VIRTUALIZATION FOR HOSPITALS

As health care providers collect increasing amounts of patient data, the burden on IT infrastructure only worsens.

CHAPTER 1

Server Consolidation in a Health Care Setting

Health care CIOs are burdened by small data centers that are difficult to expand, yet they need to accommodate growing amounts of data. Virtualization may be the answer. **BY AL GALLANT**

VERY HEALTH CARE CIO should be thankful for virtual servers. All the claims about what virtual servers can save in hardware and licenses cost are basically true. Technically, virtualization works the same as in a standard business environment. But in health care, we focus much more on the benefits virtualization brings when supporting the legacy systems found in all health care organizations.

Say you have 20 specialty clinical systems still running Windows NT and Window 2000. (Given that the vendors who design and build these systems tend to run them forever, this is not a stretch.) Without virtualization, the computer environment would be pretty much a nasty mess:

- First, you would need separate, standalone hardware for each system, taking up space and power in the computer room.
- Next would be a "network rubber room" to protect the rest of the network and other systems from these Windows NT and Windows 2000 servers that no longer receive security patch updates from Microsoft.
- Then you would need to put the servers on a separate network backbone or, minimally, a restricted subnet with a firewall appliance and an intrusion protection appliance between this subnet and the rest of the health care organization network.

■ Finally, the network team would have to run monitoring software to ensure that all the known viruses in the Microsoft OS world weren't finding ways around the firewall and intrusion protection system to get to these systems. If a virus did get through to the legacy standalone server, the only choice would be to pull the systems off the network and rebuild it from scratch or a backup.

The virtual environment prevents all that. For example, you could have those 20 legacy servers running as virtual clients on a 64-bit Intel blade server running Windows 2008 R2 Enterprise Server in a virtual clustered environment.

The same can also be done when there are legacy restrictions on client software. Say you have an enterprise lab system. Managing it on 1,000 laptops and PCs would be time- and labor-intensive. Instead, a good choice would be a virtual Citrix farm serving the lab system, with all of its unique restrictions, running virtual clients under Windows 2008 R2 virtual cluster on a 64-bit Intel blade server.

Consolidation helps health care CIOs work within severe constraints on their physical infrastructures. Keep in mind that computer rooms were not the highest priority when many hospitals and clinics were built. My hospital's 3,000-square-foot computer room was built in the early 1980s to support an IBM mainframe system. The space surrounding it is all clinical. It can't be expanded, so I must consolidate where possible. The data center now houses more than 500 Windows servers on approximately 200 physical servers, as well as 100 large servers running Unix, VMS and Solaris, one of which is a 32-bit VAX system that has a footprint of 30 square feet.

Because of that high density, upgrades to electrical and air conditioning systems may be necessary if you decide to virtualize. Make sure you understand the electrical requirements for a large blade environment among all major vendors. In addition, look at the specification sheet for your blade servers, convert the electrical power in watts consumed to British thermal units (1 kilowatt hour =3,413 BTUs) and have your facility environmental engineer ensure that your data center AC units can take care of the BTUs generated.

KEY BENEFITS

Setting up a virtual environment costs less than using standalone Citrix servers. The real savings, however, comes in several forms, such as centrally managing front-end systems in a virtual Citrix environment and deploying inexpensive PCs or laptops, even thin-client hardware, as the

front end while still providing the end user with a high-performance application experience.

Flexibility is another requirement that you can satisfy with virtualization. Let's use the example of a client/server lab system with physician order-entry and real-time interfaces to an electronic health record (EHR) system. The lab system runs Unix and Oracle RAC and the front end is a Visual Basic 2 application that requires Internet Explorer 6 and Windows XP as the OS.

You end up purchasing 1,000 clients with a downgrade option for the operating systems to run XP but with 4 GB memory, a large hard drive and a 3.2 GHz processor to accommodate the fat client. You install and roll out the lab systems, and everything works great.

Then senior management decides to purchase a state-of-the-art client/server EHR system that also has unique front-end requirements. But the EHR system requires Windows 7, Internet Explorer 8 and the .NET Framework 3.5. Now what do you do when your end users tell you they want both systems running on the 1,000 clinical PCs and laptops you purchased for the lab system?

You could run virtual machines on the laptops and the users could switch between OSes whenever they need to access one or the other system. Personally, I don't think that would go over well with physicians. The choices, then, are to offer one or both of these client options to be run under a Citrix or a Microsoft Remote Desktop Services environment.

SELECTING SYSTEMS FOR VIRTUALIZATION

The one thing that many virtual systems advocates will try to tell you is that "everything" can be virtualized. There is no "one size fits all" in the health care computer environment.

In health care, a variety of dedicated clinical systems, often approved by the U.S. Food and Drug Administration (FDA), are simply outside the scope of a virtual environment for nontechnical reasons. Several systems, including the following, should not be virtualized in most cases:

- **Picture archiving and communication systems (PACS).** Though the process of using a picture archiving and communication system is straightforward, most vendors say the liability is too high. Their worry stems from any virtual system failure affecting what they would refer to as a life-critical application. There is also little economic incentive to virtualize PACS. Some hospitals, however, do see a benefit to implementing PACS on virtual servers.

- **Cardiac procedure system.** These

single-task systems are used to insert coronary stents within arteries to open blockages. The servers used for these procedures have databases on standalone disk farms running high-availability RAID. In addition, the front-end procedural PC has unique builds (also FDA approved) and typically does not run any type of virus protection or autoupdate procedure.

- **Fetal monitoring systems.** Here a local PC system monitors the patient during prolonged labor, while a central back-end monitor records information into a database through the network during the entire labor. Although these systems increasingly run on standard PCs and laptops with standard Microsoft OS builds, liability issues keep vendors from pushing for virtualization.

- **3-D imaging systems.** These systems are used primarily for delicate and critical neurological surgical procedures. Surgeons study various image captures and go over detailed measurements, sometimes working on the images over a period of days prior to a surgical procedure.

The following questions will help you determine whether a particular health care clinical application would be a good candidate for virtualization.

- Is the system vendor managed?
- Does the system have a proprietary OS?
- Is the system used for life-safety or critical clinical procedures?
- Are updates to the system restricted by the vendor?
- Does the system have high CPU utilization?
- Does the system use a large amount of memory?
- Is the system I/O intensive?
- Does the server have special hardware device connections?
- Does the server have special license restrictions?
- Does the system require a large database?

If the answer to all these questions is yes, then the system is not a good candidate to be virtualized.

Ultimately, the best options for virtual systems are business applications. These apps may be mission-critical, but they are not life-critical. Some of my virtual systems are indeed clinical, but they are smaller, with limited user access and small databases. Most importantly, all of the virtual systems I run have 100% vendor approval. If your vendor tells you it can't support the system in a virtual environment, you should believe it. If you force a virtual environment on a vendor, you will not get support when you need it most. ■

Al Gallant is director of technical services at Dartmouth-Hitchcock Medical Center in Lebanon, N.H., and a contributing writer to SearchHealthIT.com.

CHAPTER 2

Moving Apps, Servers to Virtualized Platforms

Virtualizing both desktop applications and the servers that run them can cut desktop support, software maintenance and workstation lifecycle costs, provided that service levels and resource allocation aren't compromised. BY ELISABETH HORWITT

MORY HEALTHCARE INC. in Atlanta was something of a pioneer, at least in the health care industry, when it migrated its clients, then its servers onto Citrix System Inc.'s Xen virtualized platform several years ago. And, like most trailblazers, it faced more challenges than those who followed.

For one thing, hypervisors weren't yet a commodity that most hardware vendors offered for free, so the choice of computing platforms was limited, said Rick Aaron, director of virtualization at Emory. "We basically chose Citrix because [it was] the first virtualization vendor that our preferred blade server vendor supported." Few other health care organizations had taken the server virtualization plunge, so Emory's IT staff had to figure out a lot by trial and error.

Even so, XenApp, Citrix's virtual desktop application, paid for itself in two years, through savings in desktop support, software maintenance and workstation lifecycle costs, Aaron said. "When a workstation breaks, we just plug in a new one and the applications are up and running in minutes." The bottom line: "We're spending $350,000 to $450,000 a year on desktop replacement, down from $1.2 million," Aaron said.

Another major source of savings is being able to centrally manage client applications and patches, and to deploy updates automatically across thousands of workstations. Thus, the desktop administrative staff, which

manages 10,500 devices and 14,000 internal customers, went from 24 employees to 19.

Ensuring security and compliance for mobile devices is also easier, because nothing gets stored on them. "When a tablet or laptop is stolen, all they get is a piece of equipment—no data," Aaron said.

On the server side, virtualizing applications on Citrix's XenServer platform has let Emory "carve up one blade into as many applications as we want to" and set workflows that automatically allocate resources or move applications among blades as needed, said David Williams, Emory's Citrix architect. Virtualization hasn't enabled the IT staff members to get rid of servers, but it has allowed them to support a rapidly growing body of applications without adding any, he explained.

MOVING TO VIRTUALIZED PLATFORMS

Emory is starting to get a lot of company. Health care organizations have lagged behind other regulated industries, such as financial services, but a growing number of hospitals are rationalizing and virtualizing their computing infrastructures, largely because they're overwhelmed by the number of applications with dedicated servers and storage boxes. They're also "outgrowing their data centers at alarming rates," said Jack Wagner, an executive consultant at Vitalize Consulting Solutions Inc. in Reading, Mass.

Hospitals keep adding new electronic medical record (EMR) and clinical information systems, each of which could add another 15 to 20 servers to the data center, Wagner noted. In many cases, "they didn't plan for that growth when they built their data centers," he said, and they can't afford to build new ones. A virtualized platform enables organizations to save money on server hardware, cooling equipment and energy, and it often frees up data center space, he added.

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>
> —ANDREW PIZZIMENTI
> senior director of voice and data services, Mount Sinai Medical Center

Take the case of Mount Sinai Medical Center in New York, where space and energy costs are at a premium. The center recently began virtualizing on servers from Palo Alto, Calif.-based VMware Inc. "We were running out of data center space and wanted to reduce our energy foot-

print," said Andrew Pizzimenti, the center's senior director of voice and data services. "We went from 500 to 700 servers one year; that's not sustainable." Furthermore, New York state's power utility is offering funding to companies that can lower energy usage in their data centers.

An initial assessment of capacity utilization pinpointed a number of applications that were using only about 10% of their dedicated servers' capacity, Pizzimenti said. Deploying VMware has enabled the medical center to consolidate at least 15 applications onto a single blade server, said Lynn Kasner Morgan, Mount Sinai's vice president for IT.

THE PROS AND CONS OF VIRTUALIZATION

Still, the virtualized platform is not without its challenges. Managing virtualized servers is "in some ways a lot easier because you don't have to physically move or touch them," said Henry Escobar, Mount Sinai's director of distributed network services. "But to get that extra flexibility [of resource allocation], you pay a price in complexity."

Instead of each application having its own machine and dedicated storage, everyone depends on the same resources. This means Unix, storage area network and network support groups that were accustomed to managing systems independently must now communicate regularly to identify incipient problems before they become serious, Escobar noted. "That has required a change in attitude."

Ensuring service levels across dozens of virtualized client applications can also be challenging, health care IT executives report.

When Emory's IT team deployed XenApp, for instance, it discovered that some applications were resource hogs. "The EMR system worked fine," Williams said, but multimedia applications, such as streaming video and even Microsoft Office, could slow response time for everybody else on the server.

Organizations also can get in trouble if too many—or the wrong type of—back-end systems share the same hardware box, Vitalize's Wagner said. Web, application and front-end servers are generally good candidates for virtualized platforms, but a database server could wind up utilizing all available resources, he noted. Application vendors typically provide minimal hardware requirements for any virtualization platform they support, although the IT department should do its own baseline testing, he added.

Complicating matters, some medical application vendors have resisted supporting any virtualized platform. While such applications can still run

in virtual environments, IT workers have expressed concern about potential vendor finger-pointing if something goes wrong. Also, nonsupport can make it hard to allocate resources between applications dynamically, said Simon Crosby, chief technology officer in the Citrix Data Center and Cloud Division.

"If an application is Web-enabled, it's easy," Crosby said, because the database and application are more or less decoupled. However, with a traditional, Windows-style back-end application, where the client processes chunks of the database in memory, it may not be possible to run additional copies of that application on a virtualized platform and still guarantee database consistency. "So if you run out of horsepower for that application, you'll have to buy another server," he said.

BRIDGING THE HEALTH CARE, VIRTUALIZATION GAP

The good news is that virtualized platform vendors such as VMware and Citrix are actively working with leading health care application vendors to port their software over.

Indeed, the virtualization market has been catching up lately with the needs of customers in general, and health care organizations in particular, IT executives report.

For example, Emory is involved in a pilot test of Citrix's XenDesktop, which promises to pretty much solve the application resource-hog problem. The software "carves out virtual areas" with a set minimum capacity for each client, "so one user doing an email search doesn't affect the other 49 users," Aaron said. The product also enables desktop applications and profiles to roam with doctors and nurses making their rounds, so they can log into a different computer and continue exactly where they left off.

> "WHEN WILL WE BE DONE WITH OUR VIRTUALIZATION PROJECT? NEVER."
>
> —LYNN KASNER MORGAN
> VP for IT, Mount Sinai Medical Center

Still, a full-scale virtualized platform is a serious undertaking. It can take three to six months "if you want it done right; more if you have a lot of data and servers," Wagner said.

Then, more applications and features will have to be brought in, and performance fine-tuned.

"When will we be done with our virtualization project?" asked Morgan. "Never." ■

Elisabeth Horwitt is a contributing writer to SearchHealthIT.com.

CHAPTER 3

Desktop Virtualization for Health Care

Virtual desktops make it easy for physicians and clinicians to share critical data, but implementing virtual desktops in a health care setting requires addressing challenges that aren't present in other industries. **BY ELISABETH HORWITT**

HORTLY AFTER completing a deployment of virtualized servers, the IT staff at St. Vincent's Catholic Medical Center concluded that desktop virtualization technology was pretty much a no-brainer, said Kane Edupuganti, the hospital's director of IT operations and communications.

The medical facility has about 5,000 desktops, many of them five or six years old and containing outdated operating systems, in 42 sites in the five New York boroughs. "Every time a desktop died, our engineers had to open it up, figure out what was wrong, replace the part, or load the software onto a new machine," Edupuganti said.

His team considered and rejected a thin-client system because it would still have to maintain an OS and moving parts on those 5,000 distributed endpoints, Edupuganti said. The team ultimately chose Pano, a virtual zero-client device from Pano Logic Inc. that is essentially "a dumb terminal with a mouse, with no moving parts."

Now when a device dies or needs repairs, the desktop engineer takes it offline and installs a new box, which is registered on the server and booted up in minutes. Power use per desktop went from 150 W to just 5 W, Edupuganti said. In addition, physicians and nurses can access their desktop resources anytime, anywhere, at work or at home.

First, however, Edupuganti's team had to deal with virtual desktop infrastructure issues. Because Pano zero-client devices depend on a server host for all their processing, they

require a minimum dedicated bandwidth of 10 Mbps to avoid network latency problems. Fortunately, St. Vincent's had upgraded its metropolitan area network to electronic virtual private links, which would provide that, Edupuganti said. Storage availability was also an issue, because virtual client devices have no local hard drives.

During the next three to five years, most health care providers will exploit some form of virtualization technology, according to Barry Runyon, a research vice president at Stamford, Conn.-based Gartner Inc. As the St. Vincent's case illustrates, the rewards can be great. Centralized desktop and software provisioning means it's easier to deploy and configure new desktops and software updates, he said.

Virtualization also makes security administration both easier and more effective—when the user logs off, all local data disappears, leaving unauthorized users with nothing to access, Runyon said. All software updates and patches are managed centrally, and employees have no way of downloading dubious programs or malware from the Web.

A successful deployment of desktop virtualization technology nevertheless requires as much up-front planning and IT head-sweat as deploying server virtualization, industry experts warn.

HARDWARE: THIN, THINNER, ZERO?

Desktop virtualization technology typically refers to a hosted virtual desktop setup in which desktop "images," including the OS environment and data files, are centrally maintained on a host server and served up on demand when a user device logs on.

Desktop virtualization vendors include Citrix Systems Inc., Dell Inc., Hewlett-Packard Co., IBM, Microsoft, Moka5 Inc., NEC Corp., Pano Logic, Sentillion Inc. (recently purchased by Microsoft), Symantec Corp. and VMware Inc. Products differ widely in terms of the OS and hardware platforms they support, and, at least as important, the extent of their dependency on a host server.

At one end of the scale are zero-client devices, such as Pano. These are essentially dumb terminals, with no resident software and no local processing power or memory.

One step up are thin clients; these offer sufficient local resources for users to do some work offline but lack persistent data storage. When a connection is lost, the software automatically caches the data and re-establishes the session when the connection is restored.

Oklahoma Arthritis Center in Edmond, Okla., plans to use VMware View 4.0's offline connection option because its care providers need constant desktop availability to fill out or

access patient information, said Chris Nelson, the center's director of IT.

Some thin clients have both local processing and persistent storage capabilities. Mosaic, a nonprofit care provider in Omaha, Neb., for intellectually challenged adults and children, chose this option partly to minimize network traffic.

"We had 40 agencies operating in 14 states, each with its own localized Windows network and data," said Thomas Keown, Mosaic's data storage and security administrator. Now all agency employees use Medialogic SPA's NoMachine NX thin clients to run most applications on Mosaic's server farm, also in Omaha. They can upload and work offline on data that is routinely cleaned out within 24 hours for security reasons. NoMachine NX uses a compression algorithm to minimize network traffic. In addition, users can access the Internet and check their email locally. Bandwidth use is only about 30 Kbps per user, Keown said.

Shoppers also need to consider the type of desktop virtualization hardware a virtual client supports. Mosaic, for example, could use NoMachine NX on 80% of its legacy machines, Keown said. "And we can buy refurbished Linux desktops with more functionality than we need for about $120 each."

In contrast, many of St. Vincent's PCs were obsolete power hogs that took 10 minutes to boot up and "were ready for the scrap heap," Edupuganti said. Replacing these clunkers with Pano Logic's small, cheap, energy-conserving Pano devices was a win-win, he said.

DEPLOYMENT CHALLENGES

Virtual desktops are like infants that cannot cut loose from the umbilical cord that attaches them to the data center. This dependency can put a heavy demand on corporate computing, storage and network resources. "A hosted virtual desktop often means a forklift upgrade in the infrastructure," said Gartner's Runyon.

Given the inevitable growth of application and user capacity requirements, performance monitoring has to be ongoing to maintain acceptable service levels, industry sources warn.

"We hadn't anticipated the memory usage we would need on servers, with 80 virtual desktop users concurrent on [the] system," said Mosaic's Keown. Response time became so slow that end users, including Keown himself, couldn't work. He brought in a specialist who upgraded the IBM blades, then informed his IT director that the project couldn't go forward unless there was at least one spare server available to plug in as needed. Mosaic now has 500 end users and the capacity for 600.

Desktop virtualization technology also needs constant access to the corporate storage area network, because the client has no local memory store. St. Vincent's Edupuganti found this out the hard way, when budget constraints forced him to put off installing a backup SAN: "Our single SAN did take a hit, and we were sitting ducks—all the desktops went out." The medical center now has a secondary SAN, he said.

On the bright side, as the industry matures, vendors are introducing more resource-conserving features. One such feature is the ability to provision a virtual client image on demand, rather than maintain a persistent image for each user on the server. This saves memory space, which is important for organizations that have thousands of desktop clients. It also allows client images to be tailored to individual user needs.

On the network side, meanwhile, "you need enterprise-class switches that support VLANs so you can configure your SAN onto two different switches," Nelson advised. This is both for redundancy, in case one SAN fails, and also "to segment iSCSI traffic so it doesn't flood the main network," he said.

Health care providers should choose desktop virtualization technology that supports PC over IP, Nelson said, because this standard network protocol greatly increases performance when high-resolution graphical images or medical records are being uploaded.

EMBRACING THE VIRTUAL CLIENT

Whatever virtualized client you choose, count on end users to resist the idea of giving up their PC autonomy, experts warn. "Our biggest hurdle was convincing employees to give up their hard drives, which for some, meant giving up their computers," Mosaic's Keown said.

That's why it's so crucial to involve business users up front in a deployment of desktop virtualization technology. It can not only lower their resistance but also provide worthwhile feedback.

For instance, Mosaic's senior leadership proposed the idea of desktop virtualization as a collaborative tool, Keown said. "They used to have to drag flash drives around to get or leave documents. They said, 'Hey, I work with five, six people in the state. Can we set up folders to share stuff?'"

Mosaic's IT department is now in "responsive mode," inviting all business users to come up with ideas, Keown said. "I can't anticipate how they'll want to work, but I can see flashbulbs going off in people's heads." ■

Elisabeth Horwitt is a contributing writer to SearchHealthIT.com.

CHAPTER 4

Best Practices for Server Virtualization

As providers add electronic medical record and clinical information systems, the need for additional servers becomes apparent. The right server virtualization strategy can help CIOs keep infrastructure expansion in check. **BY STAN GIBSON**

HILE VIRTUALIZATION technology is approaching maturity in many IT shops, it's just coming of age in health care providers' data centers. It may prove to be a golden age, however, as the push to virtualize gains momentum on all fronts—servers, storage, backup and desktop. And so far, hospital IT execs say, there's little not to like.

"We were either going to many physical servers or to virtualization. It made sense in terms of space and manageability to move to a much larger virtual platform," said Alan Hite, director of IT systems at Adventist Health System in Winter Park, Fla.

Jeff Szymanski, director of data center operations at the University of Pittsburgh Medical Center (UPMC) in Pittsburgh, agreed: "Without virtualization, we would have more staff or we would have to outsource or build a new data center."

Szymanski began the push for virtualization at UPMC in 2005, but he ran into a stumbling block—major electronic health record (EHR) vendors had not yet adapted their applications to run on virtual servers. Since then, however, such vendors

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> —ALAN HITE, director of IT systems, Adventist Health System

as Cerner Corp., Epic Systems Corp. and McKesson Corp. have implemented support for virtual machine (VM) platforms.

That lack of vendor support for VM environments held back virtualization in health care IT, IDC analyst Scott Lundstrom wrote in a recent white paper. Another factor in health care organizations' slow adoption of virtualization is size—plenty of them have IT operations that are too small to benefit from virtualization. But hospital consolidation is creating larger hospitals from smaller ones, and that process inevitably will make using virtualization more attractive.

THE LACK OF VENDOR SUPPORT FOR VM ENVIRONMENTS HELD BACK VIRTUALIZATION.

Although very small hospitals may still be on the sidelines, medium-sized and large hospitals have embraced virtualization with full force—the bigger the hospital, the more servers to virtualize, the greater the savings. UPMC is the largest employer in western Pennsylvania and the second-largest in the state, according to Szymanski. In its study of UPMC's virtualization initiative, IDC's Health Insights market research group estimates the organization avoided $80 million in capital and operating costs from 2005 to 2008.

Even so, smaller organizations are able to do much more with less than ever before. "We save $3,500 per server every time we provision a virtual server," said Robert McShinsky, senior systems administrator at Dartmouth-Hitchcock Medical Center in Lebanon, N.H.

Meanwhile, the South Central Foundation in Anchorage, Alaska, is benefiting from keeping its IT staff lean—only four engineers are needed to manage 120 virtual servers. "There's no way we could have done that without [using] virtualization," said Chris Smith, South Central's operations director and CIO.

SUCCEEDING WITH VIRTUAL SERVER CLUSTERS

Adventist Health, which describes itself as the largest nonprofit Protestant health care provider in the U.S., began by running Cerner's medical charting application on virtual servers. Now it's in the middle of a push to use virtualization that encompasses all branches of IT. "In 2008, things really started to explode," Hite said.

Needing to refresh its hardware and to run more instances of the Cerner application, Adventist Health expanded the number of its VMware

Inc. virtual servers. Since then, the organization has enlarged its virtual server clusters to host new systems and has continued consolidation at the same time. Plans include implementing its picture archiving and communication system, or PACS, on virtual servers.

In addition to deploying storage and virtual server clusters at the organization's main data center, Adventist Health rolled out similar deployments on a smaller scale at its constituent hospitals, which range in size from a few dozen beds to several hundred. (Overall, AHS-IS, the information services division of Adventist Health, handles IT for 26 of the system's 37 hospitals and has 500 employees in nine states.)

Currently, the organization's typical configuration is a cluster of three VMware hosts connected to an IBM N series or Network Appliance Inc. storage device. Hite said he's also evaluating desktop virtualization. "It's good that data is not on the desktop. The more we can leave in the data center, the better off we'll be," he said.

VIRTUALIZATION HELPS CONSOLIDATE STORAGE

Starting in 2005, Dartmouth-Hitchcock began deploying Microsoft Virtual Server 2005, which it saw as a simpler and less costly alternative to VMware software, according to McShinsky. In 2008, the medical center moved to Microsoft Windows Server Hyper-V, the successor to Virtual Server.

"We now have over 330 virtual servers, or 65% of our environment. It saves money on hardware and space—more space is reserved for seeing patients," McShinsky said.

Dartmouth-Hitchcock, with its major data center in Lebanon, N.H., and smaller ones in Nashua, N.H., and Bedford, N.H., is using virtualization to consolidate storage as well, with several Fibre Channel storage area networks (SANs), each consisting of as many as 10 Hewlett-Packard Co. (HP) StorageWorks EVA8000-series devices. McShinsky's staff uses Microsoft System Center Virtual Machine Manager and Data Protection Manager to manage the SANs and perform backups.

Dartmouth-Hitchcock also uses HP's Virtual Library System disk-based tape emulation storage, which includes a data deduplication feature that reduces the amount of data. In the move to consolidate storage, the medical center has not eliminated backup tape cartridges completely, however; those that remain are encrypted and stored off-site at a secure location.

Although SAN storage offers the benefits of high throughput and the ability to manage storage vol-

umes to assure high availability, McShinsky is fighting to keep costs under control. "Disk is cheap, but not as cheap when it's on a high-performance SAN," he said. Data deduplication helps, but he is also looking at thin provisioning via Virsto Software Corp. Thin provisioning allocates storage to applications only as needed, a feature that can cut storage costs significantly.

Next up is a multimillion-dollar project that will move Dartmouth-Hitchcock from what McShinsky describes as a "homegrown" EHR application to an Epic EHR system that will be deployed on Citrix Systems Inc.'s XenApp, an application virtualization platform that can send applications to desktops or act as a terminal server to desktops.

VIRTUALIZED STORAGE PRESERVES UPTIME

The South Central Foundation deployed VMware on Windows Server systems in 2006, and subsequently migrated to VMware ESX.

"We felt it was more mature than Hyper-V. There's almost no delay, and no downtime," said Smith, who added that he was particularly impressed with the ESX software's ability to move a guest VM from one live host to another with no interruption in service. Similarly, VMware's VMotion virtualized storage software lets administrators move storage volumes from one part of a SAN to another without sacrificing uptime, he noted.

For virtualized storage, South Central is using NetApp SANs in its primary and backup data centers. "Disk-to-disk backup happens several times a day," Smith explained. "We know there's quite a bit of savings. There is a little bit of an extra cost for software around snapshotting and easy replication of your data."

> "WE'RE TRYING TO CONSOLIDATE DOWN TO A COUPLE OF KEY VENDORS."
>
> —CHRIS SMITH, operations director and CIO, South Central Foundation

Next on the horizon is an 18- to 24-month migration to Cerner applications following a deal inked a few months ago. The applications, which will be hosted on Citrix XenServer, run the gamut from computerized physician order entry and e-prescribing to lab work and X-rays. "We're trying to consolidate down to a couple of key vendors like Cerner," said Smith.

Smith is further weighing different options for a future desktop infrastructure, such as using desktop

virtualization and a broad rollout of Windows 7, he said.

CONSOLIDATION CUTS ELECTRIC BILLS

UPMC has 11 satellite data centers, one of which, a 27,000-square-foot operation, had 45 server racks before virtualization. Now that total is down to five racks of virtual servers. Absent that consolidation, UPMC would have had to build another data center. Overall, the UPMC virtualization project is 90% complete, according to Szymanski.

UPMC is using VMware, mainly on IBM AIX severs with some HP and Sun Microsystems Inc. servers as well. The environment is managed by a combination of HP ServiceCenter and IBM Tivoli software. Szymanski praised the ability to take down virtual servers when necessary without having to take down a physical machine.

For UPMC, using virtualization goes hand in hand with a green IT initiative that has enabled the organization to keep its kilovolt-ampere consumption constant in the past five years. Like many of his peers, Szymanski has yet to commit to a desktop virtualization strategy but is discussing those technologies with IBM and Microsoft. ■

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