

## Scalable Enterprise Implementation Study:

# How Dell IT Uses Virtualization to Enable Test and Development

The Dell IT group uses a server farm running virtualization software to provide more than 1,000 test and development environments on fewer than 100 physical servers. This farm enables Dell IT to manage the test and development environments with a small team of administrators, allowing engineers and developers to focus on a wide range of internal projects and minimize time spent setting up test environments.

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**A**s Dell continues to grow globally, requirements for new applications and updates to existing applications place increasing demands on the Dell IT group infrastructure. Dell IT must be able to scale its computing resources while containing the capital costs and staffing resources needed to efficiently manage these systems. Using a virtual infrastructure for test and development helps Dell to maximize its computing resources with improved server utilization, operational cost-effectiveness, and productivity through rapid provisioning.

This article discusses the virtualization best practices Dell IT has developed as well as the architecture of its large server farm—which is an example of how Dell uses a scalable enterprise architecture based on industry-standard hardware and software to achieve

tangible benefits today. It also discusses future plans and expected directions for virtualization technology used by Dell.

#### Virtualization and the scalable enterprise

Server virtualization has been possible for decades on large, proprietary mainframe systems, enabling these expensive systems to be partitioned and used for multiple purposes at the same time. In recent years, the same type of technology has become available for Intel® processor-based servers, with VMware® ESX Server software leading the way. Using virtualization, a single Dell™ PowerEdge™ server can host multiple virtual machines (VMs) concurrently, with each VM potentially running different applications. The virtualization

technology that was once available only on large mainframes can now be used by enterprises of any size.

Dell IT has implemented virtualization by using ESX Server to support more than 1,000 test and development environments on fewer than 100 physical servers. The environments' design and management is an implementation of the Dell scalable enterprise strategy—that is, using an architecture based on industry standards and helping enable simplified management, improved utilization, and cost-effective scaling.

Ultimately, the scalable enterprise vision leads to an automated data center based entirely on industry standards.<sup>1</sup> Today, enterprises can achieve limited automation in data centers, but as more standards evolve, Dell anticipates that increasing levels of automation will be possible. Dell IT has implemented the first stages of an automated virtualization infrastructure and plans to continue building an automated data center based on industry standards.

### Dell IT virtualization server farm

The Dell IT virtualization server farm was standardized on Dell PowerEdge 6650 servers. These servers each have four Intel Xeon® processors, 16 GB of RAM, two Emulex host bus adapters for connection to the back-end storage area network (SAN), and four Intel Gigabit Ethernet<sup>2</sup> network interface cards (NICs) for network connections. One NIC is dedicated for access to the ESX Server service console, one is dedicated for the VMware VMotion™ feature, and the remaining two are teamed and dedicated for use by the VMs. The SAN is a Dell/EMC CX700 storage array, with most of the VM disk files residing on RAID-5 logical units. Figure 1 shows the Dell IT virtualization server farm.

All servers in the farm run VMware ESX Server 2.5. The servers are divided into groups of 20 for manageability, but they share the same SAN and are managed by a single PowerEdge 2650 server running VMware VirtualCenter 1.2. The VirtualCenter database resides on a clustered instance of the Microsoft® SQL Server™ platform. If a failure occurs on the VirtualCenter server, a VM is installed with VirtualCenter and can be attached to the clustered

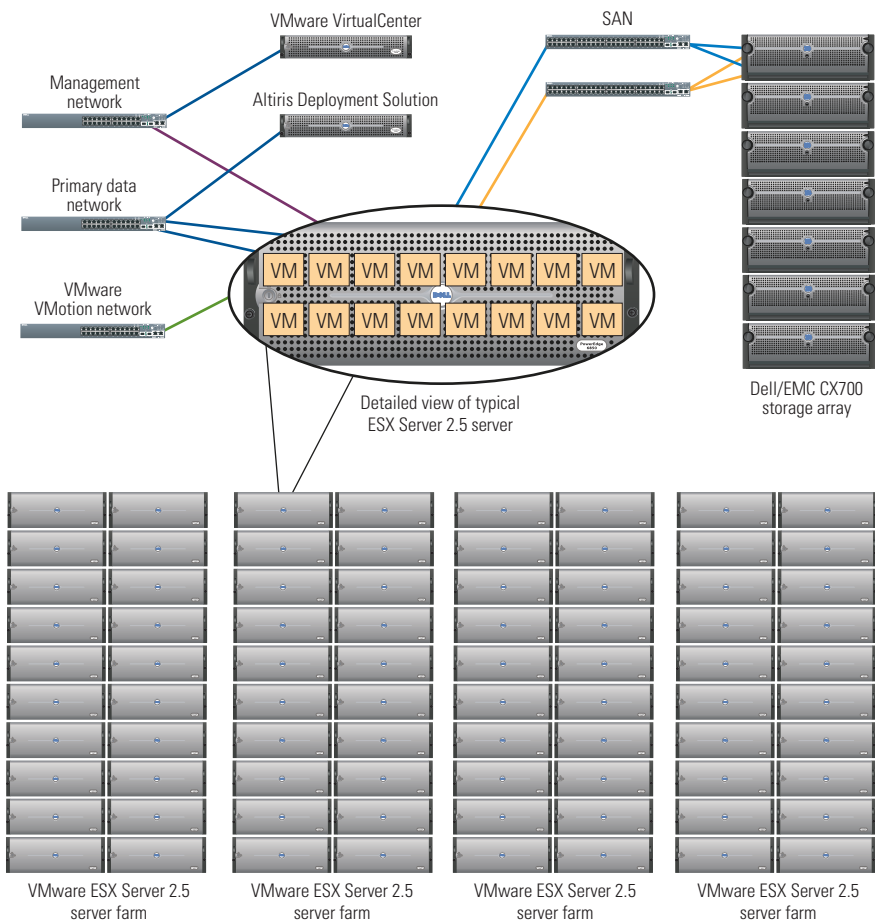


Figure 1. Dell IT virtualization server farm used for test and development

database instance. Because the VirtualCenter application cannot be clustered, this process helps mitigate the amount of possible downtime caused by server-level failure. The redundancy at the database level is much higher than at the server level, because the database runs on a clustered SQL Server instance.

### Virtualization best practices

As virtualization technology for industry-standard servers began to mature, Dell IT evaluated it for use in various roles. It became clear early on that test and development environments were well suited for virtualization. In fact, some groups within Dell IT had already started projects to use VMware products for that very purpose.

To gain control of this technology and use it efficiently, Dell IT developed two virtualization policies. The first policy was to deploy

<sup>1</sup> For more information about the Dell scalable enterprise vision, see "Dell Scalable Enterprise Architecture," by Jimmy D. Pike and Tim Abels, [www.dell.com/downloads/global/vectors/2005\\_scalable\\_enterprise.pdf](http://www.dell.com/downloads/global/vectors/2005_scalable_enterprise.pdf); and "Server Virtualization in the Scalable Enterprise," by Jimmy D. Pike and Drew Engstrom, [www.dell.com/downloads/global/solutions/server\\_virtualization.pdf](http://www.dell.com/downloads/global/solutions/server_virtualization.pdf).

<sup>2</sup> This term does not connote an actual operating speed of 1 Gbps. For high-speed transmission, connection to a Gigabit Ethernet server and network infrastructure is required.

virtualization in a controlled, managed server farm. The second policy was to use existing processes and systems whenever possible, and to only create new processes that could take advantage of virtualization capabilities or features. Dell IT used these two policies to implement test and development environments in its server farm.

### No backups for test and development virtual machines

In the Dell IT server farm, virtualization is not implemented as a backup or disaster recovery solution; instead, it is used to efficiently support and enable the test and development process. Existing systems are in place for backup and code management. To help simplify the management of the server farm, none of the VMs have a backup. Engineers and developers using the VMs are informed that these systems are not file shares or code repositories; the existing file shares and code repositories are accessible from the VMs over the network and should be used. Both the file servers and code repository servers have backups performed on a regular basis.

Even though the VMs are not backed up, the VMs themselves reside on the SAN, which is highly available. In the few instances when a server failure has occurred, all affected VMs were recovered onto other servers in the farm within a few hours.

### Server provisioning with Altiris Deployment Solution

For all Microsoft Windows® OS-based server installations, Dell IT uses a scripted installation process that includes the most recent security patches, antivirus software, systems management agents, and other corporate standards for servers. To help ensure that all VMs have the same level of security patches and adhere to all other corporate software standards, Dell IT uses the Altiris® Deployment Solution™ scripted installation to install the master VMs.

Clone copies are then made from these master VMs using either the VirtualCenter wizard for single copies or the vmclone script (available at [www.dell.com/downloads/global/solutions/vmclone.zip](http://www.dell.com/downloads/global/solutions/vmclone.zip))

to automatically create large numbers of copies. To help ensure that the security level of the master VMs remains up-to-date, they are left powered on when not being cloned. This procedure allows the standard Microsoft Systems Management Server (SMS) updates to be applied as they are pushed out to the master VMs, so that the next time a clone is made it includes the latest updates. Additionally, to help ensure that the master VMs have the latest builds, they are rebuilt with the Altiris scripted installation every quarter.

In addition to provisioning the VMs, Altiris Deployment Solution is used to deploy the physical servers running ESX Server. The Altiris job installs ESX Server using a scripted installation and includes the Dell OpenManage™ Server Administrator application for hardware management and monitoring. This process helps make deployment of new servers in the server farm quick and easy. Figure 2 illustrates the master VM update process.

Dell IT has implemented virtualization by using ESX Server to support more than 1,000 test and development environments on fewer than 100 physical servers.

### Review committee

For several years, a review committee within Dell IT has been responsible for approving requests for new hardware. This committee now includes VMs as part of its review and approval process. The default implementation for any test and development request is a VM, but exceptions are made when a case can be made for acquiring new hardware.

Not all requests for VMs are approved, however, because a virtualized test and development environment still requires server and storage resources. All groups that benefit from the virtualization farm also contribute to the farm's budget. These groups have

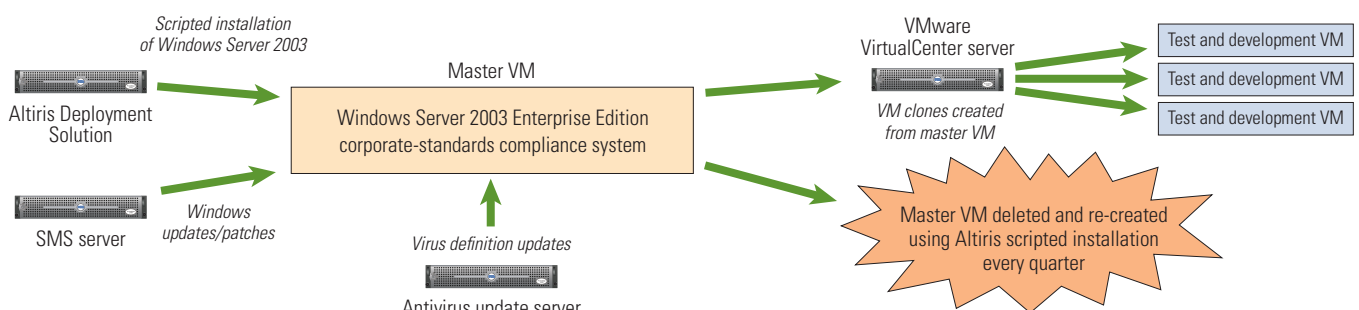


Figure 2. Master VM update process

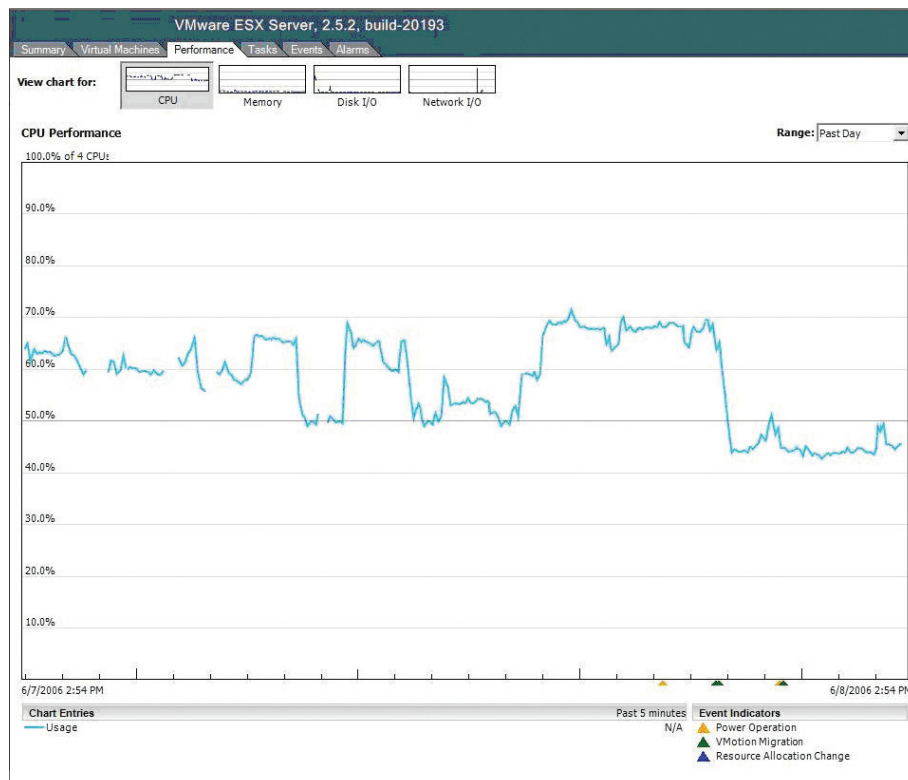


Figure 3. VMware VirtualCenter interface showing CPU performance for a Dell IT server running ESX Server 2.5

representation on the review committee, which allows them to control how their money is allocated.

### Standardized virtual machine configuration

To help simplify operations, Dell IT has defined a standard VM configuration to be used unless the review committee grants an exception. The standard VM configuration incorporates dual virtual processors, 512 MB of RAM, a 16 GB virtual disk that is split evenly onto the C:\ and D:\ drives, and the Microsoft Windows Server® 2003 Enterprise Edition OS with the latest security patches and service packs.

Using a standard VM configuration helps simplify cloning and recovery. The vmclone script can quickly create a large number of the same type of VMs, which can help dramatically reduce the administrative time required to fulfill requests for new VMs. If a server failure occurs, VM recovery is also simplified when they are all the same configuration, because administrators do not need to track which VMs were assigned different amounts of RAM or different hard disk sizes.

### Workload monitoring

One of the key advantages of using ESX Server is the ability to use the VMotion live-migration feature to move an active VM from

one physical server running ESX Server to another. This feature allows the load to be redistributed across the farm by moving VMs from heavily loaded servers to less-loaded servers. Dell IT uses VirtualCenter to identify the heavily loaded servers and to initiate VMotion as needed to move VMs around the server farm. Figure 3 shows the effects on CPU performance when VMotion is used to reduce the load on one of the Dell IT servers running ESX Server 2.5. As VMotion is initiated (denoted by the green triangles along the bottom of the graph), the load on this system is reduced because some of the busy VMs are moved to less-loaded servers.

Dell IT's standard sizing for the farm's four-processor servers is 4 VMs per processor or 16 VMs per server. The number of VMs on individual servers usually changes as the servers are monitored and VMs are redistributed based on load, but in general the number is kept as close to 16 per server as possible.

### Plans for emerging virtualization technologies

Dell IT plans to take advantage of emerging virtualization technologies as part of an initiative to expand the usage of virtualization within Dell IT. These emerging technologies include automated physical-to-virtual server conversion, automatic load balancing, and disaster recovery.

### Automated physical-to-virtual server conversion

Many older servers in Dell data centers around the world are well suited for virtualization, but legacy applications are difficult to move directly onto new hardware for a variety of reasons. Physical-to-virtual server conversion tools from VMware and third parties such as PlateSpin can help accelerate the server consolidation effort underway in Dell data centers by allowing these systems to be quickly converted into VMs. These conversion programs use many of the tools that standard imaging programs use to capture the physical server image. Typically, the physical server is Preboot Execution Environment (PXE) booted to an imaging server, which then downloads and boots a Windows Preinstallation Environment (WinPE) or Linux® OS kernel on the server to be converted. Next, the disk image is captured, and any drivers needed to run under ESX Server are added to the image. The final image is copied to the data store managed by ESX Server, which starts up the image

as a VM. The entire process may be scripted and run on multiple servers at once. Other variants of this technology can be used for virtual-to-physical conversion, which assists in creating a physical production server from a virtual development server, and virtual-to-virtual conversion, which facilitates converting VMs from one virtualization server to another (for example, from a server running Microsoft Virtual Server to one running ESX Server).

### Automatic load balancing

To help decrease the amount of manual intervention required to load balance the test and development server farm, Dell IT has begun testing with the next version of ESX Server, ESX Server 3. This version introduces the Distributed Resource Scheduler (DRS) feature, which can be used to manage virtual server loads across the many physical servers in a server farm. DRS is a policy-based tool that uses VMotion to move VMs to underutilized servers. Administrators can set the degree of automation desired, from totally automated (with DRS moving the VMs without any administrator intervention) to totally manual (with DRS notifying the administrator when an ESX Server host is overloaded and recommending another physical server for the high-utilization VMs).

### Disaster recovery

To help improve VM availability on the server farm, Dell IT is evaluating another feature introduced in ESX Server 3, VMware High Availability (VMware HA). This feature detects physical server errors and warnings and moves VMs from a failing ESX Server host to other hosts in the farm. As with DRS, administrators can set the degree of automation. Dell IT anticipates that this feature could be useful in the test and development environments currently targeted by Dell IT for consolidation.

### Scalable virtualization for the future

Dell IT has implemented a scalable solution for a large test and development environment using virtualization. This implementation has helped greatly reduce the number of physical servers required while also increasing the speed at which new test and development projects can be started compared with previous IT

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environments. As additional virtualization capabilities are developed, Dell IT intends to look for areas beyond test and development where virtualization can further increase cost-effectiveness and operational benefits. ➤

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## FOR MORE INFORMATION

### Dell Scalable Enterprise Technology Center:

[www.dell.com/setc](http://www.dell.com/setc)

### Dell virtualization solutions:

[www.dell.com/virtualization](http://www.dell.com/virtualization)

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