are much simpler and there is no concern of the virtual desktop becoming cut off from the corporate network and being unable to be supported by the IT staff.

"The big benefits to virtualized desktops definitely go to companies who have employees who roam either internally or even externally."

Almost any worker who uses a computer in the office already has one at home for personal use and often also has laptop in addition to high speed Internet access. Providing remote access to a virtual desktop at the office therefore potentially incurs no additional hardware expense for the company or staff while easing administrative burdens, lowering power consumption and increasing security. For workers still sitting at a traditional desk inside of the company's offices there is still a need for something physically sitting on the desk that will connect the keyboard, mouse and monitor to the newly virtualized desktop. This could be an old PC that was planned for retirement, a dedicated hardware thin client or even a laptop.

Internal staff can then move around the office or between

offices and sit at any available desk with a thin client and log in to their own dedicated virtual desktop and work exactly as if they were at their own desk. They can then go home and work from there as well if this is allowed.

Like virtualized servers, desktops, if the need is warranted, can be easily backed up using either traditional means or by simply taking complete system images. The flexibility is there to do whatever makes the most sense in your environment.

Desktop vs. Server Virtualization

Desktop virtualization is hardly the no-brainer that server virtualization is. It's less advantageous due to the complexity and surprise cost of licensing. And, except for remote users, hardware on the desktop must always remain.

Desktop virtualization will require careful analysis on a case-by-case basis to determine if it will meet the cost and usability needs of the individual organization. Most organizations who choose to go this route will likely opt to only partially virtualize. They'll use it only in cases where it makes the most sense, such as roaming users and remote workers, while keeping traditional desktops for many staffers.

Using terminal server options will often be far more common than "true desktop virtualization," which often makes sense only for power users, developers or to support certain applications that work poorly in a terminal server mode.

"Like virtualized servers, desktops, if the need is warranted, can be easily backed up using either traditional means or by simply taking complete system images."

Another Virtualization Use: Run Additional OSes

There is a final usage of virtualization that warrants discussion if only because it is important to understand its use in the business environment. This final type of virtualization is not used to put operating systems into the datacenter on server hardware but instead is used to run additional operating system images on traditional desktops and laptops.

This is a common scenario for people who need to test multiple operating systems for support or development. It is not useful for production systems and is generally outside the scope of this discussion. It is a highly useful use of the technology but it is rather a niche scenario primarily useful for compatibility testing.

Apple Lags in Virtualization

In all of this discussion there has been, somewhat conspicuously, no mention of Apple's Mac OSX products. There is a reason for this. Apple does not license Mac OSX so that it may be virtualized on non-Apple hardware. And Apple does not have an enterprise-ready virtualization product ready for its own platform.

The only way to virtualize Mac OSX is to purchase full, additional licenses for each operating system instance, thereby eliminating most of the cost benefits of this approach. You would then need to run it on a host-based virtualization product such as VMWare Fusion or Parallels, which are designed for use on top of a desktop and not as a server-class product.

This is a major gap in the Mac OSX portfolio and one of the ways in which Apple continues to lag behind the rest of the market in capability and in its understanding of its business customers' needs. If Apple were to change its licensing strategy around virtualization, Mac OSX would prove to be an extremely popular and useful operating system to virtualize both from the server and desktop perspective.

Virtualization: Consider It

Virtualization is a great opportunity to lower cost and raise productivity while reducing risk for businesses of any size and with budgets as low as zero. Many technologies promise important improvements for businesses but most create questionable value while incurring real cost.

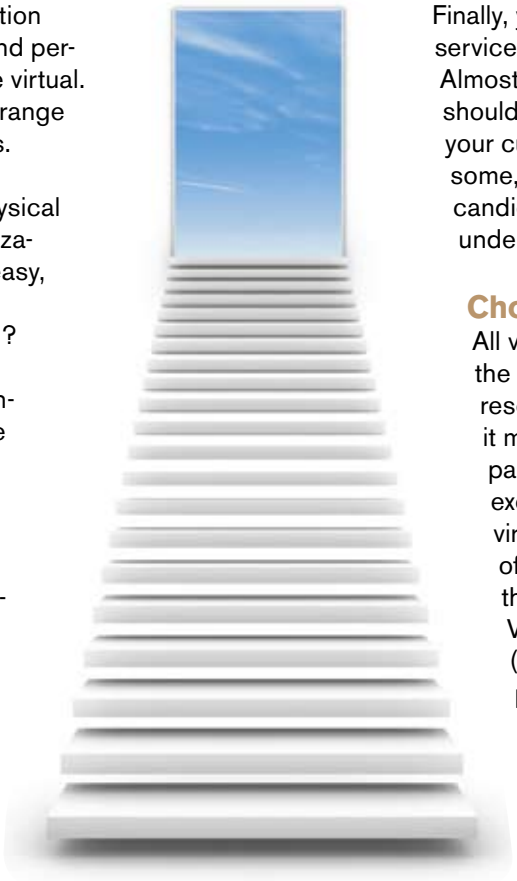
In contrast, virtualization brings real, measurable value while often costing nothing – and often reducing spending immediately. For many businesses virtualization is the technology that they have always dreamed of and is, in fact, available today. ■

The Journey to Virtual Freedom

By Kenneth Hess

Reaping the benefits of virtualization requires a change in thinking and perception from the physical to the virtual. It also requires you explore a strange new world of money-saving opportunities.

Leaving the safe and costly shores of physical systems and localized support for virtualization's promise of greener pastures isn't easy, and there are many questions to answer. How do we get started with virtualization? What's the best type of virtualization to use? Who are the major virtualization vendors? What are my support options? Are outsourced options less expensive than in-house ones?



Mapping a Strategy

Before you go off half-prepared to virtualize your infrastructure, there are a few things you should know. First, are you prepared to make a significant investment in new systems onto which you'll host your virtual machines? If not, virtualization might not be the technology haven for you. It isn't prohibitively expensive, but there are costs involved with any new or unfamiliar technology.

Second, if you choose localized virtual infrastructure over a leveraged (outsourced) solution, you'll need properly trained employees to implement this new technology with ease. Training is an essential part of any new technology so that cost mistakes aren't made during the adoption and implementation processes.

Finally, you'll need to have some idea of which services you want to convert to virtual ones. Almost any service has the potential, but each should receive its own individual evaluation by your current staff. Assuming you've defined some, or all, of your services as virtualization candidates, your journey to the new world is under way.

Choosing a Vehicle

All virtualization technologies perform the same function: Abstracting physical resources into virtual ones. This fact makes it more, not less, difficult to choose a particular virtualization strategy. With the exception of VMware's ESX product, all virtualization product strategies are free of charge. This single fact should make the choice less difficult, but it doesn't. VMware's ESX product, despite its cost (~$2,400 per processor), is the most popular choice for large businesses. Why? The simple answer is support – support from VMware itself, support from third-party vendors, support from hardware manufacturers and support from technical staff. VMware offers a free version (ESXi) of its flagship ESX product that includes the same enterprise-level features but without the operating system.

Other choices for server virtualization are Citrix XenServer, Microsoft's Hyper-V, and the little-known ProxMox VE (Virtualization Environment).

> "Training is an essential part of any new technology so that cost mistakes aren't made during the adoption and implementation processes."

- Microsoft's Hyper-V
- Citrix XenServer
- VMware ESXi
- ProxMox
- VMware Server

VMware also makes its VMware Server product available free for download and use. VMware Server lacks many of the enterprise-level features of ESX and ESXi, and it is far less hardware-finicky than the other solutions listed. For a small company or for someone with limited hardware resources, VMware Server is an excellent entry-level server virtualization product.

Watching Vacation Videos

So far this excursion included taking only the full trip on the good ship virtual, but in reality, there is another choice: Outsourcing. Outsourcing your services to a hosting company is not a bad thing. If your company is small or spread out over a large geographical area, this type of virtualization just might fit into your plans and your pocketbook. Outsourcing your services to a company such as Amazon, Elastichosts or 1and1.com provides superb service, lower costs, fewer support staff, 24x7 support and no dependence on your local Internet service to and from your office.

Each of these companies uses a different type of virtualization technology to provide services. Amazon uses XenServer, Elastichosts employs KVM and 1and1 provides virtual containers for its customers. Which of these services you choose depends on how you use your current infrastructure. Some of your services might flourish on containers while others might require fully virtualized machines on which to run.

Virtualization helps maximize resource usage while holding down costs, whether local or leveraged. Do yourself a favor and check into the technology and the providers. Talk to others who have made the great voyage to the distant shore and find out if the money they've saved is physical or virtual. Write back and discuss your experiences with local vs. leveraged virtualization. Was the journey worth the price of the ticket, or do you wish that you'd stayed home and read about it in the newspaper? ■

Hardware for Virtualization: Do's and Don'ts

By Drew Robb

Virtualization is catching on like never before. Just about every server vendor is advocating it heavily, and IT departments worldwide are buying into the technology in ever-increasing numbers.

"The use of virtualization in the mainstream is now relatively commonplace, rather than just in development and test," said Clive Longbottom, an analyst at U.K.-based Quocirca. "In addition, business continuity based on long-distance virtualization is being seen more often."

As a result, the time has come to more closely align hardware purchasing with virtualization deployment. So what are some of the important do's and don'ts of buying servers and other hardware for a virtual data center infrastructure? What questions should IT managers ask before they make selection decisions on servers? And how should storage virtualization gear be integrated into the data center?

Do's and Don'ts

There are, of course, plenty of ways to virtualize, depending on the applications being addressed. This article will focus on a typical case where infrastructure and business logic applications are the main targets.

With that in mind, one obvious target is memory. It is a smart policy to buy larger servers that hold more memory to get the best return on investment. While single- and dual-processor systems can host multiple applications under normal circumstances, problems arise when two or more hit peak usage periods.

"Our field experience has shown that you can host more VMs [virtual machines] per processor and drive higher overall utilization on the server if there are more resources within the physical system," said Jay Bretzmann, worldwide marketing manager, System x at IBM. "VMware's code permits dynamic load balancing across the unused processor resources allocated to separate virtual machines."

He advised buying servers with more reliability features, especially those that predict pending failures and send alerts to move the workloads before the system experiences a hard failure. Despite the added cost, organizations should bear in mind that such servers are the cornerstone of any virtualization solution. Therefore, they deserve the lion's share of investment.

"Businesses will lose significant productivity if the consolidation server fails," said Bretzmann. "A hard crash can lead to hours of downtime depending upon what failed."

Longbottom, however, made the point that an organization need not spend an arm and a leg for virtualization hardware – as long as it doesn't go too low end.

> "The use of virtualization in the mainstream is now relatively commonplace, rather than just in development and test"

"Cost of items should be low – these items may need swapping in and out as time goes on," said Longbottom. "But don't just go for cheapest kit around – make sure that you get what is needed."

This best achieved by looking for highly dense systems. Think either stackable within a 19-inch rack or usable as a blade chassis system. By focusing on such systems, overall cooling and power budgets can be better contained. Remember, too, not every server is capable of being managed in a virtual environment. Therefore, all assets should be recognizable by standard systems management tools.

Just as there are things you must do, several key don'ts should be observed as well. One that is often violated is that servers should not be configured with lots of internal storage.

"Servers that load VMs from local storage don't have the ability to use technologies like VMotion to move workloads from one server to another," cautioned Bretzmann.

What about virtualizing everything? That's a no-no, too. Although many applications benefit from this technology, in some cases, it actually makes things worse. For example, database servers should not be virtualized for performance reasons.

> "Customers should look for systems that can provide the same level of data protection that they already enjoy in their physical environments"

Support is another important issue to consider.

"Find out if the adoption of virtualization will cause any application support problems," said Bretzmann. "Not all ISVs have tested their applications with VMware."

Storage Virtualization

Most of the provisos covered above also apply to purchasing gear for storage virtualization.

"Most of the same rules for classic physical environments still apply to virtual environments – it's really a question of providing a robust environment for the application and its data," said John Lallier, vice president of technology at FalconStor Software.

While virtual environments can shield users from hardware specific dependencies, they can also introduce other issues. One concern when consolidating applications on a single virtualization server, for example, is that you may be over-consolidating to the detriment of performance and re-introducing a single-point-of-failure. When one physical server fails, multiple virtual application servers are affected.

"Customers should look for systems that can provide the same level of data protection that they already enjoy in their physical environments," said Lallier.

He believes, therefore, that storage purchasers should opt for resilient and highly available gear that will keep vital services active no matter what hardware problems arise. In addition, Lallier suggests investing in several layers of protection for large distributed applications that may span multiple application servers. This should include disaster recovery (DR) technology so operations can quickly resume at remote sites. To keep costs down, he said users should select DR solutions that do not require an enormous investment in bandwidth.

As a cost-cutting measure, Lallier advocates doubling up virtual environments. If the user is deploying a virtual environment to better manage application servers, for example, why not use the same virtualization environment to better manage the data protection servers? As an example, FalconStor has created virtual appliances for VMware Virtual Infrastructure that enable users to make use of its continuous data protection (CDP) or virtual tape library (VTL) systems that can be installed and managed as easily as application servers in this environment.

Of course, every vendor has a different take. Network Appliance, aka NettApp, provides an alternative to FalconStor using the snapshot technology available in its StoreVault S500. This storage array handles instant backups and restores without disrupting the established IT environment.

"Useful products are able to host VMs over multiple protocols, and the StoreVault can do it via NFS, iSCSI or FCP – whatever your environment needs," said Andrew Meyer StoreVault Product Marketing Manager at NetApp.

"Don't get trapped into buying numerous products for each individual solution. One product that is flexible with multiple options (can handle VMs, create a SAN, handle NAS needs, provide snapshots and replication) may be a smarter investment as a piece of infrastructure." ■

Virtual Servers: VMware vs. Microsoft vs. Xen

By David Strom

The world of server virtualization continues to change. New cross-platform management tools, embedded hypervisors, wider acceptance of open source methods, protocols, standards, and simplified pricing have all made virtualization much more popular with IT managers.

While the market is growing, it still represents a minor portion of the entire server marketplace – less than 10 percent, according to Microsoft representatives. What is new is that virtual machine (VM) server technology is now available and more attractive to mid-tier users for four reasons:

- The free versions are more capable.
- Prices are coming down.
- Ease of setup and management is increasing.
- The technology can help reduce power and cooling requirements just as being green is gaining traction.

Nevertheless, virtual servers are just one part of the entire virtualization market, which is growing to include all kinds of computing, from storage virtualization to streaming applications installation, to virtual desktops.

But in the past year, four trends are obvious:

1) Growth of the hypervisor: The hypervisor is now found in more places, both exploited in the latest processor chips from Intel's Virtualization Technology vPro and AMD-V, and as a standard package with most of the popular Linux distributions and soon for Solaris too. The hypervisors, or virtual machine control programs, for the three major vendors (Microsoft, Citrix and VMware) now support this embedded hardware, which makes for simplified installation and nearly one-button booting of virtual servers. And VMware has begun selling ESXi, a specialized embedded version that will begin shipping on servers imminently. HP's ProLiant servers now offer built-in support for Citrix' XenServer; older ProLiants can be upgraded too.

2) Interoperability: Interoperability has taken root, and we have seen in the past year a series of initiatives to make managing multiple VM vendors more palatable. Novell's ZenWorks VM Manager and Orchestrator products are just from one of many products that will offer a way to manage more than one vendor's hypervisor. Microsoft's SystemCenter, CA ,and others have announced plans to support both Microsoft's and VMware hypervisors, and Novell will also support Citrix's solution too. VMware announced several

> "The use of virtualization in the mainstream is now relatively commonplace, rather than just in development and test"

management tools that enable automation of the entire lifecycle of a VM, including staging the migration from a development/test environment into production, according to Bogomil Balkansky, the Senior Director of Product Marketing for the company. "Our customers tend to want to do more with virtual servers once they get it into their shops."

Another dimension to the interoperability story is a standards effort called the open VM format that is first expected to be finished sometime early summer. "With this format, organizations can use a standard set of VM management metadata to manage VMs running on different hypervisors. This architecture is fully extensible, allowing VMs to advertise custom configuration information, such as a virtual barcode, security requirements, or service level requirements," says Chris Wolf, a senior analyst with the Burton Group.

"While work remains, the eventual goal of these standards is to provide hypervisor interoperability, such as by taking a VM image built on the Microsoft Hyper-V hypervisor and running it on a Citrix XenServer hypervisor without having to modify the VM's configuration."

And as another example of increased manageability, inventory and asset management vendors such as BDNA have tools that can account for individual VMs that are hosted on virtual servers when they discover server resources across an enterprise. "This is a strong sign that the market is maturing and that customers have a choice," says Simon Crosby, the co-founder of XenSource and now the CTO of the division for Citrix.

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3) Falling Prices and Improved Functionality: Prices are coming down and functionality for even the free versions is improving. The free products – and indeed, all of Microsoft's virtual server line – continue to be a great way for enterprises to become familiar with VM technology and to do any evaluations before deploying them into production. Most noticeably Microsoft has announced they will expand their product line with Hyper-V, which will be included in all 64-bit versions of its Windows Server 2008, expected in August. Hyper-V ups the ante considerably, with support for symmetrical multi-processors and larger memory support.

On the paid products, XenServer continues to be the lower-priced spread, offering single-CPU versions and better value when compared to VMware. The latter's prices are now almost comprehendible, an improvement from their obscure complexity of last year. VMware also introduced support for 10 gigabit Ethernet networks and larger memory and disk support with its latest version, and now has more than 700 pre-built virtual "appliances" or virtual disk images that are available as well.

Citrix hasn't stood still either, and boosted the performance of XenServer since acquiring the company last year, especially when it comes to XenServer working with the company's flagship Presentation Server product line. "We recognize that our customers want to run both products to solve dynamic data center problems," says Crosby.

4) Widening Channels: The virtual server channel continues to widen, with more partnerships, agreements, and expertise than ever before. As smaller, specialty companies enter this market, they are looking to cement relationships, expand distribution, and make just about every component in the data center virtualized. "All of the services that do hardware and applications failover, disaster recovery, chargeback, and security will be built into hypervisors and run on VMs," says Susan Davis, the VP of marketing for Egenera, one of the newer specialty virtual software vendors.

"This year is shaping up to be one of the most interesting years ever in enterprise IT infrastructure," says Crosby.

Virtual Server Product Comparison

	VMware Vmware.com	**Microsoft** Microsoft.com/virtual server	**Xen** Xensource.com
Product URL			
Free server product	VMware Server	Virtual Server 2005 R2, HyperV Win Server 2008 64 bit	XenServer Express, (Enterprise 30 day eval.)
Paid server products	Infrastructure v3.5 (Starter, Standard, and Enterprise)	None	XenServer Standard, Enterprise, and Platinum Editions
Pricing range paid product	$1,640 for two CPUs, includes 1 yr. support contract	Free or included in Windows Server 2008 (64 bit)	$600 - $5,000 plus support contract
Host OS (if any)	Server: Windows Server 2003, various Linux Infra v3: bare metal	Windows Server 2003 R2, 2008; XP Pro SP2 or Vista for testing purposes only	Bare metal
Management tools	Lifecycle Manager, VMotion, Storage Vmotion	System Center VM Manager	XenCenter Management Console
Embedded hypervisor product	ESXi supports both AMD and Intel chipsets	None*	Yes
Advantages	• Over 700 pre-built appliances • Widest selection of guest OS support • Wizards galore for install aids	• Can run on any IE browser with Internet access • Less expensive option • Easy cloning of VM images • Familiar UI	• Open source solution that doesn't require any host OS • Lower cost
Disadvantages	Confusing array of pricing and configuration options (2 CPU minimum pricing)	Limited pre-built VHD appliances and just of MS server products	Limited Windows guest OS support

**While Microsoft's offering doesn't have an embedded hypervisor, it does recognize and take advantage of computers with either the AMD or Intel virtualization chipsets.*

Managing Storage in a Virtual World

By Drew Robb

Demand for storage has been growing rapidly for some time to meet ever-expanding volumes of data. And it seems that the more common virtualized servers become, the more storage is required. Together, the two trends – data growth and virtualization – are becoming a potent combination for storage growth.

Are virtual machines (VMs) accelerating storage growth? According to Scott McIntyre, vice president of software and customer marketing at Emulex, VMware is typically given a larger storage allocation than normal. This acts as an extra reserve to supply capacity on demand to various virtual machines as they are created. In fact, VMware actually encourages storage administrators to provision far more storage than is physically present, for example, giving each of 20 VMs a 25 percent share of capacity. And it also makes it easier to provision away an awful lot of storage.

In theory, this is supposed to make storage more efficient by improving utilization rates. But could it inadvertently be doing the opposite?

"VMware virtualized environments do not inherently need more storage than their physical counterparts," said Jon Bock, VMware's senior product marketing manager. "An important and relevant point is that customers do often change the way they use and manage storage in VMware environments to leverage the unique capabilities of VMware virtualization, and their storage capacity requirements will reflect that."

What seems to be happening is that companies are adapting their storage needs to take advantage of the capabilities built into virtual environments. For example, the snapshot capability provided by VMware's storage interface, VMFS (virtual machine file system), is used to enable online backups, to generate archive copies of virtual machines, and to provide a known good copy for rollback in cases such as failed patch installs, virus infections, and so on. While you can do a lot with it, it also requires a lot more space.

Solving Management Headaches

Perhaps the bigger problem, however, is the management confusion inherent in the collision of virtual servers and virtual storage.

"The question of coordinating virtualized servers and virtualized storage is a particularly thorny issue," said Mike Karp, an analyst with Enterprise Management Associates. "The movement toward virtualizing enterprise data centers, while

"Perhaps the bigger problem, however, is the management confusion inherent in the collision of virtual servers and virtual storage"

it offers enormous opportunities for management and power use efficiencies, also creates a whole new set of challenges for IT managers."

Virtualization, after all, is all about introducing an abstraction layer to simplify management and administration. Storage virtualization, for example, refers to the presentation of a simple file, logical volume or other storage object (such as a disk drive) to an application in such a way that allows the physical complexity of the storage to be hidden from both the storage administrator and the application.

However, even in one domain – such as servers – this "simple layer" can get pretty darn complicated. Just take a look at what it does to the traditional art of CPU measurement using as an example an IBM micropartition in an AIX simultaneous multi-threaded (SMT) environment that consists of two virtual CPUs in a shared processor pool. This partition has a single process running that uses, let's say, 45 seconds of a physical CPU in a 60-second interval. When you come to measure such an environment, it presents some challenges. The results can be different, for example, if SMT is enabled or disabled, and if the processor is capped or uncapped.

> "For virtual machine environments, VM Insight provides virtual machine-to-disk performance information to optimize the number of virtual machines per server"

The CPU statistic %busy represents the percentage of the virtual processor capacity consumed. In this example, it might come out as 37.5 percent. Now take another CPU measurement, this time by LPAR (Logical Partition) known as %entc. This represents the percentage of the entitled processor capacity consumed and it comes out as 75 percent. Take another metric, %lpar_pool_busy, which is percentage of the processor pool capacity consumed. It comes out at only 18.75 percent. Or %lpar_phys_busy – the percentage of the physical processor capacity consumed. It scores 9.38 percent. And there are other metrics which might show completely different results.

"A capacity planner might look at one score and think utilization is low, whereas another takes a different view and sees an entirely different picture," said Jim Smith, an enterprise performance specialist at TeamQuest Corp. of Clear Lake, Iowa. "So who's right? It's not an easy question to answer with virtualized processors. Each answer is correct from its own perspective."

Finding the Root Cause

To make things more challenging, there is the ongoing trend of marrying up virtual servers with virtual storage. That means having to manage across two abstraction layers instead of one. Now let's suppose something goes wrong. How do you find out where the problem lies? Is it on the application server, on the storage, on the network or somewhere in between?

"Identifying the root cause of the problem that potentially could be in any one of several technology domains (storage, servers, network) is not a problem for the faint of heart and, in fact, is not a problem that is always solvable given the state of the art of the current generation of monitoring and analysis solutions," said Karp. "Few vendors offer solutions with an appropriate set of cross-domain analytics that allow real root cause analysis of the problem."

EMC – majority owner of VMware – starts to look pretty smart now for its acquisition of Smarts a little while back. It is heading down the road of being able to provide at least some of the vitally needed cross-virtualization management. And NetApp is heading down the same road with the acquisition of Onaro.

"Onaro extends the NetApp Manageability Software family, as SANscreen's VM Insight and Service Insight products help minimize complexity while maximizing return," said Patrick Rogers, vice president of solutions marketing at NetApp. "These capabilities make Onaro a key element in NetApp's strategy to help customers improve their IT infrastructure and processes."

For virtual machine environments, VM Insight provides virtual machine-to-disk performance information to optimize the number of virtual machines per server. For large-scale virtual machine farms, this type of cross-domain analytics assists in maintaining application availability and performance. SANscreen Service Insight makes it easier to map resources used to support an application in a storage virtualization environment. It provides service level visibility from the virtualized environment to the back-end storage systems.

Meanwhile, the management of multiple virtualization technologies is coming together under the banner of enterprise or data center virtualization. This encompasses server virtu-

alization, storage virtualization and fabric virtualization.

"IT managers are increasingly considering the prospect of a fully virtualized data center infrastructure," said Emulex's McIntyre. "One of the characteristics of enterprise data centers is the existence of storage area networks (SANs). There is a high degree of affinity between SANs and server virtualization, because the connectivity offered by a SAN simplifies the deployment and migration of virtual machines."

SAN-based storage can be shared between multiple servers, enabling data consolidation. Conversely, a virtual storage device can be constructed from multiple physical devices in a SAN and be made available to one or more host servers. Not surprisingly then, not only are storage devices being virtualized, but increasingly there is interest in virtualizing the SAN fabric itself in order to consolidate multiple physical SANs into one logical SAN, or segment one physical SAN into multiple logical storage networks.

Emulex, for example, is providing the virtual plumbing to handle some of the connectivity gaps between storage and server silos. Emulex LightPulse Virtual HBA technology virtualizes SAN connections so that each virtual machine has independent access to its own protected storage.

"The end result is greater storage security, enhanced management and migration of virtual machines and the ability to implement SAN best practices such as LUN masking and zoning for individual virtual machines," said McIntyre. "In addition, Virtual HBA Technology allows virtual machines with different I/O workloads to co-exist without impacting each other's I/O performance. This mixed workload performance enhancement is crucial in consolidated, virtual environments where multiple virtual machines and applications are all accessing storage through the same set of physical HBAs."

No doubt over time, more and more of the pieces of the virtual plumbing and a whole lot more analytics will have to be added to the mix to make virtualization function adequately in an enterprise-wide setting. Until then, get ready for an awful lot of complexity in the name of simplification.

"It is absolutely necessary to understand the topology, in real time – or at the very least, in near real-time – in order both to identify problems and to manage the entire environment proactively as a system and preempt problems," said Karp. "In a best-case scenario, a constantly updated topology map would be available for each process being monitored." ■

Combating Virtual Machine Sprawl

By Paul Rubens

If you are embarking on a strategy of server virtualization, one thing is for sure: You're going to need more storage space. Truckloads of it.

There are a number of reasons for this, and some are, unfortunately, inevitable. Virtualization, by its nature, shifts storage requirements from internal and directly attached disks to networked storage because operating systems and applications are no longer tied to a specific physical server.

So when you get involved in virtualization, you know you are going to need more storage, but the question is how much? The answer is almost certainly more than you think.

"Most companies I speak with don't plan for enough storage simply because when they start the virtualization projects, they don't think about rapid adoption or disaster recovery, and they haven't even begun thinking about desktop virtualization," said Mark Bowker, an analyst at Enterprise Strategy Group (ESG).

Features like VMware's VMotion and the newer Storage VMotion require even more space on the same storage system. What's clear, then, is that serious advanced planning (including planning for new features that don't exist yet) is essential.

Once you've faced up to the fact that you are going to need a lot more storage, it's sensible to take steps to try to ensure you don't spend more than you need by buying more than you need. But how do you do that? What can be done to stop the data center being taken over by storage devices?

In a future article we'll look at some of the new "smart" software that is available to minimize the storage footprint of a given virtual machine strategy by building VMs on the fly, but for now we'll concentrate on some rather more straightforward – but effective – steps.

Thin and Dedupe Are In

An obvious step might be to embark on a parallel program of storage virtualization to try to ensure that the storage you have can be used as flexibly as possible, but Roy Illsley, a senior research analyst at the Butler Group, doubts that this is the best way to go.

"You certainly need SANs, but do you need storage virtual-

"Once you've faced up to the fact that you are going to need a lot more storage, it's sensible to take steps to try to ensure you don't spend more than you need by buying more than you need."

ization? It's a moot point at the moment," he said. "I would contest that you would actually get far more valuable benefits by implementing some form of thin provisioning." This, at any rate, is the experience of many of the organizations Illsley has spoken to.

Thin provisioning mirrors server virtualization rather nicely: by eliminating or substantially reducing so-called stranded storage, which has been allocated but not used, organizations can dramatically increase their storage utilization, just as server virtualization can increase the utilization of the underlying physical servers. According to research carried out by ESG some time ago, about half of all companies waste about half of their storage capacity. Virtualization requires vast amounts of storage, and thin provisioning can help you get away with needing less by wasting less.

Bowker also suggested that data de-duplication should be a priority to reduce the storage needs of virtualization. Most storage vendors offer a de-duplication engine of some sort, although some balance needs to be reached between pure storage space savings and the performance hit that can result from extreme de-duping; if you've got hundreds of VMs all trying to access the same operating system file at the same time, and to save space you only have one copy of that file anywhere in storage, then clearly this could slow the VMs down substantially.

Controlling VM Sprawl

But aside from the move from local to networked storage, there's another reason why virtualization can make storage requirements explode. It's because without some form of control, it can be far too easy to call a new virtual machine into existence in a way that is simply not possible with a physical system. When virtual machines can be built at the touch of a button, the simple fact is that they will be – especially in development labs and for testing purposes, but also for use in a full production environment. If you're not very careful, then VMs will sprout up all over your data center, created by IT staff for their own (often perfectly legitimate and productive) purposes. And, of course, these VMs will require storage resources.

To compound to the problem, virtual machines can be very difficult to inventory. In the past, it was possible to send an IT rookie around the data center with a pencil and paper to count and identify every server he or she could find. But in the absence of a lifecycle management system like VMware's Lifecycle Manager or Microsoft's Virtual Machine Manager System Center module to keep track of the virtual machines that have been created and to ensure they are deleted when they are no longer required, you can easily get into a situation where you have no idea how many there are, who made them, whether they are still needed, and whether anyone even remembers that they exist. But if they exist, they are taking up storage. (There are also software license implications of an undisciplined virtual machine environment, but that's another story.)

Virtual machine lifecycle management software can also help keep storage requirements in check by controlling the configurations of the virtual machines that are created (to ensure, for example, that they are not allocated unnecessary internal storage) and by assigning chargeback metrics to virtual machine deployments, ensuring that departmental managers have incentives to minimize or eliminate the unnecessary use of virtual machines by their staff.

To keep on top of the storage requirements of your virtualization strategy, then, you're going to have to manage your storage tightly and manage the lifecycle of your virtual machines. This can be done mostly by software but, as Illsley points out, don't forget that virtual machines need people managing them too.

"The problem is that in the past, the app team looked after apps and the server team looked after servers," he said. "But who's looking after the virtual machines?"

It's not the storage team's job, but if you don't know whose it is, then you could be in for trouble. ■