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Enabling On-Demand Desktop Streaming with the Dell Flexible Computing Solution

SPECIAL TEAR-OUT SECTION:
Windows Server 2008 Migration Guide

PLUS:
EXPLORING THE EMBEDDED VMWARE HYPERVISOR IN THE DELL POWEREDGE R805 SERVER
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GETTING READY FOR MICROSOFT WINDOWS SERVER 2008

By Laine Tsujii; Stephen Miller; Ben May; Jeanne Feldkamp; Jemilson Pierrelouis, Ph.D.; and Tom Kolnowski

Microsoft Windows Server 2008 promises to supercharge enterprise computing by providing a solid foundation to support critical workloads and deliver rich Web-based experiences—all in an exceptionally secure, industry-standard operating environment. Dell smooths the way by providing business-ready platforms optimized for Windows Server 2008 together with Structured Solution Designs to make the migration flexible, simple, and green.

SIMPLIFY MIGRATION TO MICROSOFT WINDOWS SERVER 2008

For many enterprises, the biggest hurdle in upgrading to Windows Server 2008 is the complexity of the migration process. Dell helps simplify IT and reduce risk with comprehensive service offerings and a validated, repeatable approach that includes seamless support for integrated Microsoft applications on Dell servers.

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SERVICES SHOWCASE PAGE 96

STREAMLINING CLIENT MIGRATION AND DEPLOYMENT

Client migrations can put an enormous strain on enterprise resources. The end-to-end Dell Client Migration Solution can help save time and money while relieving network congestion—using patent-pending automation technology to help cut costs by up to 62 percent, shave administrator time by up to 88 percent, and reduce required network bandwidth up to 70 percent for client deployments.

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DELL AND WINDOWS SERVER 2008: THE NEW BENCHMARK

Thanks to a strong partnership with Microsoft and hands-on experience, Dell helps simplify the adoption of the most advanced Windows Server OS ever. Here are the top 10 reasons to migrate to Windows Server 2008—and how Dell can help businesses get the competitive edge out of next-generation networks, applications, and Web services.

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CASE STUDIES

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Exploring the iDRAC for Dell PowerEdge Blade Servers

By Jon McGary

The Integrated Dell Remote Access Controllers (iDRACs) in Dell PowerEdge M-Series server blades provide powerful, easy-to-use remote management and configuration options designed to simplify management, increase flexibility, and enhance security in enterprise environments.

Introducing the Dell SAS 6 Family of RAID Controllers

By Bhanu Prakash Dixit, Sanjay Tiwari, and Kedar Vaze

The Dell Serial Attached SCSI (SAS) 6/iR family of integrated RAID controllers provides a cost-effective, entry-level RAID configuration and management solution for internal storage on Dell PowerEdge servers and Dell Precision workstations.

Modeling the Reliability of RAID Sets

By Abraham Long Jr.

By evaluating the expected reliability of different RAID levels alongside that of other system components and factors such as performance, enterprises can choose a data protection configuration appropriate to their environment and overall IT strategy.

Maintaining Dell Platforms with Dell Technical Updates

Recent firmware updates for Dell PowerEdge components and Dell PowerVault storage can help improve system functionality and minimize potential problems.

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DEPARTMENTS

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INTRODUCING THE DELL POWEREDGE R805 WITH VMWARE INTEGRATED VIRTUALIZATION

By Balasubramanian Chandrasekaran, Brent Douglas, Joseph Rispoli, and David Schmidt

The new Dell PowerEdge R805 server is designed and optimized specifically for virtualization. By including VMware integrated virtualization, the PowerEdge R805 enables quick and easy deployment right out of the box, simplified management, and enhanced security, as well as diskless configuration to help reduce power costs.

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SECURITY

SPECIAL SECTION: PARALLEL APPLICATION DEVELOPMENT SOLUTIONS

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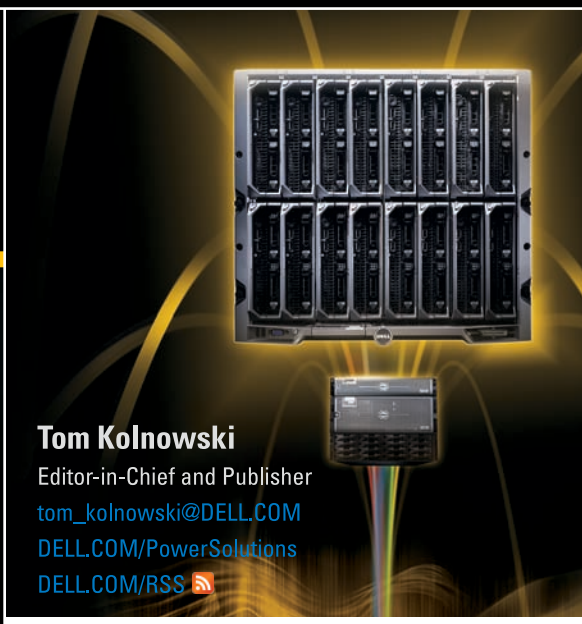
GET THIN WITH MICROSOFT WINDOWS SERVER 2008



Tom Kolnowski
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While many of the headlines around the launch of the Microsoft® Windows Server® 2008 OS focused on the new Hyper-V features—Microsoft's hypervisor-based server virtualization technology—many IT organizations are double-clicking on two of the less glamorous technologies coming out of Redmond at the same time: Server Core and the recast Terminal Services.

The Server Core installation option enables deployment of what amounts to a thinner Windows Server 2008 installation, which will be music to the ears of administrators because it enables them to build a minimal server with only the roles and features needed to accomplish a specific task—for example, purpose-built Microsoft Active Directory® or Domain Name System (DNS) infrastructure servers. The resulting thin servers can be expected to require less patching and provide higher levels of security than general-purpose servers.

Terminal Services has been a workhorse in the Microsoft Windows® server product line since the Windows NT® 4.0 OS, and has been thoroughly reengineered in Windows Server 2008. Positioned as a key component in presentation virtualization, Terminal Services RemoteApp and Terminal Services Web Access enable thin, single-click access to individual remote applications, while Terminal Services Gateway enables secure access to remote applications through firewalls without the need for virtual private network infrastructure.

Among Dell customers participating in the Dell Windows Server 2008 Early Adopter Program, the first three published case studies emerging from the program had a unifying thread: big success and high excitement around the thinner components in Windows Server 2008 Terminal Services. These customers included a major university (Terminal Services Gateway for the student body), a large bank (Terminal Services Web Access and Gateway for the IT support team), and a governmental organization (Terminal Services RemoteApp for server management). You can read more about these successes and others at DELL.COM/CaseStudies.

Not quite ready to take the Windows Server 2008 plunge in your IT shop? Read on to our feature section. Our cover story, "Getting Ready for Microsoft Windows Server 2008" (page 10), is a great place to start learning more about this versatile new server platform. On the following pages you can find another nine drill-down articles that cover the emerging Windows Server 2008 landscape. Also, you won't want to miss our special tear-out migration guide (page 48a). Looking for still more planning guidance? Join the growing contingent of Windows Server 2008 early adopters in direct dialogue with Dell engineers and developers on the Dell TechCenter wiki community site at www.DellTechCenter.com.

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DELL TECHCENTER WIKI: CONNECTING IT PEERS AND EXPERTS

As IT infrastructures become ever more complex, keeping track of the knowledge required to implement, integrate, and maintain the technologies that support them can be a real challenge. To help IT professionals meet this challenge, Dell created the Dell TechCenter wiki, a collaborative online community that provides in-depth technical information on a wide variety of topics. Through blogs, discussion groups, and weekly chats, the site enables IT professionals to communicate directly with both Dell engineers and their own peers, enabling them to find the information and answers they need to help simplify decision making and streamline IT management.

For example, the Virtualization Frontier blog, authored by senior Dell engineering consultant Todd Muirhead, explores issues and questions related to leading-edge virtualization technology. Recent entries to this blog include a discussion of running Microsoft® SQL Server® and Microsoft Exchange software on a VMware® virtualization platform, a performance analysis of Microsoft Windows® Hyper-V technology, and much more.

The Systems Edge blog, authored by Dell engineer Scott Hanson, focuses on systems management from a Dell perspective. Discussion topics range from insights on the latest release of the Dell OpenManage™ suite to video demonstrations showing how to collect power consumption reports and automate firmware and driver updates.

The Dell TechCenter wiki also hosts weekly online chats every Tuesday at 3 P.M. central time. These TechTuesday chats offer IT professionals the opportunity to engage in discussions with Dell engineers and other technical experts in real time. Recent TechTuesday chat topics have included blade server power management, host data protection with Dell EqualLogic™ PS Series Internet SCSI (iSCSI) storage arrays, and running Microsoft SQL Server on a VMware platform.

Finally, to give IT professionals a forum in which they can communicate and share knowledge directly with one another, the wiki also offers topic-centered discussion threads. Registered users can join an online discussion and comment on different pages or threads, or create a thread of their own. To learn more, visit **www.DellTechCenter.com**.

Dell TechCenter community

THE FUTURE OF COMPUTING IS EVERYWHERE

Innovation is transforming how people live and work. Businesses must respond, but the question is how, given little time and few resources. To help pave the way, the Dell Future of Computing Road Show is traveling to 148 cities around the globe, engaging directly with close to 30,000 IT leaders.

The tour kicked off in São Paulo, Brazil, on March 27. The day-long events cultivate an in-depth understanding of how Dell can help simplify IT throughout the enterprise, including breakout sessions on virtualization, data consolidation and management, flexible computing, services, systems management, blade servers, unified communications, power and cooling, client migration, mobility, and small business solutions.

Each event also features an exhibition room offering hands-on experience with Dell and partner technology, including a flexible computing scenario that demonstrates how data residing on a virtual disk server can stream the OS, applications, and images to approximately 100 end-user systems on demand. For more details and to find an event in a nearby city, visit **DELL.COM/Future**.

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GETTING READY FOR MICROSOFT WINDOWS SERVER 2008

The Microsoft® Windows Server® 2008 OS promises to supercharge enterprise computing by providing a solid foundation to support critical workloads and deliver rich Web-based experiences—all in an exceptionally secure, industry-standard operating environment. Dell smooths the way by providing business-ready platforms optimized for Windows Server 2008 together with Structured Solution Designs to make the migration flexible, simple, and green.

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By Laine Tsujii
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Microsoft Windows Server 2008 marks the biggest upgrade in the Microsoft server OS in years. Despite considerable planning challenges, there are compelling reasons to make the switch. The revamped platform can help enterprises address data security concerns, identify potential legal exposures, and streamline compliance efforts. It can help simplify support for a heterogeneous or legacy technology environment—especially if user demand is outpacing the current data center's ability to support key applications.

The new OS provides a solid foundation for workloads with advanced technologies and features such as the Server Core installation option, Windows® PowerShell, Windows Deployment Services, and enhanced networking and clustering technologies. It helps enterprises deliver rich Web-based experiences efficiently and effectively through outstanding administration, diagnostic, development, and application tools. The OS offers security innovations including Network Access Protection, Federated Rights Management, and read-only domain controllers.

Moreover, Windows Server 2008 virtualization capabilities promise to help support green IT initiatives and increase hardware utilization, optimize performance, and improve server availability. This powerful virtualization technology incorporates strong management and security features that enable enterprises to increase agility and system availability for production server consolidation, disaster recovery, testing, and development. Transitioning to Windows Server 2008 also facilitates consolidation and virtualization that can lead to a reduced data center footprint and simplified control for mission-critical applications. (For more information on the benefits of migrating to Windows Server 2008, see the "Top 10 reasons to migrate" sidebar in this article.)

REDUCING IT COMPLEXITY

Dell™ tools and processes are designed to enable automation and simplify adoption of Windows Server 2008. Dell has performed rigorous platform compatibility testing to optimize its products and services for the transition and help ensure that its servers and storage controllers are interoperable with Windows Server 2008. Integration of the latest drivers and security updates into Dell products enables organizations to simplify configuration and deployment to complete their migrations rapidly and securely.

Dell offers comprehensive, end-to-end migration services that are rightsized to the specific migration requirements of each client engagement. Having completed more than 5 million Microsoft Active Directory® and Exchange migrations, Dell has well-honed expertise to meet the needs of millions of users with diverse IT infrastructures. To that end, Dell develops a Structured Solution Design based on specific requirements for a particular organization—including functional testing on a pre-built IT infrastructure before implementing Windows Server 2008 in an actual production environment.[1]

SUPPORTING CRITICAL ENTERPRISE WORKLOADS

Windows Server 2008 provides a rock-solid foundation for critical enterprise workloads. New Windows PowerShell functionality offers a task-based command-line shell that provides comprehensive control and automation for Windows administrators. In addition, an enhanced TCP/IP stack uses an algorithm called Compound TCP to aggressively adjust the sender's TCP window size—leading to significantly increased file copy speeds, particularly over high-latency connections. Highly I/O-intensive applications such as the Microsoft SQL Server® database platform can benefit from the native support for TCP/IP Offload Engine (TOE) cards and

[1] To learn more about how the Dell Infrastructure Consulting Microsoft Practice can help organizations make the transition, see "Simplify Migration to Microsoft Windows Server 2008," in *Dell Power Solutions*, May 2008, DELL.COM/Downloads/Global/Power/ps2q08-20080290-DellSvcs.pdf.

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TOP 10 REASONS TO MIGRATE

1. Windows Server 2008 offers a **world-class Web and application platform** designed to provide security and ease of management for developing and reliably hosting enterprise applications and services.
2. The platform offers **improved networking performance** to harness the power of today's multi-gigabit networks and help IT organizations secure and control network traffic.
3. Every aspect of Windows Server 2008 is designed with **enhanced security and strict compliance** in mind. In addition, Network Access Protection features help enforce policies designed to ensure that any computer connecting to the network meets corporate requirements for system health.
4. By migrating to Windows Server 2008 now, organizations can **maximize the OS cycle** and take full advantage of the financial and technical benefits of powerful new functionality.
5. Windows Server 2008 provides **outstanding control over remote infrastructure** with enhancements to the Microsoft Active Directory directory service, including read-only domain controllers and administrative role separation.
6. The platform provides **simplified server management** through the Server Manager console—a tool that helps streamline management of server configurations, status reporting, and role management.
7. **Superior scripting and task automation** enable IT organizations to automate common tasks and easily control system administration.
8. Windows Server 2008 supports **presentation virtualization**, enabling secure access to internal applications through firewall-friendly ports.
9. **Hyper-V virtualization technology** facilitates production server consolidation, fast disaster recovery, and simplified management of dynamic data centers. Virtualization technology also allows IT departments to run legacy operating systems on the latest platforms as a virtual instance—allowing them to avoid compatibility issues.
10. Windows Server 2008 helps businesses leverage **the power of the Windows Vista® OS**. The two platforms share several networking, storage, security, and management technologies.

enhanced disk access routines. The advanced Microsoft Windows Imaging (WIM) format enables administrators to cut disk-based installation times dramatically.

Powerful management tools and security enhancements offer outstanding control over servers and networks while providing advanced protection for key applications and data. For example, to help avoid single points of failure, failover clustering features provide streamlined setup, a built-in LocalSystem account, and new alternatives for the cluster node quorum model.

STREAMLINING DEPLOYMENT WITH PRESENTATION VIRTUALIZATION

Presentation virtualization also helps simplify IT by allowing administrators to centralize application management in a distributed environment, providing access to applications through the reengineered Windows Server 2008 Terminal Services. By isolating processing tasks from graphics and I/O—for example, screens and dialog boxes—presentation virtualization lets users run applications in one location while they are controlled in another. This approach also enables remote and highly mobile users to access internal applications securely through firewall-friendly ports.

Terminal Services has been significantly enhanced for application virtualization with the Terminal Services RemoteApp and Terminal Services Web Access features, which enable individual applications to be virtualized for seamless presentation on a remote user endpoint in lieu of the entire desktop, while retaining traditional Remote Desktop Protocol (RDP) access to remote server and client nodes. Additionally, Terminal Services Gateway facilitates similar secure access to applications—while not requiring deployment of a virtual private network infrastructure.

DELIVERING RICH WEB EXPERIENCES

Windows Server 2008 is also designed to deliver rich Web-based experiences efficiently and effectively. It can help IT departments increase the flexibility of their server infrastructures while offering developers a robust Web and applications platform for building connected applications and services.

Microsoft Internet Information Services (IIS) 7.0 is designed to provide ease of management and advanced security technologies for developing and reliably hosting Web applications and services. Its modular architecture enables organizations to reduce or grow their IIS instance to exactly the size they need and no larger. The software does not require ubiquitous Microsoft Visual Basic® applications or scripts for installation—just a two-line batch file to start the package manager and then a copy of the ApplicationHost.config file from a central network share to the local system.

An enhanced HTTP compression engine with processor limiting and compressing content through Multipurpose Internet Mail Extensions (MIME) type instead of extensions help ensure that service is consistent, even during processor-intensive events. Centralized configuration allows multiple Web servers to share a single ApplicationHost.config file to help ensure that configurations are manageable and identical between servers.

The new delegated configuration feature allows application and Web site owners to share some of the configuration of their sites in IIS through local Web.config files. This approach helps eliminate concerns about keeping track of settings from one environment to the next—and also allows developers and other non-administrators some visibility into environments without compromising security.

PROVIDING SECURITY FROM THE GROUND UP

Windows Server 2008 supports key applications and Web-based platforms with exceptional security. One major advance: a Server Core installation option offers minimal, lightweight installation with

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SIMPLIFY MIGRATION WITH THE DELL READINESS ADVISOR TOOL

The Dell Windows Server 2008 Readiness Advisor is a free online tool that automates and centralizes the collection and reporting of information required to determine whether organizations are ready for Windows Server 2008 deployment. It identifies key requirements and finds unsupported devices through wizard-based support while performing advanced business logic to complete the inventory processes (see Figure A). The Readiness Advisor tool uses Active Directory Services, standard network protocols, and Windows Management Instrumentation (WMI) as follows:

- **Active Directory Services:** Finds computers on the network that are joined to an Active Directory domain using Active Directory Domain Services
- **Standard network protocols:** Finds computers on the network that are not joined to an Active Directory domain using standard network protocols; administrators inventorying systems in work groups or in Windows Server 2003 domains that include computers also joined to an Active Directory domain must run both inventory methods specifying the same results file
- **Local system evaluation:** Performs evaluation directly on the server running the tool, allowing administrators to evaluate systems that may not be connected to a network
- **Server evaluation:** Performs evaluation on a specified server on the network, by designating either computer name or IP address

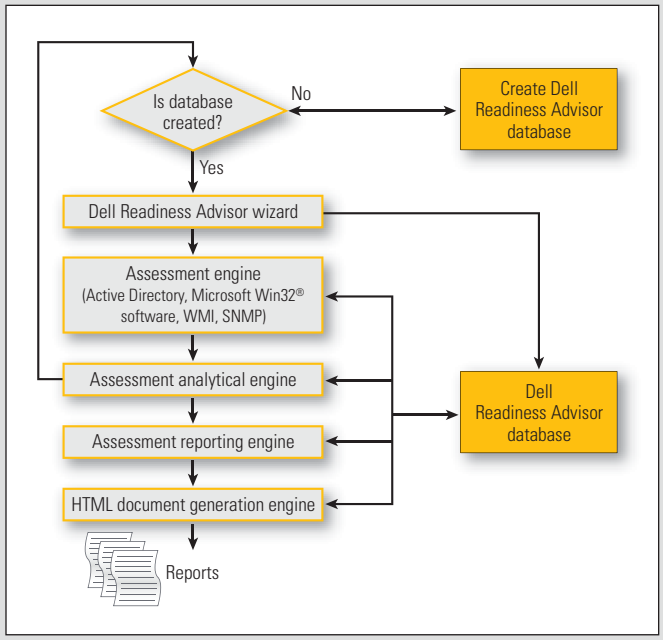

Figure A. *Dell Windows Server 2008 Readiness Advisor tool solution architecture*

Regardless of whether administrators use Active Directory Domain Services or standard network protocols to discover computers, the Dell Readiness Advisor tool uses WMI to connect to each computer and collect hardware and software information. The results file output allows administrators to specify a location and name for the evaluation reports. For more information, visit **DELL.COM/WindowsServer2008**.

limited functionality but high security. Server Core installations contain only a subset of executable files and server roles. This option is designed for organizations that have many servers, some of which need to perform only dedicated tasks but with outstanding stability, or for environments where high security requirements require a minimal attack surface on the server. Server Core installations can participate in Microsoft clusters, use network load balancing, host UNIX applications, and use encrypted drives with Microsoft BitLocker™ technology; administrators can remotely manage them using Windows PowerShell on a client system, and monitor them through Simple Network Management Protocol (SNMP).

Other security features include enhanced networking capabilities such as Receive Window Auto-Tuning, Receive Side Scaling, and Quality of Service (QoS) technologies that enable organizations to take advantage of multi-gigabit networks. Server hardening helps provide OS file protection, reduces the size of high-risk layers, segments services, and provides increased firewall protection through Windows Firewall with Advanced Security.

Group Policy objects and Public Key Infrastructure (PKI) have been improved in Windows Server 2008 to help organizations centralize and automate management of systems across the business. Server Manager tools provide out-of-the-box support for adding, configuring, and managing server roles, while integrated IP security (IPsec) and Windows Firewall with Advanced Security provide organizations with heightened protection and control over the flow of network traffic. Administrators may install only the services required for the role the server is performing.

Network Access Protection features are designed to check system health and restrict access for systems that are not in compliance. For enterprises with branch office deployments, the platform offers additional protection through a read-only domain controller that by default does not store any passwords. As a result, if the controller is compromised, IT managers do not have to worry about someone gaining access to the entire network with the information stored on that server. BitLocker drive encryption—an integral security feature—can also help protect servers at remote locations. In addition, Dell

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IMPLEMENTATION STUDY: HOW DELL DEPLOYED WINDOWS SERVER 2008 TO SIMPLIFY ITS OWN IT

Simplifying IT is job number one at Dell, and Microsoft Windows Server 2008 is playing a pivotal role in accomplishing that objective—in the work Dell does for itself as well as its customers. After working closely with Microsoft to optimize Dell products for Windows Server 2008, Dell became an early adopter of the new OS, which projections indicate should reduce server setup time, trim application deployment time, and help significantly reduce IT labor costs.

Dell had been experiencing many of the same pain points that its customers were reporting. For example, the servers that run **DELL.COM** had expanded at a rate of approximately 15 percent annually, consuming data center space and driving up power and cooling costs. With 3.2 billion page requests and 420 million visitors per quarter, the Web site required nearly 80 new servers each year to handle new content, new applications, and additional high-growth regional sites—all while keeping response times under 4 seconds globally. The IT staff was spending roughly 10 hours to set up, configure, test, and deploy applications on each new server implementation—time that was unavailable for creating new applications and online services to advance the business.

The **DELL.COM** infrastructure had been running on the Windows Server 2003 OS and Microsoft Internet Information Services (IIS) 6.0 Web server software. When Microsoft introduced Windows Server 2008, Dell was interested in taking advantage of new server configuration, administration, and diagnostic tools in IIS 7.0, a key component of Windows Server 2008.

AUTOMATED, POLICY-BASED MANAGEMENT

Dell installed Windows Server 2008 Enterprise Edition on Dell PowerEdge 2950 servers, each configured with two quad-core Intel® Xeon® processors. Using the distributed configuration features of IIS 7.0, the Dell IT staff plans to create a new e-commerce management platform to fully automate server and application deployment. The team intends to have six to eight hefty Windows Server 2008–based servers

PowerEdge™ servers are designed to help protect the confidentiality, integrity, and availability of enterprise data with preinstalled Microsoft security updates, Trusted Platform Modules (TPMs), network interface cards, and Secure Sockets Layer (SSL) adapters for enhanced server security.

HELPING DATA CENTERS GO GREEN

Dell complements Windows Server 2008 power management features with PowerEdge Energy Smart servers, energy-efficient PowerEdge M-Series blade servers, and energy-efficient data center solutions.[2] For example, running Windows Server 2008 on PowerEdge M-Series blade servers can lead to significant energy savings compared with similarly configured competitive systems. A recent study demonstrated that the PowerEdge M-Series blade server tested consumed up to 10 percent less power per blade and achieved up to 21 percent better performance per watt than the HP BladeSystem c-Class in the maximum blades configuration. This study also showed that compared with the IBM® BladeCenter H (8852), the PowerEdge M-Series blade server consumed up to 11 percent less power per blade and achieved up to 28 percent better performance per watt in the maximum blades configuration.[3] In addition, virtualization-ready platforms such as Dell PowerEdge R805,[4] PowerEdge R900, and PowerEdge R905 servers help simplify the process of consolidation, which can in turn help reduce power consumption and optimize overall data center operations.

FOLLOWING BEST PRACTICES FOR A SMOOTH TRANSITION

Dell has identified five keys to a smooth migration to Windows Server 2008 based on extensive testing of OS features; driver hardware interaction; general OS validation; platform, storage, and peripheral qualification; and Dell OpenManage™ compatibility and analysis:

1. **Strongly consider using Windows Server 2008 only as a 64-bit OS:** Making the transition to Windows Server 2008 typically requires considerable integration testing to migrate applications and services. While this effort is underway, organizations should also take the opportunity to migrate to the highly scalable 64-bit platform.
2. **Check to ensure that the targeted hardware is supported in Windows Server 2008:** To get started, see the "Simplify migration with the Dell Readiness Advisor tool" sidebar in this article.
3. **Work out the logistics around key infrastructure software:** Imaging software, antivirus clients, platform monitoring, patch deployment, and any required third-party applications must be verified before organizations can begin to roll out Windows Server 2008 in their environments.

[2] For more information about Dell's comprehensive strategy for going green, including power and cooling optimization, virtualization, and consolidation onto energy-efficient systems, see "The Energy Smart Data Center," by John Pflueger, Ph.D., and Albert Esser, Ph.D., in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20080179-CoverStory.pdf.

[3] "Windows Server 2008 SPECjbb2005 Performance and Power Consumption on Dell, HP, and IBM Blade Servers," Principled Technologies report commissioned by Dell, February 2008, www.principledtechnologies.com/clients/reports/Dell/Win2K8_blades0208.pdf.

[4] For more information, see "Introducing the Dell PowerEdge R805 with VMware Integrated Virtualization," by Balasubramanian Chandrasekaran, Brent Douglas, Joseph Rispoli, and David Schmidt, in *Dell Power Solutions*, May 2008, DELL.COM/Downloads/Global/Power/ps2q08-20080153-Chandrasekaran.pdf.

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that route traffic to back-end application servers. Dell can then write business rules that dynamically point and redirect traffic as needed. "Windows Server 2008 and IIS 7.0 are absolutely the cornerstone to how all this would work," says Ben May, senior systems engineer at Dell. "We will no longer have to touch individual machines; we'll have a cloud of servers that we can direct in an automated way."

By upgrading its **DELL.COM** systems to Windows Server 2008 and IIS 7.0, Dell expects to simplify server management, reduce costs, consolidate servers, and improve site performance. "With Windows Server 2008, server OS installation is as much as an hour faster per server, thanks to the native usage of the Windows Imaging Format over a traditional install that can take 90 minutes or more to complete," says May. Dell also estimates that it will be able to save 10–15 hours per server each quarter in software upgrades, hot fixes, and reduced individual system-by-system maintenance during application changes—a significant savings. In addition, Dell expects to realize savings by consolidating Web servers onto powerful 64-bit Windows Server 2008–based systems. Over a two-year period, Dell expects to retire 250 or more Web servers and thereafter eliminate or mitigate deployment of about 80 systems per year.

"Our vision for the DELL.COM architecture absolutely requires the new features in Windows Server 2008, which is key to our ability to simplify our online commerce environment."

— Ben May
Infrastructure architect at Dell
February 2008

4. **Get network engineers on board during the planning stages:** Windows Server 2008 can easily maximize a Gigabit Ethernet port when interfacing with other Windows Server 2008 or Windows Vista systems. Over time, combined with a growing server footprint, internal routers and switches may start to hit capacity during peak usage.
5. **Keep the operations team in the loop:** Working with a Windows Server 2008 console can be jarring to uninitiated administrators. Train operations teams on how to use the Server Manager and IIS consoles before deployment.

For details on how Dell migrated to Windows Server 2008, see the "Implementation study: How Dell deployed Windows Server 2008 to simplify its own IT" sidebar in this article.

ADVANCING BOTTOM-LINE BUSINESS OBJECTIVES

By running Microsoft Windows Server 2008 on Dell servers, organizations can reduce data center cost, complexity, and power consumption. Dell Infrastructure Consulting can help ensure a seamless transition to the new OS with well-honed best practices driving a validated, repeatable migration process. Features such as Server Core installation, Windows PowerShell, and Windows Deployment Services together with enhanced networking and clustering technologies allow enterprises to develop versatile and reliable platforms for the most demanding workloads and application environments. Advanced virtualization, Web services, and security technologies enable high availability with increased flexibility to respond quickly and securely to changing business requirements.

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SIMPLIFY MIGRATION TO MICROSOFT WINDOWS SERVER 2008

For many enterprises, the biggest hurdle in upgrading to the Microsoft® Windows Server® 2008 OS is the complexity of the migration process. Dell helps simplify IT and reduce risk with comprehensive service offerings and a validated, repeatable approach that includes seamless support for integrated Microsoft applications on Dell™ servers.

Related Categories:

Dell Services

Microsoft

Microsoft Windows Server 2008

Operating system (OS)

Operating system migration

Quest Software

Visit DELL.COM/PowerSolutions for the complete category index.

Technology moves fast—sometimes so fast that IT departments struggle to keep up with change and benefit from the advantages it can provide. Organizations are spending increasing amounts of time and money configuring systems, installing drivers, and maintaining servers when they could be channeling resources into projects that accelerate business growth. Microsoft Windows Server 2008 offers powerful new functionality and security enhancements designed to streamline business operations—but first, organizations must make the move.[1]

Dell has teamed up with Microsoft to collaborate on a wide array of initiatives, including joint engineering and testing, to design solutions that are easy to manage and can integrate seamlessly into existing IT environments. This includes Windows Server 2008, and now Dell helps simplify the process of upgrading to Windows Server 2008 by providing an end-to-end service that offers technical advice in a workshop scenario, a Comprehensive Readiness Assessment to determine options and requirements prior to migration, Structured Solution Design based on specific organizational requirements, and a validated, repeatable migration process. Best practices recommend that a proof-of-concept approach be taken to test the new solution before migrating to a production environment. Through this framework, the Dell approach equips IT managers with the resources and flexibility to adapt to change as it occurs.

BENEFITING FROM THE DELL AND MICROSOFT PARTNERSHIP

As a Microsoft Gold Certified partner, Dell provides a single point of contact for everything from software and hardware to infrastructure consulting and technical support through Dell ProSupport. The result of this partnership is cost-effective, end-to-end Microsoft solutions designed on standardized infrastructure that scales to deliver bottom-line business value from the desktop to the data center.

Dell provides seamless ordering, installation, integration, and support for Microsoft applications on Dell infrastructure. Dell Infrastructure Consulting further extends these benefits with certified Microsoft professionals that provide advice, design, planning, and integration for Microsoft solutions on Dell platforms. Finally, Dell complements deployment and maintenance capabilities for Microsoft by helping ensure that an organization's IT team is trained to manage the environment.

Dell and Microsoft actively participate in several reciprocal areas of joint development: Microsoft Windows® Unified Data Storage Server (the Dell PowerVault™ NX1950 offering), Web services, Windows Server 2008, Exchange, and SQL Server®

[1] For more information on how migrating to Microsoft Windows Server 2008 can help simplify IT, see "Getting Ready for Microsoft Windows Server 2008," by Laine Tsujii; Stephen Miller; Ben May; Jeanne Feldkamp; Jemilson Pierrelouis, Ph.D.; and Tom Kolnowski, in *Dell Power Solutions*, May 2008, DELL.COM/Downloads/Global/Power/ps2q08-20080305-CoverStory.pdf.

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software. Dell also works closely with Microsoft to test beta code and optimize hardware configurations. Dell Consulting experts offer field-tested experience based on the advanced deployment of Windows Server 2008 in production environments for organizations around the world as part of the Windows Server 2008 Early Adopter Program.

Dell also provides organizations with product validation of Microsoft solutions on Dell platforms. Solution and product validation is performed jointly through the Microsoft Product Development group and Dell Enterprise Solution Centers, where a dedicated Dell team focuses on solutions testing, verification, and certification of the Microsoft solution stack.

The Dell Infrastructure Consulting Microsoft Practice is focused on Microsoft's core advanced infrastructure stack, which includes messaging functions through Exchange, Microsoft Office SharePoint® software, Unified Communications, and office worker optimization software; server functions through OS upgrades; and SQL Server management. Dell and Microsoft solutions are designed to complement each other—for example, Unified Communications is closely tied to the Microsoft Active Directory® directory service, while SharePoint is closely tied to SQL Server and Unified Communications. Because the Dell Infrastructure Consulting Microsoft Practice is global, Dell distills best practices and knowledge gained worldwide in proof-of-concept tests and implementations. This approach helps ensure a validated, repeatable deployment and migration process for Microsoft solutions.

Dell further helps simplify Windows Server 2008 migration through factory integration, designed to deliver a customer-verified solution as part of the build-to-order model. Through this service, organizations can receive Dell equipment with the Microsoft solution stack included. Dell has also extended the concept of factory integration to a process that allows businesses to securely extend their networks into the Dell factory environment—enabling real-time image deployment that integrates an organization's operational environment at the point of production.

ASSESSING INFRASTRUCTURE PRIOR TO MIGRATION

Dell and Quest Software have worked together extensively on systems migration projects, using Quest software to enable migration and implementation of Microsoft solutions. For example, Dell uses Quest Migration Manager for Active Directory to help automate the migration of operating systems to Windows Server 2008. Throughout a customer engagement, Dell also uses tools from Quest to help detect and diagnose problems with Active Directory as well as automatically synchronize, restructure, and migrate Active Directory to Dell design specifications. Dell consultants have extended the use of Quest software to include Exchange Server 2007, SharePoint, and several related migration scenarios.

STREAMLINING MIGRATION WITH STRUCTURED DESIGN

With the Microsoft partnership and Quest migration software, Dell Infrastructure Consulting extends an organization's IT team and helps free valuable human resources to innovate on projects that advance enterprise goals. Dell helps simplify the migration process to Windows Server 2008 by breaking it down into a four-step methodology (see Figure 1):

1. **Workshop:** Dell consultants help IT administrators understand how Windows Server 2008 can benefit their organization. The workshop session focuses on the simplification and adoption of Windows Server 2008 usage scenarios, including remote infrastructure with Active Directory, high availability, and presentation virtualization or Terminal Services. Dell also determines enterprise objectives and the current state of IT infrastructure relative to the proposed usage scenarios. A Dell solution architect discusses design points, then concludes with a brief planning exercise.
2. **Windows Server 2008 Comprehensive Readiness Assessment:** The assessment helps organizations make informed decisions and explores the implications of transitioning to Windows Server 2008. A detailed technical and operational overview is provided as well as a validation of the current Active Directory infrastructure and dependent services prior to migration, by using Quest software to streamline on-site analysis.
3. **Structured Solution Design:** The Structured Solution Design produces a validated OS architecture based on specific organizational requirements. This design, along with automated tools from Quest, can facilitate a rapid, seamless migration by enabling a pre-built IT infrastructure, which provides a tested implementation plan through to the pilot stage.
4. **Implementation:** Once the pilot deployment has been completed and validated, Dell consultants help ensure that Windows Server 2008 is implemented according to the specified design. Dell experts also perform knowledge transfer to the organization's technical resources and system administrators. Typical tasks during implementation may include hardware and software installation, migration of users or data, and further testing to help ensure that functionality is available to client systems throughout the enterprise.

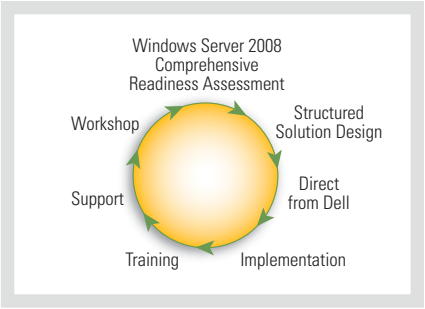

Figure 1. *The Dell Infrastructure Consulting Microsoft Practice helps simplify migration*

Visit DELL.COM/WindowsServer2008 for more information.

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RUN WINDOWS SERVER® 2008 ON DELL

GET UP TO 28% BETTER PERFORMANCE PER WATT

When running Microsoft® Windows Server® 2008, Dell™ PowerEdge™ M-Series blade solutions offer 28% better performance per watt than IBM Blade Center and 21% better performance per watt than HP BladeSystem.* Just another way that Dell is helping to make your data center greener.

GET GREEN AT DELL.COM/WS2008

DELL

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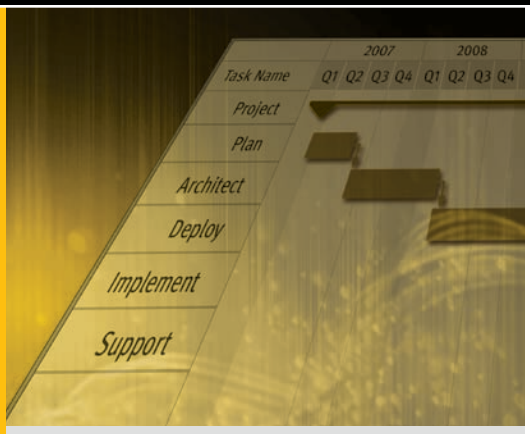

MIGRATING DELL POWEREDGE SERVERS TO MICROSOFT WINDOWS SERVER 2008

By Aarthi M.
Jemilson Pierrelouis, Ph.D.
Narayanan D.
Perumal Raja P.

Upgrading to the Microsoft® Windows Server® 2008 OS can offer myriad advantages, including enhanced performance, security, and stability. By following best practices for in-place upgrades and taking advantage of tools such as the Dell™ Windows Server 2008 Readiness Advisor, administrators can help ensure a smooth migration on their Dell PowerEdge™ servers.

Related Categories:

Dell OpenManage

Dell PowerEdge servers

Dell Windows Server 2008 Readiness Advisor tool

Microsoft

Microsoft Windows Server 2008

Operating system deployment

Operating system migration

Visit DELL.COM/PowerSolutions for the complete category index.

Microsoft Windows Server 2008—the first major server OS release from Microsoft in five years—is designed to provide a productive platform for applications, networks, and Web services from the workgroup to data center, and incorporates valuable enhancements to key features and to the base OS itself. Some of the primary areas of improvement include networking, advanced security features, remote application access, centralized server role management, performance and reliability monitoring tools, failover clustering, deployment, and the file system. These enhancements and many others can help organizations maximize server flexibility, availability, and control—for example, Windows Server 2008 introduces Server Core installation, a minimal server installation option that provides a low-maintenance environment capable of acting as a file server, Dynamic Host Configuration Protocol (DHCP) server, Domain Name System (DNS) server, media server, Web server, and Microsoft Active Directory® server.

Dell supports Windows Server 2008 on an array of PowerEdge server platforms across five server generations. Depending on the system, Dell servers can support both 32- and 64-bit versions of Windows Server 2008—including Standard Edition, Enterprise Edition, Datacenter Edition, and Web Edition—except for the 32-bit version of Windows Server 2008 Datacenter Edition.[1] By following the best practices described in this article when planning, preparing for, and executing a migration to Windows Server 2008, administrators can help ensure a smooth upgrade process.

IDENTIFYING SUPPORTED UPGRADE PATHS

Microsoft server operating systems typically can be upgraded only to an equivalent or higher-level OS. The first step in choosing a suitable version of Windows Server 2008 is to determine the nearest equivalent to the OS that the system is currently running (see Figure 1). As a minimum requirement, servers that administrators plan to upgrade to Windows Server 2008 should be running Windows Server 2003 with Service Pack 1 (SP1) or SP2 or Windows Server 2003 Release 2 (R2). Servers running the released-to-manufacturing (RTM) version of Windows Server 2003 or servers running earlier Microsoft operating systems (such as Windows NT® Server or Windows® 2000 Server) should first be upgraded to one of these three Windows Server 2003 versions before being upgraded to Windows Server 2008.

Administrators should note that because the 64-bit version of Windows Server 2008 Web Edition does not have a direct equivalent in Windows Server 2003, they cannot perform an in-place upgrade to that version of Windows Server 2008.

[1] For a list of Dell PowerEdge servers that support Windows Server 2008 and the specific versions each can run, visit www.delltechcenter.com/page/Migrating+Dell+PowerEdge+Servers+to+Microsoft+Windows+Server+2008.

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Current Windows Server 2003 version	Windows Server 2008 upgrade path			
	Standard Edition	Enterprise Edition	Datacenter Edition	Web Edition
Standard Edition with SP1 or later	✔	✔		
Enterprise Edition with SP1 or later		✔		
Datacenter Edition with SP1 or later			✔	
Web Edition with SP1 or later				✔

Figure 1. *Possible upgrade paths from Microsoft Windows Server 2003 to Windows Server 2008*

EVALUATING SYSTEM REQUIREMENTS

As part of confirming hardware compatibility, administrators should verify that the system they plan to migrate to Windows Server 2008 meets the minimum OS system requirements, and ensure that the system has the latest BIOS, firmware, and hardware device driver versions available from the Dell support Web site at support.dell.com. Dell engineering teams have worked with Microsoft to package most of the necessary storage and network controller drivers with the OS installation media; in cases where these drivers are not on the installation media, however, administrators can download them from the Dell support Web site. Unlike in Windows Server 2003 (which required using a floppy disk to install non-native boot drivers during OS installation), Windows Server 2008 allows administrators to browse for driver files on storage media such as CDs, DVDs, and USB drives in addition to floppy disks.[2]

The Dell Windows Server 2008 Readiness Advisor tool (available as a complimentary download from DELL.COM/WindowsServer2008) automates and centralizes the collection and reporting of information required to determine whether servers running a Windows OS meet the minimum or absolute maximum requirements to run Windows Server 2008. Designed to be easy to learn and use without special training, it helps simplify the assessment process and identify key requirements by providing graphical wizard-based support while using advanced business logic for completing the inventory process. Dell invested thousands of engineering hours in research and analysis to discover unsupported devices, RAID and storage controllers, and many more components that may affect PowerEdge servers upgrading to Windows Server 2008.

The tool uses Microsoft Active Directory Domain Services, Windows Networking Protocol, and Windows Management Instrumentation (WMI) to perform the assessment, and is designed to produce a very low level of network traffic (typically from 115 KB to 1 MB per server). Running it requires Microsoft .NET Framework 2.0, Microsoft SQL Server® Express Edition, a normal Active Directory user account with local administrator rights to each server, a 1 GHz or faster processor, at least 1 GB of available hard drive space, and at least 512 MB of memory. The tool also requires certain ports to be open as well as certain exceptions using Group Policy Editor.

PERFORMING THE MIGRATION

After administrators have identified and evaluated the servers they want to upgrade, they must choose an appropriate process to carry out the migration. Figure 2 provides a basic flowchart that they can use as a guide.[3] Best practices for performing an in-place upgrade also recommend backing up data using the Windows Server Backup utility, upgrading to version 5.4 of the Dell OpenManage™ systems management suite, using the Dell filter driver removal tool to avoid issues with Adaptec filter drivers, and removing non-Windows-delivered software before performing the upgrade.

Backing up data

In Windows Server 2008, the Windows Server Backup utility replaces the Windows NT Backup utility. This utility supports backup and restore operations using removable media such as CDs and DVDs as well as local or network drives. Because it does not support tape media, organizations migrating from Windows Server 2003 cannot use it to restore data backed up on tape. Windows Server 2008 does support the Windows NT Backup utility in restore mode, however, allowing administrators to use it to restore backups made on Windows Server 2003 to systems running Windows Server 2008. This restore tool is a stand-alone utility, not part of the base OS, and can be downloaded from support.dell.com.

Upgrading to Dell OpenManage 5.4

The Dell OpenManage systems management suite provides proactive monitoring, notification, and remote access for Dell systems. Because Dell OpenManage 5.4 is the first version of this software to support Windows Server 2008, organizations running a previous version of the suite on Windows Server 2003 must upgrade to this version when they upgrade to Windows Server 2008. (Organizations already using Dell OpenManage 5.4 on Windows Server 2003 can upgrade directly to Windows Server 2008.)

When upgrading a system to Dell OpenManage 5.4 and Windows Server 2008, Dell recommends that administrators first uninstall the existing Dell OpenManage software, upgrade the OS to

[2] For details on unsupported storage and network controllers and the availability of native drivers for storage controllers, visit www.delltechcenter.com/page/Migrating+Dell+PowerEdge+Servers+to+Microsoft+Windows+Server+2008.

[3] For more information on replacing a PERC 3/DC, PERC 3/QC, or PERC 3/SC with a PERC 4 as indicated in Figure 2, and on creating a software mirror as a RAID replacement for a PowerEdge CERC SATA 2s, see the "Upgrading from Dell PERC 3 to PERC 4" and "Installing Microsoft Windows Server 2008 and Configuring Operating System RAID on Your Dell System Using Dell CERC SATA 2S as a Boot Controller" documents available at support.dell.com/support/edocs/software/ws2k8.

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Windows Server 2008, and then install Dell OpenManage 5.4. For detailed installation instructions, see the *Dell OpenManage Installation and Security User's Guide* available on the Dell Systems Management Tools and Documentation DVD.

Using the Dell filter driver removal tool

The Dell filter driver removal tool, available for download from support.dell.com, uninstalls the Adaptec filter driver from systems with a PowerEdge Expandable RAID Controller (PERC) 3/Di or PowerEdge Cost Effective RAID Controller (CERC) Serial ATA (SATA) 6/Ch to help avoid errors when upgrading to Windows Server 2008. Removing this driver should not typically cause problems or loss of functionality after the OS upgrade is complete. This tool performs no operations on systems that do not have this driver.

Removing non-Windows-delivered software

Microsoft recommends that administrators remove non-Windows-delivered software—defined as any software or software component that was not shipped with Windows Server or delivered through Windows Update, including Microsoft utilities and applications—from Windows Server 2003 systems before upgrading to Windows Server 2008. Performing an in-place upgrade with this software installed may cause it to function incorrectly. (Dell does support upgrading to Windows Server 2008 on systems with Dell OpenManage 5.4 installed, however.)

To verify software compatibility in the Windows Server Catalog of Tested Products and to download other tools and documentation, visit support.microsoft.com/kb/948070.

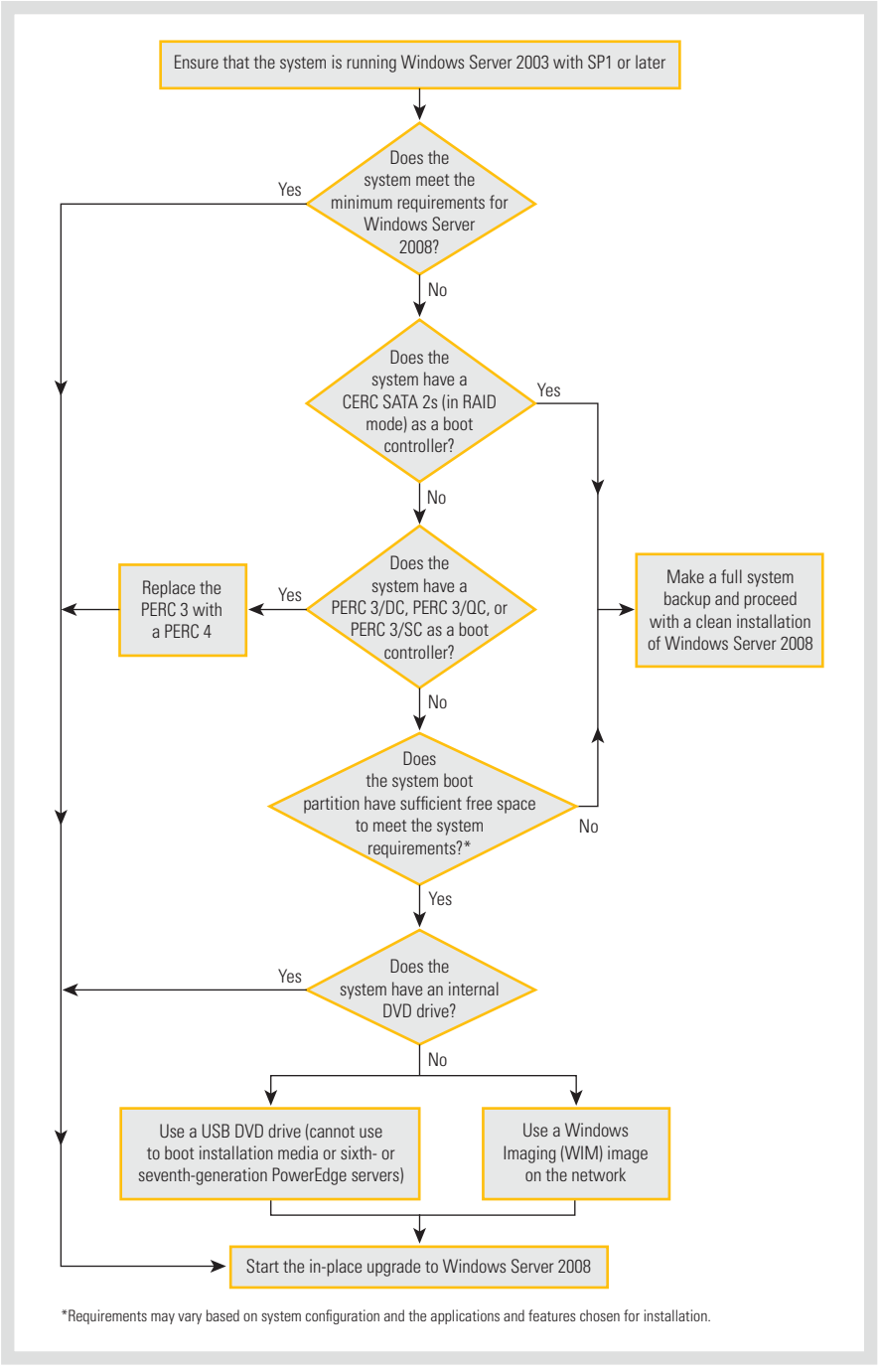

Figure 2. *Migration flowchart for Microsoft Windows Server 2008*

SUCCESSFULLY MIGRATING TO WINDOWS SERVER 2008

Microsoft Windows Server 2008 introduces major changes and features that can help significantly enhance OS performance, security, and stability. Carefully considering the deployment paths explored in this article, evaluating hardware compatibility, and addressing potential server management issues can help administrators plan and execute an optimal deployment in their organizations.

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Perumal Raja P. is a senior engineering analyst on the Dell Server OS Engineering team.

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IMAGE-BASED INSTALLATION FOR MICROSOFT WINDOWS SERVER 2008

The image-based installation and systems management support in the Microsoft® Windows Server® 2008 OS can offer multiple advantages over conventional native installation on local and remote systems, including streamlined OS image deployment on Dell™ PowerEdge™ servers in complex, heterogeneous environments.

By Weijia (John) Zhang, Ph.D.

Related Categories:

Dell PowerEdge servers

Image deployment

Microsoft

Microsoft Windows Server 2008

Operating system (OS)

Operating system deployment

Systems management

Visit DELL.COM/PowerSolutions for the complete category index.

Complex IT environments may contain a heterogeneous set of computer platforms and operating systems that can be challenging to manage when using an image-based paradigm for OS installation. Although image-based deployment can offer a number of advantages, it generally requires the source system and the target system to be identical or similar to enable duplicating preconfigured operating systems from the source system to one or more target systems.

In the past, vendor-supplied OS media have typically been based on native installation, which requires copying files one by one from the installation media to the target system. However, the potential benefits of image-based installation—including minimal human intervention, reduced errors, and increased consistency—can make it a preferable method for locally and remotely installing operating systems and software.

The release of Microsoft Windows Server 2008 marks an important milestone in enabling wide adoption of image-based installation for local or remote deployments. In unifying the methods for installing operating systems through image-based installation, Microsoft has overcome several technical issues and built a proprietary framework to help streamline software installation and deployment processes. Administrators planning to deploy Windows Server 2008 on Dell PowerEdge servers can use this framework for local and remote image-based installations in their environment.

The Windows Server 2008 image-based installation process described in this article is similar to the process of reproducing a photo, in which a studio takes an original image, stores it, and then develops or reproduces it in on film. This process comprises three key steps (see Figure 1):

1. Preparing the source image, which administrators can do by capturing the entire OS from a master system or porting an OS image shipped by a vendor.
2. Preparing the target systems to make them available for image deployment.
3. Deploying the images to the target systems, then making any necessary adjustments to each system's configuration.

PREPARING THE SOURCE IMAGE

Windows Server 2008 supports two basic image types: Windows® Preinstallation Environment (WinPE) images and OS images. WinPE images are normally boot.wim files designed to run in a pre-OS environment; administrators can use them to configure hardware offline and to capture and deploy OS images. OS images, in contrast, are install.wim files on the Windows Server 2008 installation media that serve as representations of an installed OS and

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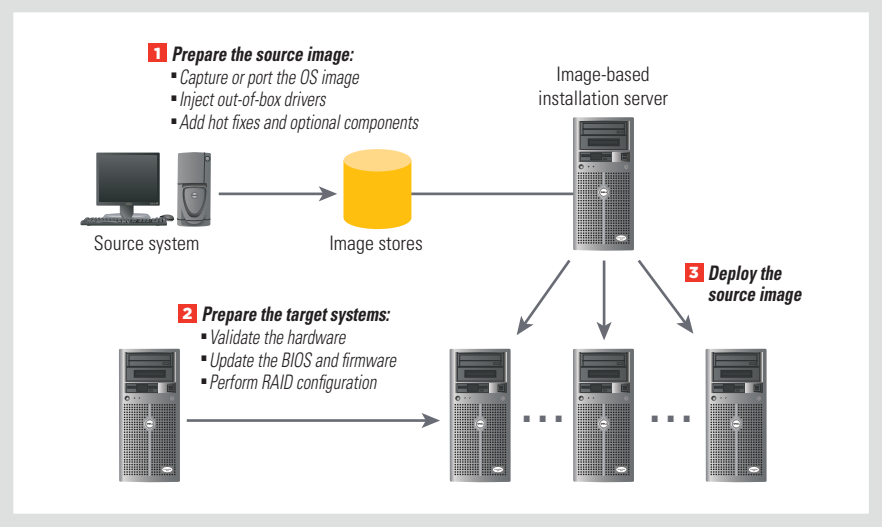

Figure 1. *Image-based installation process for Microsoft Windows Server 2008*

contain multiple stock-keeping units (SKUs) for supported operating systems. Administrators can capture an OS image from a source system running Windows Server 2008, then use image preparation and processing tools to process these images (see Figure 2).

Administrators using deployment tools for Windows operating systems should keep in mind that these tools typically require the source system and target system to be compatible. One enhancement to Windows Server 2008 deployment is the ability to customize images after capturing them from the source system, which allows the source image to be different from the customized images deployed on the target system.

The imagex.exe utility is a key tool when performing this customization, allowing administrators to customize a system image for specific hardware characteristics of the target systems; they can also use peimg.exe and pkgmgr.exe in the Original Equipment Manufacturer (OEM) Preinstallation Kit to customize the image offline. The peimg.exe tool, which is typically used only for handling WinPE images, can be useful for injecting drivers and optional packages into images, while the pkgmgr.exe tool is helpful for injecting applications, languages, and drivers.

PREPARING THE TARGET SYSTEMS

Windows Server 2008 does not include utilities for pre-OS processes such as RAID configuration or firmware updates. However, some preparations may be necessary before bringing a target system into the deployment environment. When preparing target systems, administrators should ensure that they meet the Windows Server 2008 system requirements for RAM, storage, optical drives, and so on. Some legacy platforms may lack the certified drivers for the storage controller and should therefore be excluded as target systems for deployment. Administrators should also ensure that the systems have the latest BIOS and firmware versions available; if they are not configured properly, they can use Dell OpenManage™ systems management tools in the pre-OS environment to upgrade them.

Administrators can perform RAID configuration on target systems locally using the BIOS option ROM or the Dell OpenManage systems management tools. They can perform this configuration remotely using the Dell OpenManage Deployment Toolkit combined with a deployment framework, which allows the tool to run in a pre-OS environment such as WinPE or a customized Linux® distribution.

DEPLOYING THE SOURCE IMAGE

Deploying an image requires several steps. First, administrators should use a discovery mechanism to locate and identify the target systems through a Dynamic Host Configuration Protocol (DHCP) process or through a proprietary process. After the target system is found, a Preboot Execution Environment (PXE) server may locate a small bootstrap and download it to the target system. This bootstrap can then fetch a lightweight OS kernel from the deployment server and start running it in the pre-OS environment. The kernel can run utilities to fetch the source image

	Function	Image type	Operation
peimg.exe	Injecting drivers, hot fixes, and optional components into Windows images and customizing bootable WinPE images with a comprehensive set of drivers for heterogeneous environments; supports processing both 32-bit and 64-bit images	WinPE images only	Offline
imagex.exe	Expanding, capturing, and generating Windows images; normally used to customize a source image for deployment on target systems	WinPE and OS images	Offline and online
pkgmgr.exe (Package Manager)	Injecting drivers, hot fixes, and optional components such as language packs into Windows images	OS images only	Offline and online
Windows System Image Manager	Exploring OS images and generating unattended answer files for image deployment	OS images only	Offline

Figure 2. *Image preparation and processing tools for Windows Server 2008*

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Deployment scenario			Use case	Deployment options
Local	Attended	One to one	Manually installing OS on a single local system	Use the Windows Server 2008 OS media combined with Dell OpenManage systems management tools.
		One to many	Manually installing OS on multiple local systems	Boot to WinPE for multiple systems and run setup.exe from a central location, or use WDS and the Windows Automated Installation Kit (AIK).
	Unattended	One to one	Using unattended setup to install OS on a single local system	Obtain out-of-box drivers from the Dell OpenManage systems management tools or from the Dell support Web site at support.dell.com, then use the Windows Server 2008 OS media and an unattend.xml file to complete the installation.
		One to many	Using unattended setup to install OS on multiple local systems	Use WDS and the Windows AIK.
Remote	Attended	One to one	Manually installing OS on a single remote system	Use the same approach as for a local, attended, one-to-one deployment, but combined with the virtual media feature for Dell servers.
		One to many	Manually installing OS on multiple remote systems	Remotely boot to WinPE for multiple systems and run setup.exe combined with unattend.xml from a central location, or use WDS and the Windows AIK.
	Unattended	One to one	Using unattended setup to install OS on a single remote system	Use the same approach as for a local, unattended, one-to-one deployment, but combined with the virtual media feature for Dell servers.
		One to many	Using unattended setup to install OS on multiple remote systems	Use WDS and the Windows AIK.

Figure 3. *Multidimensional deployment scenarios for Microsoft Windows Server 2008 images*

from the image server and deploy it to the target systems.

Microsoft provides a variety of methods for installing Windows Server 2008 depending on three factors: deployment scope (local or remote), deployment autonomy (attended or unattended), and deployment scale (one to one or one to many). Figure 3 outlines the eight possible installation types based on these three factors. The combination of Windows Deployment Services (WDS) and Dell OpenManage systems management tools can provide comprehensive support for deploying Windows Server 2008 on Dell PowerEdge servers.

USING LINUX TOOLS TO DEPLOY WINDOWS SERVER 2008

Administrators should keep in mind that they typically cannot use a Linux deployment framework to deploy Windows Server 2008. There are several significant obstacles to performing this type of deployment. First, the Linux environment must support modifying the Boot Configuration Data (BCD) file, which replaces the original boot.ini file that controls the OS boot process. However, currently the BCD file can only be modified by using the bcdedit.exe tool, and Linux does not support a tool that can reliably modify the file.

Second, Windows Server 2008 only supports NT File System (NTFS), and no tool is available for using a FAT32 partition and deploying the OS to that partition. And third, because the Windows Imaging (WIM) format is proprietary, the open source community should not attempt to reverse engineer the BCD file, NTFS, and WIM format to allow a Linux tool to deploy Windows Server 2008. One possible workaround, however, may be to stage WinPE in the Linux framework and then use WinPE to deploy Windows Server 2008.

STREAMLINING WINDOWS SERVER 2008 DEPLOYMENT

Image-based installation can offer a variety of advantages over native installation, including minimal human intervention, reduced errors, and increased consistency. By allowing administrators to perform local and remote image-based deployments on Dell PowerEdge servers even in complex, heterogeneous IT environments, Microsoft Windows Server 2008 marks a significant advancement for this installation paradigm—one that may have a tremendous impact on the OS deployment methodologies used in enterprise data centers.

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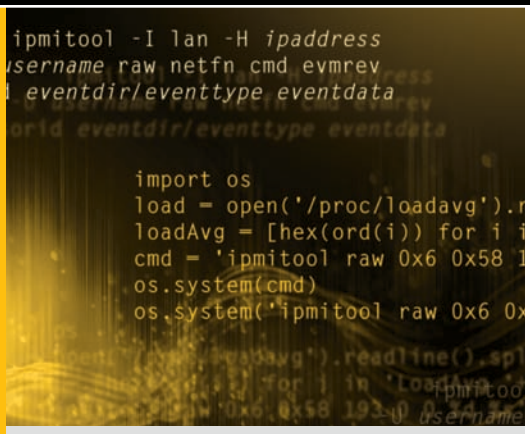

ACCELERATING OS DEPLOYMENT WITH MICROSOFT WINDOWS DEPLOYMENT SERVICES

By David Waggoner

Microsoft® Windows® Deployment Services (WDS) provides an accessible, flexible way to perform mass deployments of current and legacy Windows operating systems. Using customized answer files and taking advantage of scripting and other tools with WDS can help dramatically reduce the time to perform highly configured mass deployments with minimal infrastructure impact.

Related Categories:

Microsoft

Microsoft Windows Deployment Services (WDS)

Microsoft Windows Server 2008

Operating system (OS)

Operating system deployment

Operating system migration

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First introduced in the Microsoft Windows Server® 2003 OS around the time of the Service Pack 2 (SP2) release, Windows Deployment Services (WDS) is now the standard mass deployment tool in Windows Server 2008. It is flexible and capable enough that some IT departments may use it to roll out Microsoft Windows Vista® or Windows Server 2008 platforms throughout their enterprise, while those with considerable investments in Microsoft Systems Management Server or System Center Configuration Manager can use WDS in enclosed lab environments for testing or for creating deployment images and scenarios. This article discusses key differences between Windows Server 2003 and Windows Server 2008 installations and delves into some of the specific WDS options and customizations—including customized answer files and WDS support for scripting and hardware tools—that can help simplify and accelerate Windows Server 2008 deployments.

EVOLUTION OF WINDOWS MASS DEPLOYMENT

WDS is the latest in a line of Microsoft mass deployment tools that has previously included Remote Installation Services (RIS), introduced in Windows 2000 and refined for Windows Server 2003, and Automated Deployment Services (ADS), introduced later for Windows Server 2003. While WDS does not incorporate every feature of both RIS and ADS, it replaces them as the simple, supported deployment tool at no additional cost, and can be very effective in this role for Windows Vista and Windows Server 2008 deployments. (For more information on the differences between RIS, ADS, and WDS for previous Windows operating systems, see the "Comparing RIS and ADS with WDS for legacy OS deployments" sidebar in this article.) Figure 1 shows the WDS graphical user interface (GUI).

WDS IN WINDOWS SERVER 2003 AND WINDOWS SERVER 2008

The Windows Server 2003 and Windows Server 2008 versions of WDS are very similar in function and features. In fact, the Windows Server 2008 version is a superset of the Windows Server 2003 version, offering additional features such as multicast support and enhanced Trivial FTP (TFTP) performance, which can help reduce the impact on networks configured to support multicast.

Multicast works in two modes: ScheduledCast and AutoCast. ScheduledCast is a timed event that only sends to those systems that are configured before the event. AutoCast functions like a normal multicast. The

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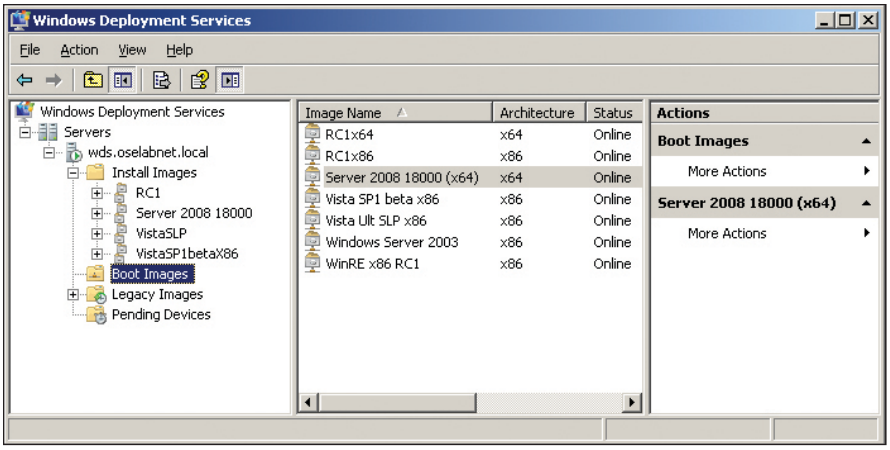

Figure 1. *Microsoft Windows Deployment Services GUI*

target systems can "subscribe" to the image as it is streaming and then keep track of the necessary bits. If the system that initiated the download stream is already 20 percent complete when a second system joins, both systems will get the same bits after that first 20 percent; then, after the first system is complete, the second system gets the 20 percent that it had missed previously. This approach helps feed many systems the same image while only utilizing the bandwidth of a single stream. The TFTP changes help improve network performance by allowing the network stack to negotiate increased time windows to communicate before an acknowledgment packet is sent.

One other difference is that the Windows Server 2008 version of WDS can automatically detect whether a target system supports 64-bit operating systems and can show those operating systems on the WDS installation list. Administrators must manually configure the Windows Server 2003 version to perform the architecture detection; otherwise, 64-bit operating systems may not be offered to that target system.

CUSTOMIZED ANSWER FILES

Customizing deployments of Windows Vista and Windows Server 2008 is far more straightforward than customizing deployments of previous OS versions. The various unattended installation answer files have been combined into a single unattend.xml file, and many more options are available than have been in the past.

A key component used to create these files, the Windows System Image Manager (SIM), is part of the Windows Automated Installation Kit (AIK) available as a complimentary download from the Microsoft Web site.[1] While its exact configuration and operation are beyond the scope of this article, the Windows SIM can be used to create detailed, customized unattend.xml files that can be applied to OS images within WDS, or can be placed on USB drives for individual use. If the unattend.xml file is applied to the image within WDS, it is applied to each installation performed with that image. Without an unattend.xml file, administrators or other IT staff would go through the normal GUI installation process; alternatively, they could put the unattend.xml file at the root of a USB drive inserted into the target system, with the system then using the configuration settings in that file.

Having a variety of configurations detailed in individual unattend.xml files allows administrators or other IT staff to choose the installation configuration and walk away, without requiring the intervention of a WDS administrator. If they can use the Windows SIM, they would have

COMPARING RIS AND ADS WITH WDS FOR LEGACY OS DEPLOYMENTS

A key difference between Remote Installation Services (RIS) and Windows Deployment Services (WDS) is that WDS deploys legacy operating systems (such as Windows Server 2003, Windows XP, and others) only as images—meaning that it functions similarly to a traditional imaging server such as Symantec Ghost. Automated Deployment Services (ADS) works similarly to WDS, but uses different technology that is not supported for use with Windows Vista and Windows Server 2008.

RIS installations go through text-mode setup and the standard installation process to help ensure proper hardware detection, driver loading, and setup. WDS captures an image of a configured system and typically deploys that image much more quickly than RIS can, even if the RIS system is fully automated. RIS infrastructures are typically much more difficult to configure and maintain than WDS infrastructures, and have a reputation for being fragile because of this complexity.

RIS systems can be more efficient than WDS in environments with significant variation between systems or in environments that have many different architectures that require a large number of hardware abstraction layers and drivers. Generally, however, organizations tend to standardize on a few server types or on closely related systems, and in this type of environment, WDS is typically much more efficient than RIS because of the minimal number of Windows Server 2003 images that must be managed.

It is possible to have both RIS and WDS functioning on the same Windows Server 2003 system, making it easy to add the functionality of WDS to a fully configured RIS system. For more information on configuring a mixed-mode deployment server, visit technet2.microsoft.com/WindowsVista/en/library/9e197135-6711-4c20-bfad-fc80fc2151301033.mspx.

[1] The Windows AIK download is available at www.microsoft.com/downloads/details.aspx?FamilyID=c7d4bc6d-15f3-4284-9123-679830d629f2.

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virtually unlimited access to the available configuration options. Additional details are available from the WDS help menu and within the components of the Windows AIK.

WINDOWS PREINSTALLATION ENVIRONMENT

In versions of Windows prior to Windows Vista and Windows Server 2008, OS installation was initiated in *text-mode setup*; this setup performed disk partitioning and formatting, and enabling a system to see a disk controller that did not have a driver on the OS CD required loading a driver from a floppy disk by pressing F6 within a certain window of time. Many work-arounds were developed to support this requirement, including using virtual floppy drives and specially formatted USB drives mimicking a floppy drive.

In Windows Vista and Windows Server 2008, Microsoft has shifted to using Windows Preinstallation Environment (WinPE), which generally avoids the need for these work-arounds and helps significantly simplify installation and increase flexibility. WinPE has existed for several years through various iterations, but has not previously been as broadly available and as well supported as it is now. It is a core component of WDS, used to prepare target systems and download files onto the hard drive in the standard WDS configuration. Administrators can customize WinPE using a one-line command to inject drivers, enabling rapid support for new storage controllers or network interface cards (NICs). WinPE customization includes not only injecting drivers, but also adding scripts and applications to the image using tools available in the Windows AIK.

WinPE supports command-line scripting natively, enabling certain vendor tools to flash firmware or configure specific settings and then begin the OS installation. For example, a NIC vendor's tool might be scripted to check for a certain firmware version, flash it, and then configure it to point to a specific Internet SCSI (iSCSI) target. WinPE could then lay down an image on that iSCSI logical unit (LUN), resulting in a configured system ready to boot. Although this is a complex example, it shows some of the flexibility of an environment that supports scripting and disk provisioning tools.

The ability to map a network drive and run various tools from that drive while writing logs or other files makes WinPE incredibly flexible. Microsoft has based the official Windows disaster recovery application, Windows Recovery Environment (WinRE), on a customized version of WinPE. Dell provides a customized version of WinRE on factory-installed Windows Server 2008–based systems at no additional cost. WinRE can also be placed on WDS, so that administrators have a recovery GUI available to help them recover a failed system or restore a previous backup. WinPE can also be used to boot from a USB drive or a CD, and by default provides a command-line prompt that helps simplify mapping drives or running other applications. Administrators can use custom tools written for specific hardware to extract logs that are inaccessible when the device is in use, helping make problem isolation as simple as network booting and choosing a particular image, which would run the automated tools and copy the logs to a disk share.

A major upgrade in the Windows Server 2008 version of WinPE (2.1) compared with the Windows Vista version (2.0) is the ability of an x86 version of WinPE to deploy both x86 and x86-64 operating systems. During installation, administrators need only inject a single boot.wim file with drivers to support new hardware, rather than needing to maintain separate versions for each architecture. For more information, tips, and walk-throughs on customizing WinPE, visit the Dell Enterprise Technology Center wiki at www.delltechcenter.com/page/Windows+Server+2008.

FLEXIBLE ONE-TO-MANY DEPLOYMENTS

Windows Deployment Services represents a substantial improvement over the previous mass deployment tools included (or provided as a complimentary download) with Microsoft Windows operating systems. It can support a large number of systems, and in Windows Server 2008 it can support a large number of simultaneous installations on an optimized network without affecting other applications.

The flexibility of WDS is evident in its ability to support legacy OS images and deploy them quickly and efficiently while providing fast, highly customizable installations for Windows Vista and Windows Server 2008. Administrators can easily customize WDS by adding modified WinPE images that can perform an enormous variety of tasks. It typically works well in lab or test environments, where installing exact configurations can be time-consuming and keeping track of media can be a challenge. WDS is one of the most accessible mass deployment tools ever produced by Microsoft, and can help fill the deployment requirements of organizations of all sizes, from those who need to deploy only a few servers to those with large data centers requiring a significant investment in a managed systems architecture.

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Microsoft Windows Deployment Services:
www.microsoft.com/windowsserver2008/deployment/services.mspx

Dell Enterprise Technology Center wiki:
www.delltechcenter.com/page/Windows+Server+2008

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USING THE MICROSOFT WINDOWS SERVER 2008 SERVER CORE INSTALLATION OPTION

By Peter Tsai
Barun Chaudhary
Steven Grigsby
Joseph Rojas

The Microsoft® Windows Server® 2008 OS offers an alternative Server Core installation option that creates a minimal environment for specific server functionality. Although this installation option can present challenges when upgrading Dell™ PowerEdge™ servers, administrators can use native tools and the Dell OpenManage™ suite to help customize Server Core installations for optimum performance.

Related Categories:
Dell OpenManage
Dell PowerEdge servers
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The number of network nodes continues to grow worldwide, creating complex IT environments that are increasingly challenging to manage efficiently while maintaining security. In an effort to meet these challenges, enterprises continue to look for simple, cost-effective ways to streamline IT infrastructures and optimize operations performed routinely on dedicated servers.

To help organizations meet these goals, Microsoft has developed a scaled-down, secure Server Core installation option in Windows Server 2008. This option helps increase efficiency by providing a minimal OS environment designed for running specific server roles and features. The reduced feature set available in Server Core installations helps lower the overhead typical of full OS installations and helps avoid the need to install or maintain extraneous OS components and services. By providing a streamlined OS installation footprint, Server Core installations can help free administrators' time to enable them to focus on more critical enterprise tasks than routine server administration.

Integrating systems running Server Core installations and the Dell OpenManage suite can give administrators an efficient way to deploy and manage server resources. In addition, by helping reduce the overhead associated with maintaining additional components in a full Windows Server 2008 installation, administrators can use a combination of OS-native tools and Dell OpenManage to deploy images quickly for Dell PowerEdge servers.

SERVER CORE INSTALLATION ADVANTAGES AND LIMITATIONS

In contrast to a full Windows Server 2008 installation, the Server Core option installs only the essential OS components required to manage specific server roles and features. Reducing the number of OS components not only helps minimize maintenance requirements, but can also help reduce the number of potential attack points typical of a full installation. Because administrators can configure Dell PowerEdge servers with only relevant components for dedicated roles, a Server Core installation typically requires only one-third of the disk space of a full Windows Server 2008 installation, and typically boots more quickly than a full installation.

However, Server Core installations can present challenges for administrators maintaining enterprise systems, including the intrinsic limitation that the installed OS supports only selected server roles and features. The Server Core installation option does not provide a traditional graphical user interface (GUI), which can diminish ease of use and require in-depth knowledge of command-line tools and scripting. However, when properly configured,

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	Minimum	Recommended
Processor speed	1 GHz for x86 processors, or 1.4 GHz for x86-64 processors	2 GHz or faster
Memory	512 MB	2 GB or more*
Available disk space	10 GB	40 GB or more**

*On 32-bit systems, Windows Server 2008 Standard Edition supports a maximum of 4 GB of RAM, while Windows Server 2008 Enterprise Edition and Datacenter Edition support a maximum of 64 GB of RAM. On 64-bit systems, Windows Server 2008 Standard x64 Edition supports a maximum of 32 GB of RAM, while Windows Server 2008 Enterprise x64 Edition and Datacenter x64 Edition as well as Windows Server 2008 for Itanium-Based Systems support a maximum of 2 TB of RAM.

**Systems with more than 16 GB of RAM typically require additional disk space for paging, hibernation, and dump files.

Figure 1. *Microsoft Windows Server 2008 hardware requirements*

administrators can use a terminal server connection or the Microsoft Management Console (MMC) to remotely manage Server Core installations.

Server Core installations also do not support the Microsoft Windows® Explorer shell or Microsoft .NET Framework, and must be installed as a clean installation—administrators cannot upgrade a legacy OS or a full Windows Server 2008 installation to a Server Core installation, or vice versa. In addition, administrators cannot directly run the Microsoft Active Directory® Installation wizard (dcpromo.exe) to install or remove domain controllers. Administrators must run an unattend.xml file with the dcpromo.exe file to install, configure, or remove the domain controller role.

SERVER CORE INSTALLATION REQUIREMENTS AND PROCESS

Server Core installations provide a subset of roles and features available in full Windows Server 2008 installations, and the installation requirements for Server Core installations are the same as those for full Windows Server 2008 installations (see Figure 1). The setup.exe file enforces the RAM and disk space requirements during the installation process, but not the processor speed.

Both full Windows Server 2008 installations and Server Core installations support attended and unattended installation processes. Administrators performing attended installations must select "Windows Server 2008 (Server Core Installation)" on the "Select the operating system you want to install" screen to begin the installation. The installation should proceed in the same manner as selecting the "Windows Server 2008 (Full Installation)" option. They can also use the Dell Systems Build and Update Utility to help simplify attended installations by installing nonnative drivers and setting up RAID volumes.

Administrators can perform unattended Server Core installations from the Windows Server 2008 media using an unattend.xml file stored on a floppy disk or USB drive. In addition, they can deploy a Server Core installation over a network using Microsoft Windows Deployment Services (WDS) with an unattend.xml file, or by browsing to a network share that contains a Windows Server 2008 installation disk and then running the command `setup.exe /unattend:unattend.xml`.

The Server Core installation option supports a minimal set of roles and features that is a subset of the roles and features available in full Windows Server 2008 installations. After installation with the default options is complete, administrators can install available server roles depending on their OS version, as shown in Figure 2. Server Core installations also support several optional Windows Server 2008

	Windows Server 2008 Standard Edition	Windows Server 2008 Enterprise Edition	Windows Server 2008 Datacenter Edition	Windows Server 2008 Web Edition	Windows Server 2008 for Itanium-Based Servers
Web services (Microsoft Internet Information Services)*	▲	▲	▲	▲	✖
Print services	■	■	■	✖	✖
Hyper-V	■	■	■	✖	✖
Active Directory domain services	■	■	■	✖	✖
Active Directory lightweight directory services	■	■	■	✖	✖
DHCP server	■	■	■	✖	✖
DNS server	■	■	■	✖	✖
File services	▲	■	■	✖	✖

*ASP.NET is not available with the Server Core installation option in any edition.

■ = Full availability ▲ = Partial/limited availability ✖ = Not available

Source: www.microsoft.com/windowsserver2008/en/us/compare-core-installation.aspx.

Figure 2. *Server roles available in different Microsoft Windows Server 2008 editions*

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features, which administrators can install using either the command line or an unattend.xml file: failover clustering, Microsoft Network Load Balancing, subsystems for UNIX® OS–based applications, Windows Backup, Microsoft Multipath I/O (MPIO), Removable Storage Manager (RSM), Windows BitLocker™ Drive Encryption, Simple Network Management Protocol (SNMP), Windows Internet Naming Service (WINS), the Telnet client, and Quality of Service (QoS).

SERVER CORE INSTALLATION MANAGEMENT AND CONFIGURATION

After completing a Server Core installation, administrators can use local command-line tools or remote tools to manage and configure Dell PowerEdge servers. Server Core installations do not include GUI tools, but administrators can use command-line tools, the MMC, or Windows Remote Management (WinRM) for management and configuration.

Using command-line tools

To remotely manage and configure systems running Server Core installations, administrators can begin by logging in to the local console. From a command prompt, they can then enable Microsoft Remote Desktop for Administration using the following command:

```
cscript C:\Windows\System32\
  scregedit.wsf /ar 0
```

Figure 3 provides a list of commands that administrators can use for common setup and configuration tasks.

Using the Microsoft Management Console

Administrators also have the option of remotely managing and configuring servers set up with a Server Core installation through the MMC. To begin, administrators can use the following command to configure the firewall, which must be completed first to allow the system to be administered remotely:

```
netsh advfirewall firewall set
  rule group="remote
  administration" new enable=yes
```

In addition, administrators can configure the firewall to allow connections to only specific MMC snap-ins by using the following command, where *rulegroup* corresponds to one of the options listed in Figure 4:

```
netsh advfirewall firewall set
  rule group="rulegroup" new
  enable=yes
```

After configuring the Windows Firewall to enable remote management, administrators can use the MMC from another system to connect to a server running a Server Core installation.

Using Windows Remote Management

WinRM is the Microsoft implementation of the WS-Management protocol, a standard Simple Object Access Protocol (SOAP)–based protocol that allows hardware and operating systems from different vendors to interoperate and enables administrators to remotely execute command-line tools and scripts.[1] It is installed by default on Windows Server 2008, but no WinRM listener is configured. Administrators can configure the default listener on a system running a Server Core installation by executing the `winrm quickconfig` command from a command prompt.

In addition to the WinRM command-line tool, administrators can use WinRM

Command	Setup or configuration task
netdom.exe	Join a domain
dcpromo.exe	Promote server to domain controller
netsh.exe	Configure network settings and firewall
sc.exe	Manage services in the Microsoft service control manager
oclist.exe	List available optional components
ocsetup.exe	Install optional roles and features
shutdown.exe	Shut down or reboot the system
scregedit.wsf	Run a script for making changes to the registry

Figure 3. *Example commands for setting up and configuring systems running Microsoft Windows Server 2008 Server Core installations*

MMC snap-in	Rule group
Event Viewer	remote event log management
Services	remote services management
Shared Folders	file and printer sharing
Task Scheduler	remote scheduled tasks management
Disk Management	remote volume management
Windows Firewall with Advanced Security	windows firewall remote management

Figure 4. *Rule group options to configure a firewall for connections to MMC snap-ins*

[1] For more information on using WinRM, visit msdn2.microsoft.com/en-us/library/aa384372.aspx.

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scripting objects and the Windows Remote Shell command-line tool (winrs.exe) to manage remote Server Core installations. On a remote system running a Windows OS, administrators can use the winrs.exe file to execute commands using the syntax `winrs -r:servername command`. Both the client system and the system running the Server Core installation must be members of the same domain when using this command syntax.

INTEGRATED MANAGEMENT USING DELL OPENMANAGE

The Dell OpenManage suite provides a comprehensive set of standards-based tools that can automate OS deployment, instrumentation, and management. Version 5.4 is the first Dell OpenManage version to support Windows Server 2008 deployment—version 5.3 supports management only—and its tools are combined onto a single bootable Dell Systems Management Tools and Documentation DVD. Dell OpenManage includes three components:

- The Dell Systems Build and Update Utility for installing and deploying an OS
- Managed System Node for installing Dell OpenManage Server Administrator (OMSA), the hardware instrumentation and Web-based console for local and remote one-to-one management of Dell PowerEdge servers
- Dell OpenManage Management Station for installing remote administration tools and consoles, including Dell OpenManage IT Assistant for one-to-many management of Dell PowerEdge servers

Deploying Windows Server 2008

After booting the Dell Systems Management Tools and Documentation DVD, the Dell Systems Build and Update Utility launches, which administrators can use to start the Server OS Installation wizard, set the system date and time, and select Windows Server 2008 for installation. This wizard also allows administrators to configure hard disks and RAID volumes.

The Server OS Installation wizard configures and formats the disks and begins copying files from the systems management tools and documentation media to the system volumes. The wizard can automatically determine the system's model, scan its devices, and copy updated drivers to the hard disk. Before completion, the wizard prompts for a reboot and requests that the Windows Server 2008 media be inserted to launch the native Windows Server 2008 setup and replace in-box drivers updated by running the wizard.

The key advantage of using the Dell Systems Management Tools and Documentation DVD when installing an OS on Dell PowerEdge servers is automatic injection of the updated drivers during installation. Administrators typically do not need to install additional drivers after the OS setup is complete.

Configuring the firewall

Additional configuration of the Windows Firewall is required to enable remote systems management using Dell OpenManage tools. The easiest method is typically to launch the MMC console on a client system, then add the Windows Firewall with Advanced Features snap-in, which allows administrators to set up rules to open the necessary ports. For a list of these ports, see Figure A in the supplemental online section of this article, available at DELL.COM/PowerSolutions.

Checking prerequisites

To install Dell OpenManage, administrators should first run a prerequisite check from the command prompt. The prerequisite checker program scans the system for drivers and services that Dell OpenManage requires, and writes the output to an omprereq.htm file in the %TEMP% folder. Administrators can copy the output file to another system for inspection. OMSA and Dell OpenManage Management Station on the Dell Systems Management Tools and Documentation media have separate prerequisite checkers. The OMSA prerequisite checker program is in the SYSMGMT\srvadmin\windows\prereqchecker folder, and the Management Station prerequisite checker program is in the SYSMGMT\ManagementStation\windows\prereqchecker folder.

The command to launch the prerequisite check for both OMSA and Management Station is the same. Administrators can use the `/s` switch to force the prerequisite check to run in silent mode using the command `runprereqchecks.exe /s`.

Managing systems remotely

Installing OMSA installs the hardware instrumentation and the Web server on the managed server, which administrators can then remotely manage by either connecting to the Web server or using Dell OpenManage IT Assistant. On Dell PowerEdge servers running a full Windows Server 2008 installation, administrators can launch the OMSA console locally; however, because a Web browser is not available on PowerEdge servers running a Server Core installation, on those systems they must connect to OMSA remotely.

Administrators can install OMSA on PowerEdge servers running a Server Core installation by running the sysmgmt.msi package from the command line. This package is included on the Dell Systems Management Tools and Documentation DVD in its SYSMGMT\srvadmin\windows\SystemsManagement folder. After navigating to this folder, administrators can install OMSA using the command `msiexec /i sysmgmt.msi`.

After completing the installation, administrators can test it by using a Web browser on another system on the network to connect to the system by entering the URL https://*ipaddress*:1311. For this test to work, the Windows Firewall must be configured to allow incoming connections on port 1311.

Installing Dell OpenManage Management Station

Installing Dell OpenManage Management Station on a Dell PowerEdge server

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running a Server Core installation installs the Dell Remote Access Controller (DRAC) and baseboard management controller (BMC) tools as well as the Microsoft Active Directory snap-in. Dell OpenManage IT Assistant is not supported on Server Core installations because a Web browser is not available; however, administrators can install Dell OpenManage IT Assistant on a remote system and use it to manage PowerEdge servers running a Server Core installation and using OMSA instrumentation.

Administrators can install Dell OpenManage Management Station on PowerEdge servers running a Server Core installation by running the mgmtst.msi package from the command line. This installation package is included on the Dell Systems Management Tools and Documentation DVD in the SYSMGMT\ManagementStation\windows\ManagementStation folder. After navigating to this folder, administrators can install the software using the command `msiexec /i mgmtst.msi`.

STREAMLINED OS FOR DEDICATED SERVERS

Microsoft designed the Windows Server 2008 Server Core installation option to provide a minimal environment for running specific OS server roles and features. Using this option can be beneficial for enterprises using PowerEdge servers to perform dedicated tasks in a domain environment. In addition to administrators managing PowerEdge servers dedicated to Active Directory, Dynamic Host Configuration Protocol (DHCP), Domain Name System (DNS), file and print services, and streaming media services, developers of network and file service infrastructures, developers of server management tools and utilities, and enterprise IT planners and designers may find the Server Core installation option useful. Using both native OS tools and Dell OpenManage to efficiently deploy and manage Server Core installations can help ease the management, configuration, and instrumentation of dedicated servers in medium and large enterprises.

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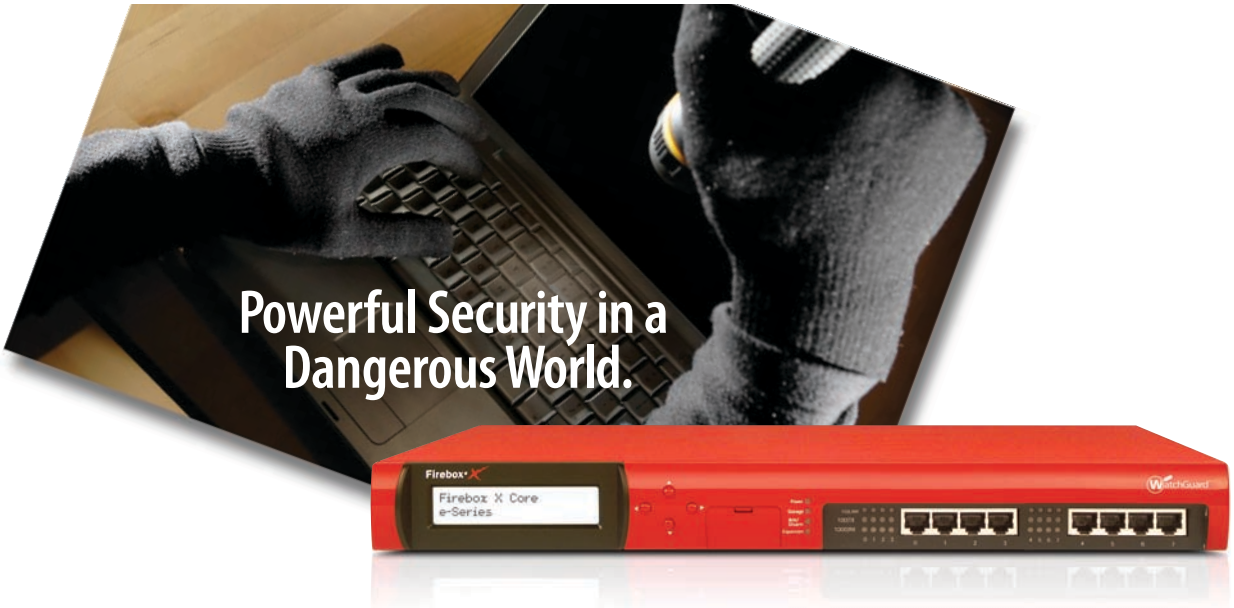

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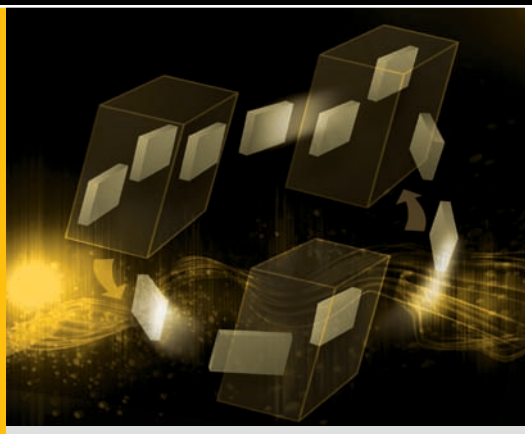

INSTALLING MICROSOFT WINDOWS SERVER 2008 DRIVERS ON DELL POWEREDGE SERVERS

By David Troeger
Weijia (John) Zhang, Ph.D.

Upgrading Dell™ PowerEdge™ servers to the Microsoft® Windows Server® 2008 OS also typically requires selecting, installing, and troubleshooting device drivers. Using tested and validated drivers and following best practices can help administrators ensure optimal performance in their environments.

Related Categories:

Dell OpenManage
Dell PowerEdge servers
Device drivers
Microsoft
Microsoft Windows Server 2008
Operating system deployment
Operating system migration

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A fundamental challenge for successfully installing Microsoft Windows Server 2008 on Dell PowerEdge servers is locating and installing optimal device drivers for the system. Device drivers—the software components that act as the essential glue for binding the server environment to an OS—are available in two types: those available in the OS are known as in-box drivers, while those not available in the OS are known as out-of-box drivers.

Administrators can choose from several methods when installing Windows Server 2008 device drivers, and from several sources for obtaining drivers that are not native to the OS. In addition, administrators need to be aware of symptoms caused by unsuccessful installations and the resolutions for fixing or working around errors that may occur. Recognizing the differences between both types of drivers, the methods available for planning driver upgrades, the priorities necessary to assess system needs, and the processes for troubleshooting unexpected results can help ensure a successful installation of drivers when upgrading PowerEdge servers to Windows Server 2008.

OBTAINING IN-BOX AND OUT-OF-BOX DRIVERS

Administrators responsible for maintaining environments employing PowerEdge servers may find that the device drivers they need are already available in Windows Server 2008. The availability of these in-box drivers helps provide a seamless experience from OS installation to first use of the system. However, in some cases recent out-of-box drivers may also become available, and these drivers can contain updates or fixes that help increase the performance of systems running Windows Server 2008. In addition, although default in-box drivers support many devices, out-of-box versions can offer advanced features and extended management capabilities.

Dell typically factory installs the latest available in-box and out-of-box drivers on PowerEdge servers. Administrators can also take advantage of the following resources available for locating and accessing device drivers:

- **Dell Web site:** Administrators can visit DELL.COM to see recent PowerEdge server releases available with Dell factory-installed operating systems, which contain updated in-box and out-of-box drivers for servers.
- **Dell support Web site:** The Dell support Web site at support.dell.com is routinely updated with the latest drivers for PowerEdge servers. Figure 1 illustrates the process for locating and downloading drivers on this site.
- **Dell OpenManage™ Systems Management CD:** In addition to systems management tools and documentation, this CD contains a set of device drivers that support PowerEdge servers. It also contains

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a device driver extraction tool that allows administrators to obtain drivers based on custom filters.

- **Vendor Web sites:** Vendor Web sites often have resources that can be helpful for some devices, such as tape storage systems. Frequently, vendors provide advanced management tools for the device drivers they support.

The Dell support Web site organizes device drivers into component-level groups. These categories help administrators not only identify specific device drivers, but also determine priority when considering an upgrade. For example, chipset, storage, and network device drivers may require frequent attention because they can be critical for the system to function properly. Other types such as drivers for audio and communication (modem) devices may be less important, depending on the environment, but can be helpful to address specific needs. Figure 2 lists some of the primary categories Dell uses to organize device drivers.

When identifying an out-of-box driver, administrators can evaluate whether to apply the update depending on the importance level—urgent, recommended, or optional—assigned to each driver download. The importance level is based on the following guidelines:

- **Urgent:** Dell highly recommends applying urgent driver updates as soon as possible; these updates typically contain changes to enhance server reliability and availability. Administrators can evaluate the update to determine the feasibility of changes for a specific environment.
- **Recommended:** Dell recommends applying recommended driver updates during the next scheduled update cycle; these updates typically contain feature enhancements or changes to help keep PowerEdge system software current and compatible with other modules such as firmware, BIOS, other drivers, and software.
- **Optional:** Dell recommends that administrators review specifics about an optional driver update to determine applicability to specific systems. These updates typically contain changes that affect only certain configurations or provide new features that may or may not apply to a specific environment.

For systems running 24/7, evaluating whether a device driver update is necessary can be critical to help avoid unnecessary problems.

INSTALLING AND TROUBLESHOOTING DRIVERS

After locating appropriate device drivers for a system, administrators can choose from several methods to install them. The method chosen for any driver depends on the needs of a specific environment:

- **Windows Server 2008 Load Driver option:** This option is typically best suited for RAID controller drivers during OS installation.
- **Dell OpenManage Systems Management CD:** Administrators can use this CD to install updated and optimal Dell-supported drivers when installing an OS. The Dell OpenManage software also provides self-extracting packages to update drivers directly.
- **Third-party customized deployment tool:** Third-party tools can be particularly useful when performing one-to-many OS installations.
- **Windows Server 2008 Device Manager snap-in:** This utility is typically best suited for installing driver updates that are not critical for OS installation. Devices that are missing drivers display a yellow exclamation point in this utility.
- **Windows Server 2008 driver autosearch feature:** Administrators can use this feature to install out-of-box drivers when performing an unattended installation of device drivers during OS installation.

Dell employs a rigorous process to develop and release device drivers that

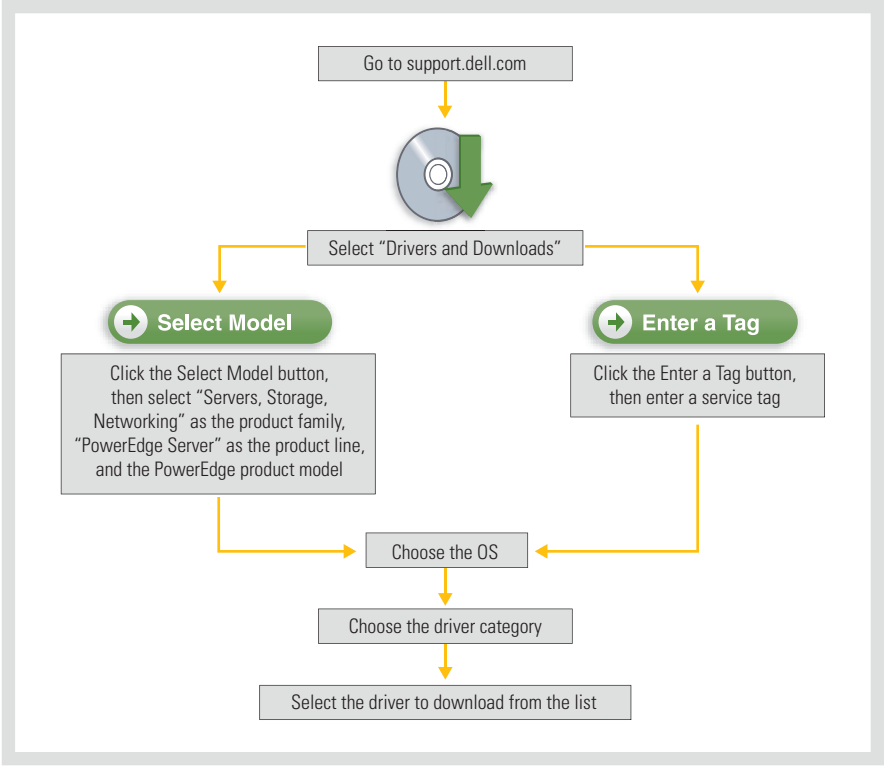

Figure 1. *Process for locating and downloading device drivers on the Dell support Web site*

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Driver or device category	Device support
Audio	Although audio devices generally are not used in PowerEdge servers, these out-of-box device drivers are available in case an audio device is installed.
CD/DVD	Although default drivers for CD and DVD drives generally are available in Microsoft Windows® operating systems, out-of-box drivers can be useful for special optical drives that may require fixes.
Chipset	Although chipset drivers are generally available as in-box drivers, these out-of-box drivers can be critical to help system devices and motherboards function properly. Administrators may need to frequently evaluate drivers for these devices.
Communication	These out-of-box drivers are for modem devices.
Fibre Channel	These drivers are only needed when a PowerEdge server is connected to a Dell PowerVault™ storage device.
Network	Although drivers for network adapters include in-box drivers for network interface cards, out-of-box driver updates often provide additional features and bug fixes.
SAS RAID Controller	Serial Attached SCSI (SAS) RAID drivers generally are available for recent platforms that support SAS-based disk drives. This category includes drivers for the SAS-based PowerEdge Expandable RAID Controller (PERC) 5, PERC 6, and so on.
SAS Non-RAID Controller	These drivers are for SAS devices in non-RAID mode.
SCSI Non-RAID Controllers	These drivers are available for legacy SCSI devices.
SCSI RAID Controllers	These legacy storage drivers are available for SCSI RAID controllers.
Tape Backup	Although these drivers are available for tape devices, many third-party vendors also provide drivers for these devices that include additional management features.
Video	Although Windows Server 2008 provides in-box drivers for default VGA devices, device-specific, out-of-box drivers can enhance graphics and display quality.

Figure 2. *Example Dell categories for out-of-box device drivers*

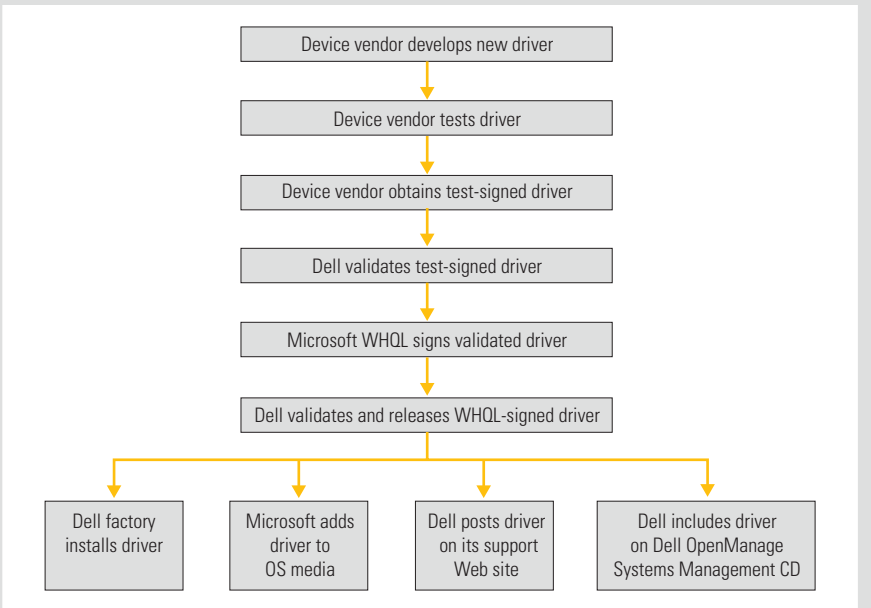

Figure 3. *Life cycle for developing, testing, validating, and releasing device drivers*

can optimize the performance of PowerEdge servers. Driver releases for Windows Server 2008 are usually Windows Hardware Quality Labs (WHQL) signed and have typically been tested and validated by both Dell and Microsoft (see Figure 3). Despite these processes and proper evaluation and planning of driver installation, however, errors can occur. In the event that driver installation does not go as planned, administrators can use Figure A in the supplemental online-only section of this article, available at DELL.COM/PowerSolutions, to help them resolve or work around typical problems.

PLANNING SUCCESSFUL DEVICE DRIVER INSTALLATIONS

Device drivers are an essential part of IT environments, and administrators have multiple methods at their disposal for locating and installing them. By installing the appropriate in-box or out-of-box device drivers and following the best practices outlined in this article, administrators can help ensure that their Dell PowerEdge servers continue to perform optimally after upgrading to Microsoft Windows Server 2008.

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HIGH-AVAILABILITY CLUSTERING IN MICROSOFT WINDOWS SERVER 2008

By Nam Nguyen
Shabana M.
Biraja Ashis Deo

Cluster environments enable multiple systems to provide higher availability for applications and services than a single system can typically provide. The Microsoft® Windows Server® 2008 OS introduces multiple enhancements designed to increase the availability, scalability, and manageability of failover clusters.

Related Categories:
Cluster management
High availability (HA)
Microsoft
Microsoft Windows Server 2008
Operating system migration
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As system uptime becomes increasingly important for critical operations, many enterprises are turning to cluster configurations for handling increased workload and availability requirements. Clustering enables multiple systems to work together to deliver high availability, scalability, and manageability and facilitates organization-wide consolidation of servers, storage, and IT staff.

Deploying clusters of Dell™ PowerEdge™ servers running the Microsoft Windows Server 2008 OS offers multiple advantages in enterprise environments:

- **High availability:** Failover clusters help minimize downtime. When a software or hardware failure occurs on one node, applications or services on that node can fail over to other nodes in the cluster and restart there, typically with only a slight delay or momentary decrease in performance for client systems. Windows Server 2008 is designed to provide higher availability than previous OS versions by removing the quorum disk as a single point of failure.
- **Outstanding scalability:** Microsoft clustering technologies advance scale-out capabilities by allowing up to 16 nodes per cluster—enabling more efficient use of storage systems and storage area networks than was possible with the 8 nodes supported in Windows Server 2003. When the cluster has reached its workload capacity, administrators can add nodes to the cluster and then redistribute load-balancing application instances to the newly added nodes.
- **Simple management:** Managing a cluster rather than each system individually helps simplify administration. In addition, virtual servers ease management by providing a single point of administration for the cluster resources, and because client applications connect to these virtual servers, cluster-aware applications can reconnect without manual intervention.

This article outlines the basics of failover clustering in Windows Server 2008 as well as key feature enhancements, which include simplified setup and migration; enhanced management; increased availability, scalability, and reliability; and enhanced networking and security. Enterprises can take advantage of tested and integrated Dell clustering solutions built on standards-based Dell servers and storage to further simplify deployment and help maintain the availability of critical enterprise applications and services.

HIGH AVAILABILITY WITH MICROSOFT CLUSTER SERVICE

Microsoft Cluster Service (MSCS), a component of Windows Server 2008 Enterprise Edition and Datacenter Edition, allows virtual servers to fail over between physical servers running the cluster service. Client systems connect to the IP address of the virtual

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server, and are then directed to the physical server node that currently owns the clustered application or service (see Figure 1); the clients are unaware of which physical server they are connected to. If a software or hardware failure occurs, the application or service can restart on the same physical server. If the application or service fails to restart on the same physical server, the cluster resource group containing the virtual server and the application or service fails over to another physical server. Clients connected to that virtual server typically can reconnect and resume access to the application or service with just a momentary disruption.

Multiple virtual servers can run in a single cluster. In an active/active or active^{n} cluster (where *n* is the number of active nodes), each node owns at least one virtual server. In an active/passive or *N* + *I* cluster (where *N* and *I* are the numbers of active and passive nodes, respectively), at least one cluster node does not own a virtual server and functions as the backup for the active cluster nodes.

Although a single MSCS cluster can support multiple applications or multiple instances of a single application, each application or application instance accesses a separate data set. An MSCS cluster provides application failover, but does not load balance a single application instance across multiple servers. Administrators can also initiate failover manually, which they might do when performing routine maintenance on cluster nodes.

WINDOWS SERVER 2008 CLUSTERING ENHANCEMENTS

Windows Server 2008 introduces multiple enhancements to cluster setup, migration, management, and other features to help increase availability, reliability, and manageability. Administrators should also be aware of two key changes in cluster installation options: the Validate a Configuration Wizard and the Server Core installation option.

Before configuring a cluster, administrators can run the Validate a Configuration wizard to help determine whether the configuration can work in the cluster environment. The tests in this wizard are designed to verify that the configuration meets specific hardware and software requirements for clustering and that the network and storage can properly support cluster operations. Microsoft does not require that cluster configurations have the "Certified for Windows Server 2008" logo and be listed in the Windows Server Catalog to qualify for Microsoft support, but configurations must pass all tests in this wizard. Administrators should also visit DELL.COM/HA for configurations and component revisions that have been tested and validated by Dell.

The Server Core installation option in Windows Server 2008, which provides a minimal environment for running specific server roles and helps reduce management requirements and potential points of attack, also supports failover clustering. Administrators can manage Server Core installations through the command-line interface or from a remote management station.[1]

Simplified cluster setup and migration

Windows Server 2008 incorporates several wizards designed to simplify the process of creating a new cluster or migrating resource groups from a cluster running Windows Server 2003 to one running Windows Server 2008. The Create Cluster wizard has streamlined, easy-to-follow steps to allow administrators to create a new cluster quickly and easily (see Figure 2). The High Availability wizard can automatically create resources for a high-availability service or application with the correct dependencies. The setup process is fully scriptable for automatic deployment.

The Migrate a Cluster wizard is designed to migrate resource groups from a cluster running Windows Server 2003 to one running Windows Server 2008. It helps capture certain resource group settings from the Windows Server 2003 cluster and apply them to a new Windows Server 2008 cluster (see Figure 3).[2]

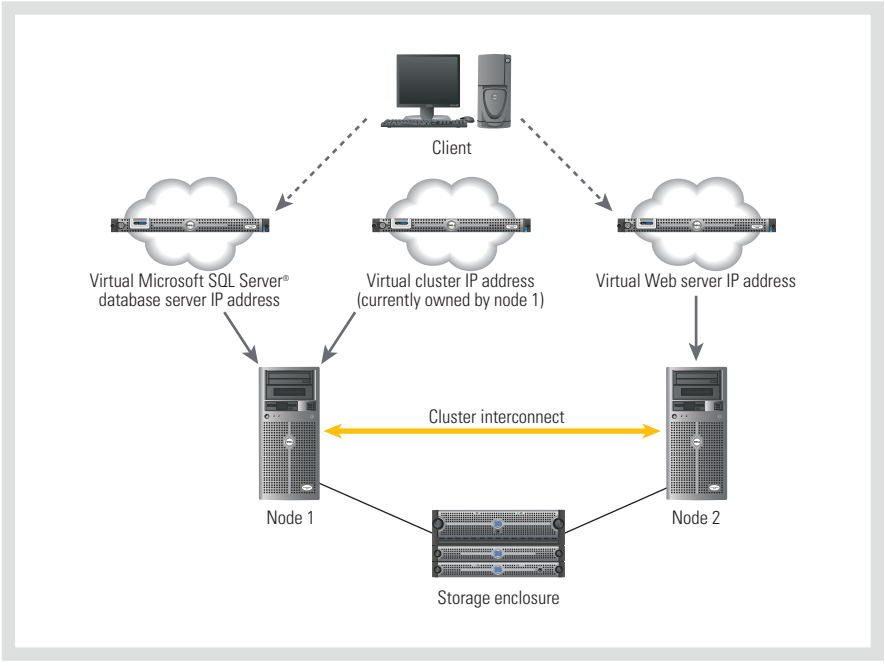

Figure 1. *Example active/active cluster using Microsoft Cluster Service*

[1] For more information, see "Using the Microsoft Windows Server 2008 Server Core Installation Option," by Peter Tsai, Barun Chaudhary, Steven Grigsby, and Joseph Rojas, in *Dell Power Solutions*, May 2008, DELL.COM/Downloads/Global/Power/ps2q08-20070611-Tsai.pdf.

[2] For more information, see "Migrating Failover Clusters to Microsoft Windows Server 2008 on Dell PowerEdge Servers," by Bhushan Gavankar, Subhashini Prem, and Daniel Moges, in *Dell Power Solutions*, May 2008, DELL.COM/Downloads/Global/Power/ps2q08-20080224-Gavankar.pdf.

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Enhanced cluster management

The Windows Server 2008 cluster management interface is designed to be simpler and more intuitive than previous versions. Administrators can use this interface to manage their high-availability applications rather than just the cluster itself, and can perform additional tasks using the command-line interface or Windows Management Instrumentation (WMI).

Backup and restore and troubleshooting functionality have also been simplified. Windows Server 2008 failover clustering includes comprehensive integration with Microsoft Volume Shadow Copy Service (VSS) to help administrators back up and restore cluster configurations. The Event Tracing feature, meanwhile, enables administrators to quickly gather a sequence of events across cluster nodes in a single location, helping avoid the need to review individual cluster logs or system event logs to determine an event sequence during troubleshooting.

Increased availability, scalability, and reliability

Windows Server 2008 failover clustering introduces multiple enhancements to help increase cluster availability, scalability, and stability, including support for additional cluster nodes, new quorum models, online modifications to cluster resource groups, and new methods for reserving a disk and breaking a reservation.

Administrators can now create clusters of up to 16 nodes (increased from 8 in Windows Server 2003), enabling clusters to handle multiple server failures and offering administrators additional options when deploying applications and configuring failover polices that can meet enterprise requirements. In addition, Windows Server 2008 introduces new quorum models to help eliminate the quorum disk as a single point of failure. In the node and disk majority quorum model, for example, the cluster configuration is stored on the shared witness disk and replicated among nodes, allowing the cluster to function even if the witness disk fails. The node and file share majority quorum model—an enhancement to the Windows Server 2003 majority node set model—enables the deployment of geographically dispersed clusters across multiple sites to support disaster recovery. A primary site failure with a Windows Server 2003 majority node set cluster typically required manual intervention to bring the resources at the secondary site online, whereas using a file share located at a third site as a witness can allow this process to become automatic.

To help increase cluster scalability and flexibility, Windows Server 2008 clusters allow administrators to add resources to a group or modify dependencies among resources while the group is online. Administrators can add resources such as physical disks to a resource group without interrupting applications or services.

To enhance cluster reliability, Windows Server 2008 uses persistent reservation commands to reserve cluster shared disks and break disk reservations during cluster arbitration. This method enables load balancing among the paths in multipath storage devices and helps avoid using logical unit (LUN) or target resets—a disruptive approach for breaking disk reservations used in Windows Server 2003. Some Windows Server 2003 Microsoft Multipath I/O device-specific modules translate RESERVE (6),

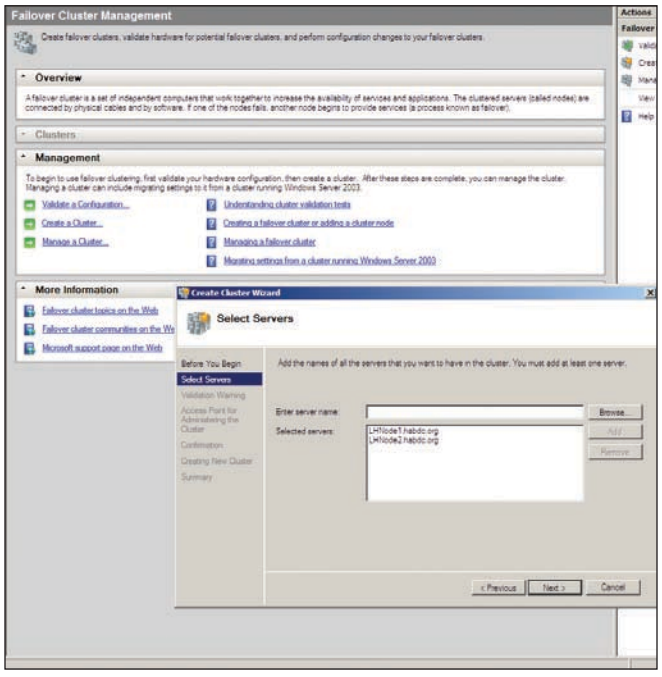

Figure 2. *Microsoft Windows Server 2008 Create Cluster wizard*

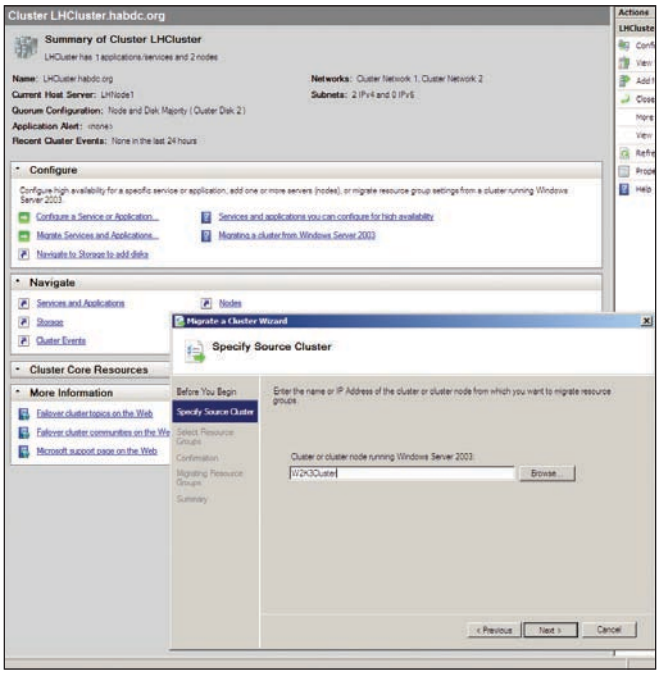

Figure 3. *Microsoft Windows Server 2008 Migrate a Cluster wizard*

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RELEASE (6), and RESET commands to appropriate persistent reservation commands to help achieve similar results.

Other key availability, scalability, and reliability enhancements to Windows Server 2008 failover clustering include the following:

- **Support for Globally Unique Identifier (GUID) Partition Table (GPT) disks:** GPT, part of the Extensible Firmware Interface (EFI), is a standard for the layout of the partition table on a physical hard disk. GPT disks provide built-in redundancy by storing partition information at both the beginning and end of a disk and support partition sizes larger than 2 TB, helping provide increased redundancy and larger disk sizes compared with master boot record disks.
- **Enhanced maintenance mode:** Administrators can now use maintenance or extended maintenance mode to check, fix, back up, or restore cluster shared disks with minimal disruption to the cluster.
- **New resource dependency:** Administrators can now use OR operations on resource dependencies in addition to AND operations. For example, in a cluster with multiple IP address resources in the resource group, the group can be online if any of the IP addresses are online.
- **Multiple subnets:** Cluster nodes can now be on different IP subnets, helping increase cluster availability and simplify the process of implementing geographically dispersed clusters.

Enhanced networking and security

Windows Server 2008 failover clustering includes comprehensive support for IP version 6 (IPv6), which administrators can use for both cluster communications and client access, and support for network name resolution using only Domain Name System (DNS), which helps avoid the need to configure Microsoft Windows® Internet Naming Service (WINS) on the cluster and the need to broadcast Network BIOS (NetBIOS) in the network traffic. In addition, Windows Server 2008 clusters use TCP for communication between nodes—typically a more robust and reliable protocol than User Datagram Protocol (UDP), which is used in Windows Server 2003 clusters.

Key security features include enhanced authentication and encryption using IP security (IPsec). Administrators can also use auditing to track who has been accessing a cluster and at what specific dates and times.

DELL CLUSTERING SOLUTIONS

Dell offers highly available two-node clusters using Serial Attached SCSI (SAS) storage and running Windows Server 2008 Enterprise Edition. These clusters are well suited for file and print, messaging, or database servers for workgroups.

Dell also offers 2- to 16-node clusters of Dell PowerEdge servers based on Dell/EMC Fibre Channel storage or on Dell PowerVault™ or Dell/EMC Internet SCSI (iSCSI) storage. Cluster components are designed to be fully redundant and scalable to help meet enterprise requirements. Individual components can be repaired or replaced, and the cluster itself can be upgraded with the latest software, driver, and firmware versions while it is still online serving client systems. Administrators can connect multiple clusters and nonclustered servers to redundant fabrics, and these clusters and servers can share multiple storage systems and tape libraries. The storage systems used in these clusters offer optional advanced features such as storage mirroring or snapshot copies of disks for backup. These clusters are well suited for highly available messaging servers, database servers with large data sets, and consolidation of applications, servers, or storage.

HIGHLY AVAILABLE CLUSTERS FOR CRITICAL APPLICATIONS

The enhancements to failover clustering in Windows Server 2008 are designed to help simplify deployment, increase performance, enhance security, and promote increased uptime for clustered applications and services. Dell PowerEdge clusters running Windows Server 2008 combine the high performance, availability, scalability, and reliability features of Dell servers and storage with the powerful clustering capabilities in Windows Server 2008 to help enterprises achieve high availability for critical applications and services.

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MIGRATING FAILOVER CLUSTERS TO MICROSOFT WINDOWS SERVER 2008 ON DELL POWEREDGE SERVERS

By Bhushan Gavankar
Subhashini Prem
Daniel Moges

The Microsoft® Windows Server® 2008 OS includes significant changes to the failover clustering architecture designed to enhance flexibility and availability, but migrating a cluster from Windows Server 2003 can be challenging. Following best practices can help administrators plan and execute a smooth migration for clusters based on Dell™ PowerEdge™ servers.

Related Categories:

Clustering
Dell PowerEdge servers
High availability (HA)
Microsoft
Microsoft Windows Server 2008
Storage

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Failover clustering in Microsoft Windows Server 2008 offers significant advantages over failover clustering in Windows Server 2003, including new quorum models, simplified configuration, and other enhancements that can help increase flexibility and availability. However, like many data center tasks, migrating from a failover cluster running Microsoft Windows Server 2003 to one running Windows Server 2008 can be time-consuming and require significant advance planning. Before proceeding with a migration for clusters based on Dell PowerEdge servers, administrators should understand the potential benefits, the tools available to help them assess their cluster and plan the migration, and the possible methods they might choose to carry out the migration.

UNDERSTANDING WINDOWS SERVER 2008 FAILOVER CLUSTERING

Microsoft has made significant changes to the failover clustering architecture in Windows Server 2008 compared with Windows Server 2003, including the following:

- **New quorum models:** The Windows Server 2008 quorum models help eliminate the quorum disk as a single point of failure by enabling clusters to survive the loss of the quorum disk. The new models include a node and disk majority, node majority, disk-only majority, and node and file share majority.
- **Simplified configuration:** Failover clustering in Windows Server 2008 is designed for simplicity, security, and stability, offering streamlined, intuitive configuration and setup through an enhanced management graphical user interface.
- **Enhanced storage features:** Storage enhancements for failover clustering include a mechanism for managing shared disks designed to integrate smoothly with storage area networks. Failover clustering also now offers enhanced disk fencing with the use of persistent reservations, tightened integration with core OS disk management, and support for Globally Unique Identifier (GUID) Partition Table (GPT) to allow partition sizes greater than 2 TB.
- **Support for increased distances:** Failover clusters are no longer limited to a single subnet across nodes and now include comprehensively configurable heartbeats, enabling the use of geographically dispersed clusters over greater distances than were possible in Windows Server 2003.

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- **Increased configuration flexibility:** Qualifying for Microsoft support previously required that the entire failover cluster—including its overall configuration and individual hardware and software components—be validated by Microsoft and have the Microsoft logo. Individual hardware components in Windows Server 2008 failover clusters still must have a "Certified for Windows Server 2008" logo, but Microsoft now typically supports clusters provided they have passed the tests in the Validate a Configuration wizard (included in the failover clustering snap-in). This change offers increased flexibility and helps keep minor modifications to a cluster configuration from being disqualified for Microsoft support. Dell maintains a list of tested, recommended configuration matrices in the "Products & Services" section at DELL.COM/HA.

Administrators should also be aware of restrictions introduced in Windows Server 2008 before planning a migration. For example, failover clustering now only supports Serial Attached SCSI (SAS), Internet SCSI (iSCSI), and Fibre Channel, and no longer supports SCSI as a shared bus type—meaning organizations cannot use Dell SCSI-based enclosures such as PowerVault™ 220S and PowerVault 221S systems as shared storage. Host bus adapters must use the Storport mini-port driver, and the multipath software must be based on Microsoft Multipath I/O and/or have a Windows Server 2008 logo.[1]

PLANNING THE CLUSTER MIGRATION

Failover clusters in enterprise data centers typically host critical applications and data. Although Dell engineers have extensively validated failover clusters with Windows Server 2008 running on a variety of Dell-supported hardware, Dell strongly recommends that organizations validate their migration plan in a test lab to help identify potential problems, take corrective action, and refine migration plans.

The Dell Windows Server 2008 Readiness Advisor tool (available as a complimentary download from DELL.COM/WindowsServer2008) is designed to automate and centralize the collection, assessment, and reporting of information required to help determine system readiness for Windows Server 2008. However, administrators should keep in mind that only a subset of Dell PowerEdge servers, storage arrays, peripherals, and controllers are supported in Windows Server 2008 failover clusters.

Administrators must perform two key tasks when planning to migrate an existing failover cluster to Windows Server 2008. First, they must ensure that the hardware components—servers, controllers, storage arrays, switches, and so on—have the "Certified for Windows Server 2008" logo. Dell and its partners have worked closely with Microsoft to help ensure that hardware supported by Dell has been certified to run Windows Server 2008 and validated for failover clustering. Administrators can view a detailed list of supported components, driver and firmware versions, and so on in the "Products & Services" section at DELL.COM/HA.

Second, administrators must run all tests included in the Validate a Configuration wizard and be sure that the cluster has passed all tests. This tool runs a focused set of tests on a collection of servers to help identify potential hardware and configuration problems before they are configured as a production cluster. (*Note:* Administrators must add the failover cluster feature to access the snap-in containing this tool.)

PERFORMING THE CLUSTER MIGRATION

Administrators can use a variety of methods to migrate a cluster running Windows Server 2003 to Windows Server 2008. The following methods represent two possibilities, depending on hardware availability in the environment:

- **Create a new failover cluster and then migrate the settings from the existing cluster:** In this method, administrators install Windows Server 2008 on the nodes (servers), add the failover cluster feature, and run the Validate a Configuration wizard, then create the new failover cluster and migrate the settings from the existing cluster. Setting up a new failover cluster can allow administrators to experiment with cluster settings and help them isolate

"The architectural enhancements in Windows Server 2008 and the extensive validation work performed by Dell and its partners are designed to ease the burden on enterprise IT staff and help maintain cluster uptime. Following the best practices described in this article can help administrators plan and execute a successful migration in their environments."

[1] For more information on key changes introduced in Windows Server 2008 failover clustering, visit technet2.microsoft.com/windowsserver2008/en/library/13c0a922-6097-4f34-ac64-18820094128b1033.mspx.

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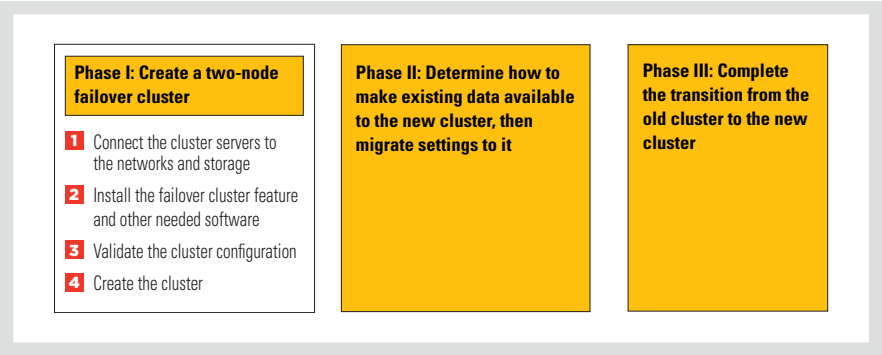

Figure 1. *Process for creating a new failover cluster and then migrating settings from an existing cluster*

potential problems before performing the migration and removing the existing cluster. This method is well suited for environments with spare hardware available, and is required when the existing cluster is based on PowerEdge servers and/or PowerVault storage systems that are not supported for Windows Server 2008 failover clustering (see Figure 1).

- **Perform an in-place migration on a two-node cluster:** In this method, administrators remove one of the servers from the existing cluster, install Windows Server 2008 on it, configure the connections, and run the Validate a Configuration wizard. They then create a single-node cluster on this server and migrate the cluster settings from the other node (running Windows Server 2003) to this new node (running Windows Server 2008). Next, they install Windows Server 2008 on the other node and run the validation tests before joining it to the first node. Finally, they bring the migrated resources online in the new Windows Server 2008 failover cluster. Provided the hardware in the existing cluster is supported for Windows Server 2008 failover clustering, this method helps minimize spare hardware requirements (see Figure 2).[2]

MIGRATING CLUSTER RESOURCES

The Migrate a Cluster wizard in the Windows Server 2008 failover clustering snap-in is designed to help migrate some types of resources from a cluster running Windows Server 2003 to one running Windows Server 2008.[3] This wizard can perform a comprehensive migration for file shares, physical disks (except the quorum disk), IP addresses (except the cluster IP address), network names (except the cluster name), and print servers.[4] It can perform a partial migration for Dynamic Host Configuration Protocol (DHCP) services, Windows Internet Naming Service (WINS) services, Distributed File System (DFS) namespaces, and generic applications, scripts, and services, and then provide guidance on the remaining steps that administrators must perform manually.

The Migrate a Cluster wizard cannot migrate e-mail servers or database applications, and it does not copy or move data during the migration. In addition, if administrators plan to use new storage in a failover cluster after migration and want to assign the same drive letters as were used in the previous cluster, they must do so manually; migrating a cluster that uses mount points also requires several additional steps.[5]

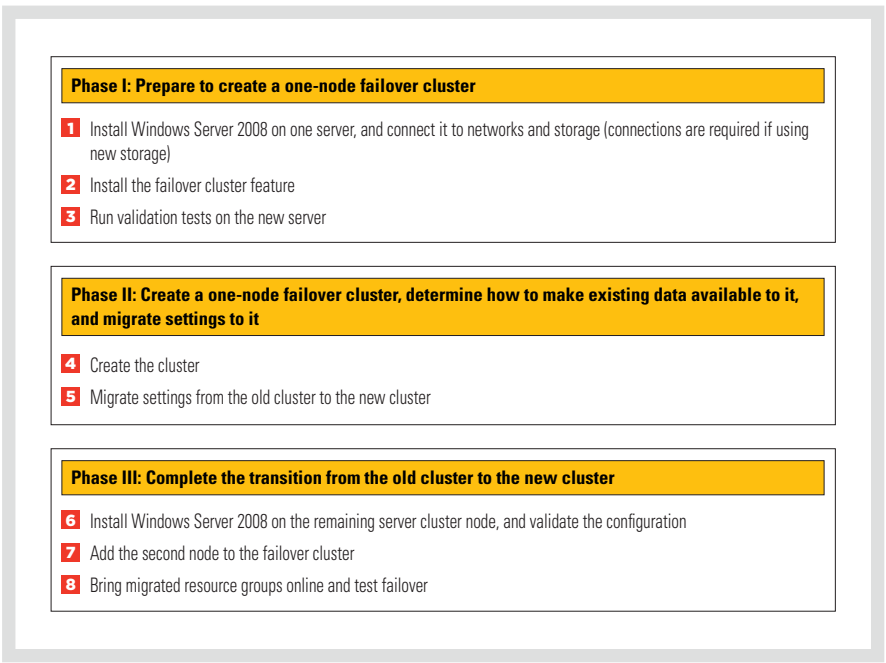

Figure 2. *Process for performing an in-place migration on a two-node cluster*

[2] For matrices of Dell-supported hardware and software, see the "Products & Services" section at DELL.COM/HA. For a detailed step-by-step guide on performing each of these types of migration, visit technet2.microsoft.com/windowsserver2008/en/library/6820ae3f-1ecc-43fd-8a76-fe8c2125cfe61033.mspx.

[3] For more information on the Migrate a Cluster wizard, visit technet2.microsoft.com/WindowsServer2008/en/library/6cb27a88-0708-4068-87cf-45b5b2b793c91033.mspx.

[4] Migrating print servers also requires the Printer Migration wizard built into the Windows Server 2008 print management snap-in. For more information on migrating print servers, visit technet2.microsoft.com/windowsserver2008/en/library/71b0e978-d1ff-47a2-b4bd-1f4d19280dbe1033.mspx.

[5] For more information on maintaining existing drive letters and labels after a migration, visit technet2.microsoft.com/WindowsServer2008/en/library/093b5270-a117-411c-be88-c6dd1afb144e1033.mspx. For more information on mount points, visit technet2.microsoft.com/WindowsServer2008/en/library/a281bc1a-344e-47c8-9ab5-f8d9b62188cc1033.mspx.

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DEPLOYING FLEXIBLE, SIMPLIFIED FAILOVER CLUSTERS

Failover clustering in Microsoft Windows Server 2008 can provide a high degree of flexibility and help simplify overall cluster management. As with any change in a data center, administrators must anticipate and plan for potential risks during the migration process, but the architectural enhancements in Windows Server 2008 and the extensive validation work performed by Dell and its partners are designed to ease the burden on enterprise IT staff and help maintain cluster uptime. Following the best practices described in this article can help administrators plan and execute a successful migration in their environments.

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Dell Windows Server 2008 Readiness Advisor tool:
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Windows Server 2008 failover clustering:
www.microsoft.com/windowsserver2008/en/us/high-availability.aspx

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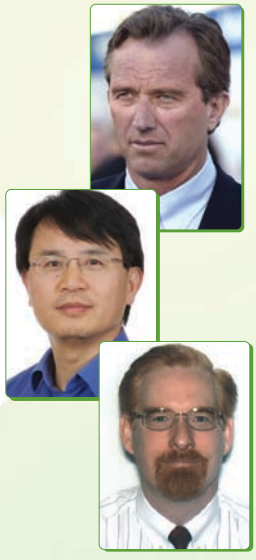

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DELL STORAGE AND COMMVAULT SIMPANA EASE ADOPTION OF MICROSOFT WINDOWS SERVER 2008

By K. E. H. Polanski

Migrating data associated with Microsoft® operating systems, applications, and other software can be a challenge administrators overlook when planning system upgrades. Dell™ PowerVault™ and Dell EqualLogic™ storage and CommVault® Simpana® data management software enable flexible data migration and transparent, release-specific data object recovery and backup to help simplify upgrades in enterprise environments.

Related Categories:

CommVault

Dell EqualLogic storage

Dell PowerVault storage

Microsoft

Microsoft Windows Server 2008

Operating system migration

Storage management

Storage software

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When migrating to updated versions of Microsoft operating systems and applications, a key challenge administrators often overlook is how previous versions of this software—and even UNIX® or Linux® operating systems—handle data. Although this challenge is not always taken into consideration, it can derail, delay, and add significantly to the cost and complexity of upgrades. Difficulties with handling data in previous migration efforts can cause anxious IT departments to hesitate in providing access to updated application features and decide to live with a "good enough" environment, because their environment lacks a method for easily handling existing data.

Combining Dell PowerVault and Dell EqualLogic storage with CommVault Simpana data management software can help administrators overcome these challenges. By providing a simplified way to rapidly migrate data between different versions of Microsoft operating systems and applications, CommVault Simpana provides a powerful, flexible tool to ease adoption of the Microsoft Windows Server® 2008 OS and other Microsoft software.

HANDLING THE COMPLEXITIES OF DATA AND SYSTEMS MIGRATION

Updating typical enterprise environments based on Microsoft software can be a complex process. As Microsoft evolves its product lines, those products can become interdependent within enterprise systems—Microsoft Exchange servers, for example, require the Microsoft Active Directory® directory service (see Figure 1). Microsoft Office SharePoint® Server, which relies on Microsoft SQL Server® database systems, can also serve as the public folder system for Exchange. Components in an enterprise system based on Microsoft software require Windows® file systems, and the environment also likely includes client systems running the Microsoft Windows Vista® or Windows XP operating systems.

Adopting an updated version of a Windows file system or a Microsoft application can create a cascading effect in which systems and software must be upgraded simultaneously to continue to work properly. Also, administrators should keep in mind that almost all 2007 and 2008 Microsoft software can benefit significantly from a 64-bit architecture—and some, such as Exchange Server 2007, even require it. For this reason, IT departments may consider

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upgrading the network topology and storage architecture at the same time.

When thinking about the proper handling of data within a complex, interdependent systems environment, several challenges can confront IT departments, any one of which could derail a successful upgrade:

- **Legacy data archives:** Appropriate handling of existing tape archives can be challenging—because organizations often must maintain their ability to recover and use data backed up from previous versions of applications, they must also keep previous versions of the applications deployed.
- **Policy and security requirements:** Even when data may be usable, it may not adhere to requirements for secure access, which may cause organizations to inadvertently violate privacy laws, internal policies, and other security considerations.
- **Data migration flexibility:** The ability to flexibly move data among multiple versions of the same application—backward to previous versions and forward to newer ones—can help simplify management of mixed-version environments. These environments can be common for some period of time during migration efforts.
- **Data recovery rollback:** Administrators may plan for data recovery and can recover data back to previous versions of applications during testing, and when pulling back a move over to newer systems.
- **Transparent migration:** Administrators must ensure they can handle and migrate data easily and transparently without disrupting the production use of application systems.

MIGRATING DATA IN MICROSOFT ENVIRONMENTS

The combination of Dell PowerVault and Dell EqualLogic storage and CommVault Simpana data management software can help organizations meet the type of technical requirements typically necessary to support rapid, flexible data migration. These requirements include comprehensive data management capabilities such as backup and restore for the types of data that Microsoft software can generate, combined with granular handling of individual data objects. This combination makes it possible to easily recover individual files, e-mail messages, documents, and other data objects from one version of Microsoft software to another.

For example, in environments running multiple versions of Exchange, using CommVault Simpana software as part of normal processes can help simplify restoring an e-mail message for an end user regardless of the version of Exchange used to create the original message. Furthermore, administrators can be confident that secure access is preserved for the restored e-mail message.

Providing continuous access to previous sets of e-mail data can be important for many reasons, ranging from maintaining end-user productivity to increased accuracy in meeting the requirements of an audit or legal discovery search. For example, recovering an entire database may be advantageous for test purposes, to help ensure that the latest version of Exchange is running well before it is moved into a production environment.

Integration and awareness of Active Directory at the object and attribute level through systems migration can be critical for handling virtually any type of Microsoft data. Administrators can restore Active Directory objects and attributes such as user groups and names rapidly and easily, helping simplify systems management in ways that are particularly helpful when migrating data to updated versions of file systems and applications. Active Directory integration can also be critical for preserving Microsoft attributes of individual files, e-mail messages, attachments, and SharePoint documents and objects. Because Microsoft attributes must be preserved through a restore process, this integration helps ensure that secure access to files is sustained by tracking which users and user groups should have access to files.

Granular, object-level recovery during systems migration can also include one-step

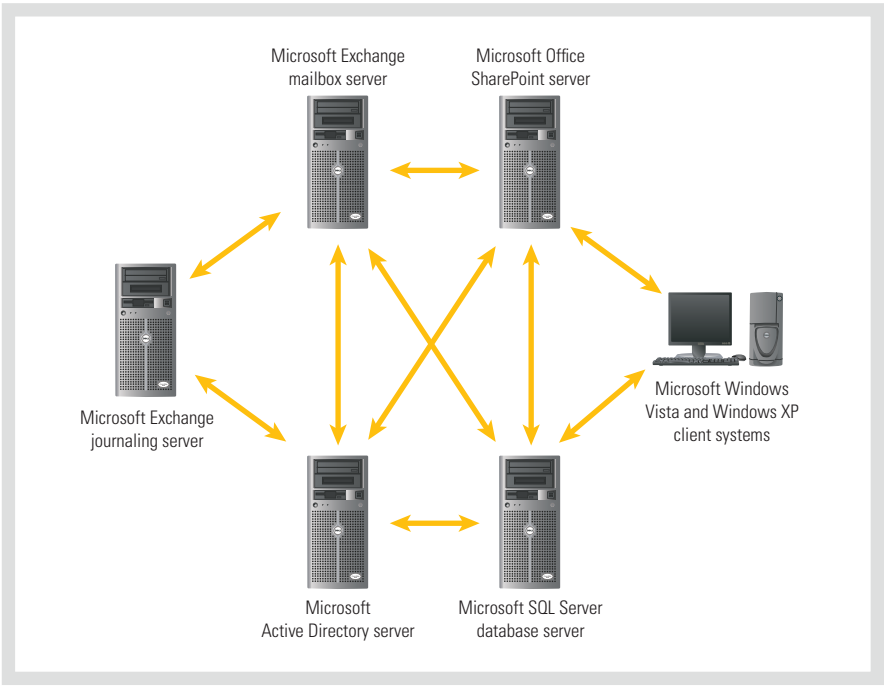

Figure 1. *An environment comprising a mix of Microsoft operating systems and applications can present challenges when migrating data*

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> **"Combining Dell PowerVault and Dell EqualLogic storage with CommVault Simpana data management software offers a flexible, transparent way to manage release-independent data for Microsoft applications."**

recovery methods to help ensure it is easier, faster, and more practical to manage than traditional recovery methods. For example, granular recovery in a SharePoint deployment *without* one-step document restore can be time-consuming, typically requiring the following steps:

1. Setting up a staged SharePoint environment, because documents and other objects cannot be restored directly back to the production SharePoint repository.
2. Recovering the documents to the staged environment.
3. Resetting the document attributes.
4. Adding the documents back to the production SharePoint repository.

Integration with Active Directory in addition to SharePoint awareness can allow preserving and recovering document attributes along with the data. And the ability to recover attributes and data together in one step can enable efficient recovery of an individual SharePoint document to a production SharePoint repository.

Managing Exchange e-mail messages and attachments can be similarly demanding. Efficient, granular protection requires support for the single-instance store capabilities in Exchange that can help prevent each e-mail and attachment from being written more than once in the backup data copy. This support helps reduce the space required to store the backup copy and the time required for the backup process. Recovery must include e-mail attributes to help ensure secure access, and in many cases secure access to e-mail is a requirement for complying with organization policies, government audits, and regulations.

PLANNING FOR WINDOWS SERVER 2008 MIGRATION

The Microsoft Windows Server 2008 OS is the latest version of Windows Server and the server follow-up to the Windows Vista client OS release in 2007. Like the Microsoft software releases in 2007, Windows Server 2008 can leverage 64-bit server systems and add large-enterprise scalability and power to Microsoft environments. Windows Server 2008 continues to extend the value of other Microsoft technologies, including Exchange, SharePoint, and SQL Server systems. Windows Server 2008 also relies on Active Directory services, including single-sign-on security features.

CommVault Simpana can help ease management burdens because it provides comprehensive support for Windows Server 2008 for backup and recovery of files integrated with Active Directory and single sign-on. In combination with 64-bit Dell PowerEdge™ servers, CommVault Simpana can help deliver enterprise-scale power for backup and recovery processing. In combination with Dell PowerVault and Dell EqualLogic storage, CommVault Simpana software provides options for storing single-instance copies of Windows Server 2008 backup files and objects.

If administrators are already using CommVault Simpana to help protect existing Windows systems, then they are likely already prepared for migrating Windows data to a Windows Server 2008 environment. CommVault Simpana helps simplify file restore processes from previous versions of Windows to these systems, and can enable the recovery of files from Windows Server 2008 systems to previous versions of Windows servers that may be present in some environments.

ENABLING FLEXIBLE, TRANSPARENT DATA MIGRATION

Migrating data between versions of Microsoft software can be a significant challenge when moving to Windows Server 2008 or deploying upgraded versions of Microsoft software. Combining Dell PowerVault and Dell EqualLogic storage with CommVault Simpana data management software offers a flexible, transparent way to manage release-independent data for Microsoft applications, delivering an additional level of flexibility when adopting upgraded versions of Microsoft operating systems and applications.

K. E. H. Polanski is a partner at the KEHP Group, a marketing and public relations firm specializing in storage and data management. She was previously the director of product marketing at CommVault, and has worked in product marketing and management, business development, and channel marketing at EMC, Legato, the Qualix Group, and Octopus Technologies. She has a degree in Computer Science from Augustana College.

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FASTER: We have ensured that our servers, both past and present, are ready for Windows Server 2008. Our migration services are also "right-sized" and tailored to your specific needs. You'll spend less time on deployment and configuration and more time on growing your business.

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We are dedicated to helping you reclaim time and resources through IT simplification.

ONE SIZE DOES NOT FIT ALL
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FULLY INTEGRATED
We partner with industry leaders such as Microsoft to help ensure that our solutions always work with the latest technologies.

MORE THAN HARDWARE
We complement our cutting-edge hardware with premier software and services for rapid deployment, increased manageability, and real business value.

SIMPLY PUT

DELL OFFERS A COMPLETE PORTFOLIO OF SERVICES TO HELP SIMPLIFY ADOPTION OF WINDOWS SERVER 2008

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THE NEW BENCHMARK

Windows Server® 2008

DELL + WINDOWS SERVER 2008: A POWERFUL COMBINATION

Microsoft has launched the most advanced Windows Server operating system yet: Windows Server® 2008. Dell closely collaborated with Microsoft during development, gaining expertise in all aspects of its features and functionality. We created a validated, repeatable process designed to add reliability, lower risk, and drive quicker engagement for migration.

Thanks to this strong partnership and our hands-on experience, we can help simplify the adoption of Windows Server 2008. Our hardware is optimized for the new OS, outperforming competitive platforms, and our robust consulting services offer exceptional flexibility when upgrading or migrating.

TOP 10 REASONS TO MIGRATE TO WINDOWS SERVER® 2008

THE EVOLUTION OF SERVER TECHNOLOGY

Windows Server 2008 is designed to provide increased reliability and control over your server infrastructure. New virtualization tools, Web technologies, and security enhancements help save time and reduce costs, and provide you with high availability and increased flexibility for your changing business needs.

Windows Server 2008 builds on the success and strengths of Windows Server 2003, but is much more than a refinement of the previous version. It delivers powerful new functionality that will add real value by simplifying your business operations and improving efficiency. Enhancements are in four key areas:

WEB

Deliver rich, Web-based experiences efficiently and effectively with the powerful Web Application and Services Platform. Internet Information Server 7.0 offers improved administration and diagnostics, better development and application tools, and lower infrastructure costs.

SECURITY

Windows Server 2008 is the most secure Windows Server ever, providing security innovations such as Network Access Protection, Federated Rights Management, and Read-Only Domain Controller. Combined with the enhanced security features of Dell servers—Trusted Platform Modules, Network Interface Cards, Secure Socket Layer (SSL) adapters—you have unprecedented levels of protection for your data.

VIRTUALIZATION

Server virtualization is often considered to be complex and time-consuming, but Dell has greatly simplified the process, making it a smart solution for companies of any size. And with Hyper-V technology built into Windows Server 2008, it's now even easier. Windows Server uses a 64-bit hypervisor-based platform for better reliability and scalability, and also provides high availability and increased security.

BUSINESS WORKLOAD FOUNDATION

With features such as Server Core, PowerShell, Windows Deployment Services, and enhanced networking and clustering technologies, Windows Server 2008 offers a versatile and reliable platform for your workload and application requirements.

1. **WORLD-CLASS WEB AND APPLICATION PLATFORM**
   A secure, easy-to-manage platform for developing and reliably hosting applications and services.
2. **IMPROVED NETWORKING PERFORMANCE**
   Take full advantage of today's multi-gigabit networks, and completely secure and control the flow of network traffic.
3. **ENHANCED SECURITY AND COMPLIANCE**
   Developed from the ground up for security, helping you adhere to the strictest IT compliance standards. Plus, Network Access Protection helps ensure that any computer connecting to the network meets corporate policy for "healthy" requirements.
4. **MAXIMIZED OS CYCLE**
   By migrating to Windows Server 2008 now, you can maximize the operating system cycle and take full advantage of the financial and technical benefits of the new functionality.
5. **CONTROL OVER YOUR REMOTE INFRASTRUCTURE**
   Streamline the management of your remote infrastructure with enhancements to Active Directory, including Read-Only Domain Controllers and administrative role separation.
6. **SIMPLIFIED SERVER MANAGEMENT**
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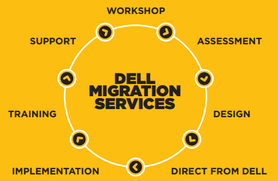
   Automate common tasks and easily control system administration.
8. **PRESENTATION VIRTUALIZATION**
   Secure access to internal applications through firewall-friendly ports.
9. **WINDOWS SERVER 2008 WITH HYPER-V**
   Hyper-V virtualization technology helps you increase system availability for production server consolidation, disaster recovery, and end-to-end management of dynamic data centers. You can also run a legacy OS, such as Windows 2000, on the latest platforms as a virtual instance to avoid compatibility issues.
10. **THE POWER OF WINDOWS VISTA®**
    Windows Server 2008 and Windows Vista share a number of technologies across networking, storage, security, and management.

MIGRATING THE DELL WAY

Windows Server® 2008 can revolutionize your data center, but migrating to a new OS can be complicated and risky without the proper planning. You may have concerns about data migration, hardware limitations, integration of existing applications, and licensing issues.

That's where Dell comes in. We have conducted extensive engineering around Windows Server 2008 to minimize the amount of work for your IT department. We will create a roadmap that is customized to your needs, ensuring that your migration is fast and reliable, with no interruption to your day-to-day business. Here's how:

- Windows Server 2008 is tested and validated on Dell servers to ensure it will work in your environment.
- Dell's Readiness Advisor tool scans your network to determine which Dell servers are ready for Windows Server 2008, saving you time and money.
- Unmatched speed and security. We pre-install Microsoft security updates in every server we sell, enabling secure integration and speeding up deployment time.
- We worked with customers in a variety of industries and, as part of our Early Adopter Program, have devoted thousands of hours to developing our field readiness and expertise around Windows Server 2008. Now we can pass our best practices on to you.



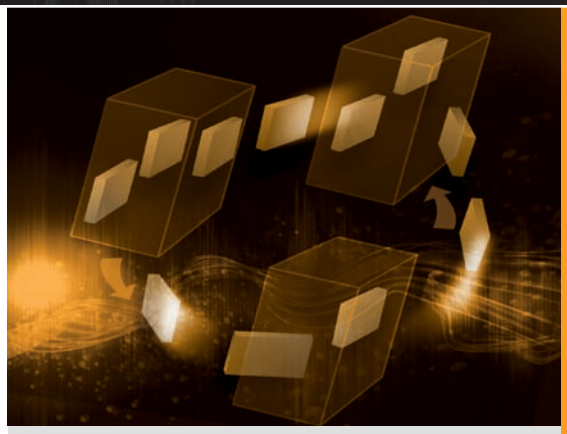
GLOBAL INFRASTRUCTURE CONSULTING SERVICES

Dell Global Infrastructure Consulting Services is working with customers worldwide to deliver smooth Windows Server 2008 migrations. We provide technology workshops, a comprehensive Readiness Assessment, and a structured design to ensure a solution built around your specific needs. Select the services you require; scale up or down as needed. No hassle, no army of consultants, just a solution that delivers results.

WHY DELL + WINDOWS SERVER 2008?

ISSUE	SOLUTION
The energy costs, space limitations, and management complexity that come from server sprawl	Virtualization. Windows Server with Hyper-V uses a 64-bit hypervisor-based platform, and when run on Dell™ PowerEdge™ servers, you can see lower energy consumption and increased availability, accessibility, and control—without taking up additional space in your data center.
Currently run Windows Server 2000 or 2003	To continue to receive server support, and take advantage of the latest IT advances, a transition to 2008 is necessary. Windows Server 2003 users can upgrade to Windows Server 2008, but Windows Server 2000 users must back up data and install Windows Server 2008 from scratch. Dell's Global Infrastructure Consulting Services will advise you on best practices for this process to ensure a successful migration.
The accessibility and management issues that come from a decentralized workforce	With work conducted outside the confines of the office, security and productivity are critical concerns. Features such as remote infrastructure administration, BitLocker, SharePoint, and Network Access Protection (NAP) can all help simplify your operations.
Security threats such as viruses, spam, unauthorized access; and federal mandates	Dell's new generation PowerEdge servers are the most secure we've ever produced, and are designed to help ensure the confidentiality, integrity, and availability of your data. Dell pre-installs Microsoft security updates on every server, which also features Trusted Platform Modules (TPM), Network Interface Cards (NIC), and Secure Socket Layer (SSL) adapters for enhanced security.
Complex IT infrastructure management	Dell's OpenManage 5.3 supports Windows Server 2008 and delivers a set of server tools that help simplify everything from deployment to monitoring to change management.
Concerns about the timing or risks of migration	As a result of our field expertise, Dell services can help speed deployment time and ensure a seamless Windows Server 2008 transition by creating a validated, repeatable migration process.

INTRODUCING THE DELL POWEREDGE R805 WITH VMWARE INTEGRATED VIRTUALIZATION



By Balasubramanian Chandrasekaran
Brent Douglas
Joseph Rispoli
David Schmidt

The new Dell™ PowerEdge™ R805 server is designed and optimized specifically for virtualization. By including VMware® integrated virtualization, the PowerEdge R805 enables quick and easy deployment right out of the box, simplified management, and enhanced security, as well as diskless configuration to help reduce power costs.

Related Categories:
Dell PowerEdge servers
Virtualization
VMware
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Virtualization has entered the mainstream, and is now a critical component when building cost-effective, highly available, and scalable enterprise IT infrastructures—enabling both flexible resource management and automated resource allocation based on strategic enterprise policies. Virtualized infrastructures help simplify IT operations in multiple ways, helping shield software from hardware, enabling secure resource sharing, and facilitating software deployment and relocation. They also help increase business agility by enabling IT staff to dynamically reprovision resources as needed and avoid planned downtime, enhance the efficiency of application testing and development, and facilitate rapid, cost-effective disaster recovery.

Although virtualization helps significantly increase manageability and flexibility, it also comes with its own set of challenges. It introduces an additional software layer—the hypervisor—that, like other software, typically calls for special skills to install and configure and requires regular patches, upgrades, and maintenance. Administrators must consider the deployment and maintenance of virtualization software on every node in a server farm before rolling out their software in virtual machines (VMs).

Virtualization also places additional requirements on the hardware. While virtual disks and configuration files are typically stored in shared consolidated storage, the hypervisor itself requires hardware resources on the server. Compared with single-core processors, dual- and quad-core processors can allow more VMs to run on a single platform, but also increase the burden on memory and I/O subsystems.

With the introduction of the Dell PowerEdge R805 server with VMware integrated virtualization, Dell has taken a major step toward simplifying and reducing the complexities of virtualized environments. This article discusses the key advantages of this server and how virtualization has been optimized and integrated into the system's design.[1]

INTRODUCING THE DELL POWEREDGE R805 SERVER

The 2U, two-socket PowerEdge R805 server includes the same high-availability and management features as the PowerEdge 2950 and PowerEdge 2970, including hot-pluggable redundant power and cooling components, remote management through the Dell Remote Access Controller 5 (DRAC 5), and an optional embedded RAID controller. In contrast to these other servers, however, the PowerEdge R805 is designed specifically to help simplify virtualization deployments, optimize external storage access, and reduce overall power consumption. Almost every subsystem within

[1] The PowerEdge R805 server with VMware integrated virtualization was demonstrated at VMworld 2007 by VMware CEO Diane Greene and Dell CMO Mark Jarvis during the September 11, 2007, opening keynote presentation, available at www.vmworld.com/webcast.

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the server includes updated technologies that help increase overall capacity and performance in virtualized environments. The PowerEdge R805 is the first Dell server to feature an internal flash device dedicated to hosting an integrated hypervisor, which helps eliminate the need for power-consuming local drives and enables virtualization to work out of the box with minimal configuration.

In designing the PowerEdge R805 server, Dell recognized that the virtualization software should not function as another OS—it should be an integral part of the system, and easy for administrators to deploy and manage. With that in mind, Dell integrated VMware ESX Server 3i software into the server itself. Unlike previous ESX Server versions, ESX Server 3i does not have a service console, helping greatly reduce the installation footprint of the software and allowing the hypervisor (and limited applications) to be installed on the server's internal storage.

INTEGRATING VMWARE VIRTUALIZATION

VMware integrated virtualization on the PowerEdge R805 server can offer multiple advantages, including easy installation, deployment, and maintenance; a simplified management architecture; reduced power consumption; advanced hardware resources for VM hosting; enhanced security; and simplified backup and restore compared with previous-generation servers.

	VMware ESX Server 3	VMware ESX Server 3i
Installation	17 minutes	0 minutes
Configuration, including IP address, disk partitions, and licensing	10 minutes	3 minutes
Boot	3 minutes	Just over 1 minute
Patching or upgrading	10 minutes for patching, 20 minutes for upgrading	Not tested, but predicted to be approximately 3 minutes

Note: Times may vary in different infrastructures.

Figure 2. *Times for installation, configuration, boot, and patching or upgrading tasks on VMware ESX Server 3 and ESX Server 3i*

Easy installation, deployment, and maintenance

The PowerEdge R805 server is designed to provide a virtualization-ready server right out of the box. Because this system includes factory-installed VMware ESX Server 3i software, administrators do not need to install a virtualization platform themselves. ESX Server 3i can also come pre-activated on each server based on the specific order, helping avoid the need to acquire host licenses from VMware and helping further reduce deployment times, costs, and the possibility of a failed installation or mis-configuration. After booting for the first time, the server provides a simple interface for basic configuration, making it easy for administrators to bring the server online quickly (see Figure 1).

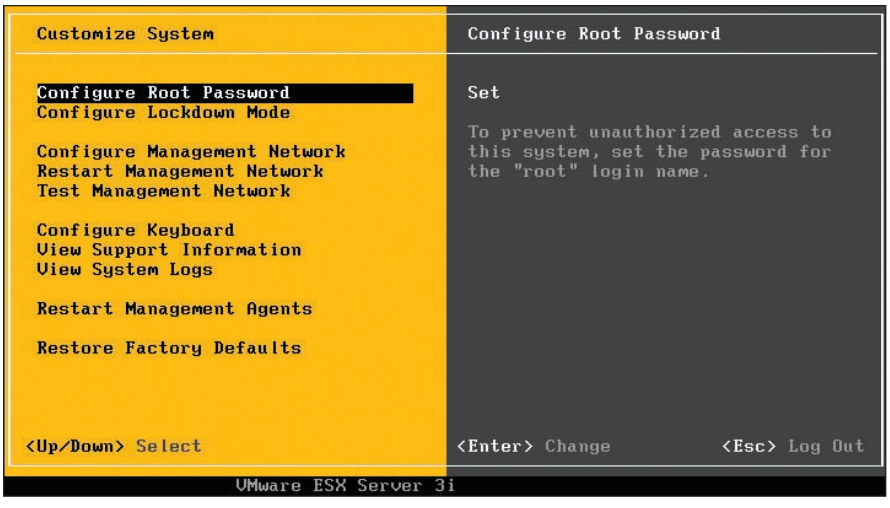

Figure 1. *Administrative setup window for VMware integrated virtualization on the Dell PowerEdge R805 server*

The reduced software footprint also helps simplify patch management, particularly compared with the upgrade process for ESX Server 2.*x* and 3.*x*, and the absence of a service console can help reduce the number of patches and upgrades compared with these two standard versions. Administrators can easily manage the software versions and apply patches through VMware VirtualCenter. In addition, the integrated Secure Digital (SD) card maintains the two latest versions of ESX Server, and patches are applied to the older of these two versions; if the patch is not successful, the server can automatically boot to the last known functioning version.

Figure 2 summarizes the installation, configuration, boot, and patching or upgrading times for ESX Server 3 and ESX Server 3i, as measured in tests by Dell engineers in September 2007. Both platforms were tested on the same PowerEdge R805 server with quad-core AMD Opteron™ 2350 processors and 8 GB of RAM. As these times show, a server with integrated ESX Server 3i software can help significantly reduce the time to perform common tasks, helping increase administrative efficiency—an advantage that multiplies when these servers are deployed across the data center.

Simplified management architecture

Reducing the footprint of the virtualization software and integrating it into the

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server can help significantly simplify management as well. Managing VMware integrated virtualization is more like managing server firmware than managing a new and complex software layer. Once the server boots, it provides a simple interface for basic configuration and management of the virtualization software layer, without requiring complex command-line interfaces (CLIs). Once administrators have set up the management network and administrator passwords, they can easily manage the server using VMware Virtual Infrastructure Client and/or VMware VirtualCenter.

To help reduce the system footprint and simplify deployment, ESX Server 3i does not have a traditional service console management interface where Dell OpenManage™ agents are installed. Instead, ESX Server 3i exposes hardware health information through standard protocols like WS-Management or Simple Network Management Protocol (SNMP). Administrators can now monitor and manage the hardware through any management application that supports any of these standard protocols—for example, by using Dell OpenManage IT Assistant to monitor the PowerEdge R805 server through SNMP. In addition, VMware provides a remote CLI packaged as a VM that advanced administrators can use to remotely configure and manage the server. Administrators who currently utilize Dell OpenManage, or another management tool that requires an agent in the service console, should consider deploying ESX Server 3.5 rather than ESX Server 3i to provide a familiar management approach.

Reduced power consumption

The PowerEdge R805 server includes several power-saving features. Integrating ESX Server 3i allows both solid-state and low-power operations. Local hard drives are optional, and can be eliminated to save power or included to store VM files locally. A configuration without local hard drives or a storage controller can help reduce power consumption by up to 35 W compared with a configuration that includes those components.[2] Dell recommends a diskless configuration with ESX Server 3i.

Advanced hardware resources for virtual machine hosting

Dell has redesigned the architecture of the PowerEdge R805 server to help increase VM performance. Figure 3 outlines this server's key features alongside those of the PowerEdge 2970, and Figure 4 illustrates its key components.

The quad-core architecture of the AMD Opteron 2300 series processors in the PowerEdge R805 enables the system to run more VMs than servers with previous-generation single- or dual-core processors. In addition, ESX Server 3i software takes advantage of the Rapid Virtualization Indexing feature of this series of processors, enabling VM memory mapping information to be stored directly in the processor and helping reduce the overhead previously required by software hypervisors.

The PowerEdge R805 server is also designed to offer significantly higher I/O bandwidth than the PowerEdge 2950 and PowerEdge 2970, and is one of the first PowerEdge models to include four Gigabit Ethernet network ports without using an expansion slot. Dell also anticipates that in 2008, two of these ports will be upgradable to 10 Gigabit Ethernet. Four PCI Express (PCIe) slots—three x8, one x4—offer support for four additional dual- or quad-port network interface cards or host bus adapters.

Server memory capacity is a key factor in determining how many VMs a server can host. The PowerEdge R805 server includes 16 dual in-line memory module (DIMM) slots, supporting up to 128 GB of memory. The AMD Non-Uniform Memory Architecture (NUMA) also helps enhance the performance of many applications running on VMs.

Enhanced security

By basing its service console on a hardened Linux® distribution, ESX Server software already helps provide a secure virtualization environment. ESX Server 3i

	Dell PowerEdge 2970	Dell PowerEdge R805
Processor series	AMD Opteron 2200 or 2300	AMD Opteron 2200 (to provide backward compatibility with VMware VMotion™ technology) or 2300
Memory slots	8 DIMM slots	16 DIMM slots
Memory capacity	Up to 64 GB	Up to 128 GB
Local hard drives	Up to eight drives	Up to two drives (not required for integrated virtualization)
I/O slots	Three PCIe slots (two x8, one x4)	Four PCIe slots (three x8, one x4)
RAID controller	Integrated RAID controller	Integrated RAID controller (not required for integrated virtualization)
Networking	Two embedded Gigabit Ethernet network ports (not upgradable to 10 Gigabit Ethernet ports)	Four embedded Gigabit Ethernet network ports (two of which Dell anticipates will be upgradable to 10 Gigabit Ethernet in 2008)
Internal solid-state storage	None	One internal SD slot to store integrated virtualization software

Figure 3. *Key features of the Dell PowerEdge R805 server compared with those of the PowerEdge 2970*

[2] Based on tests performed by Dell engineers in October 2007 comparing two PowerEdge R805 servers with AMD Opteron 2350 processors, 8 GB of RAM, and VMware ESX Server 3i: one with no hard drives, and one with a PowerEdge Expandable RAID Controller (PERC) 6/i and two 36 GB, 10,000 rpm Serial Attached SCSI (SAS) hard drives.

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further enhances security by eliminating the service console altogether, thereby helping to reduce the number of open network ports, to prevent other programs from being installed that can compromise security, and to simplify the process of securing the IT infrastructure.

Simplified backup and restore

Enterprises often use redundant mirrored local drives in their IT environment. Although eliminating local drives on the PowerEdge R805 server can help reduce power consumption and simplify management, it also renders this level of redundancy unavailable. To help compensate, VMware VirtualCenter provides simplified backup and restore processes for the integrated ESX Server hypervisor, helping administrators protect their VMs and configurations.

SIMPLIFYING DATA CENTER VIRTUALIZATION

Data centers in enterprises of all sizes are rapidly adopting virtualization as a key element of their IT infrastructure. Ideally, servers should enable virtualization out of the box, requiring very little configuration and utilizing a transparent virtualization software layer to help simplify deployment, management, and maintenance. Administrators should be able to directly provision tasks on virtualized servers without worrying about installing and configuring the hypervisor.

By integrating VMware virtualization software into the PowerEdge R805 server, Dell has taken a significant step toward this goal, offering virtualization that no longer depends on a special software layer requiring specific skills to install and manage. Instead, the PowerEdge R805 is designed to seamlessly integrate virtualization—helping significantly simplify the installation, deployment, management, and maintenance of virtualized environments.

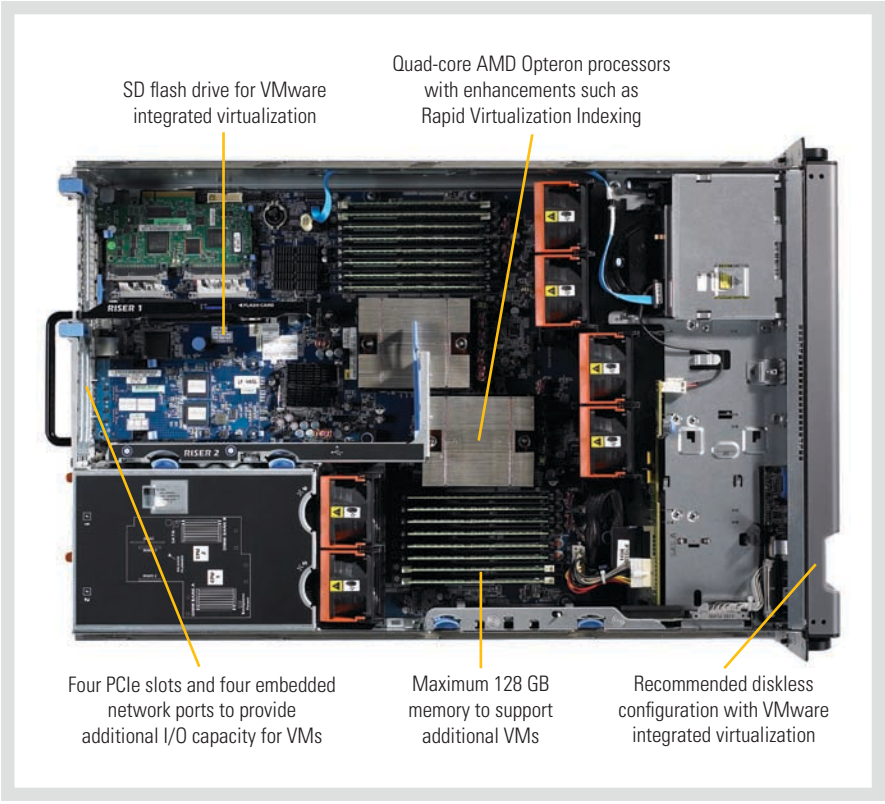

Figure 4. *Key components of the Dell PowerEdge R805 server*

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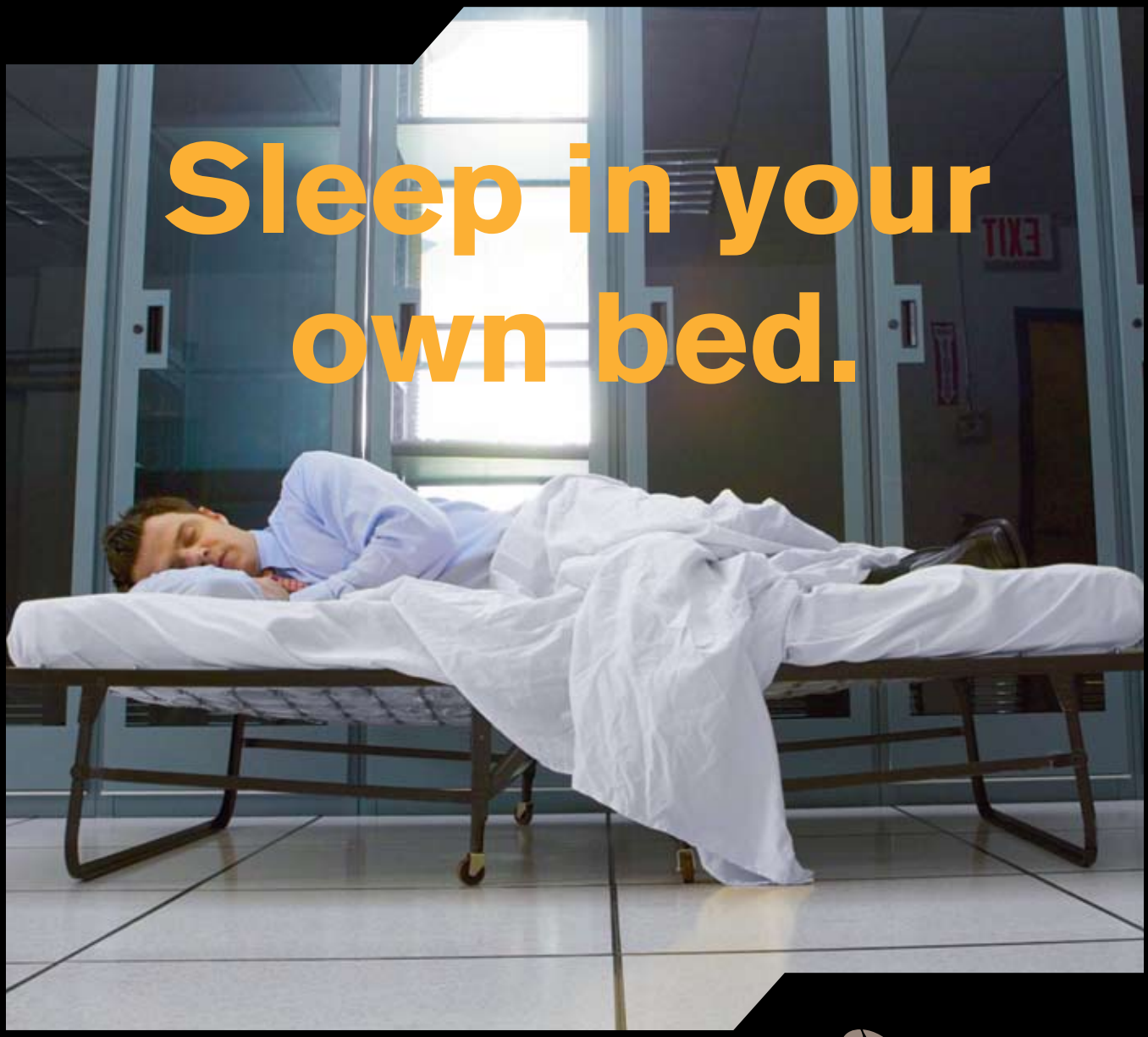

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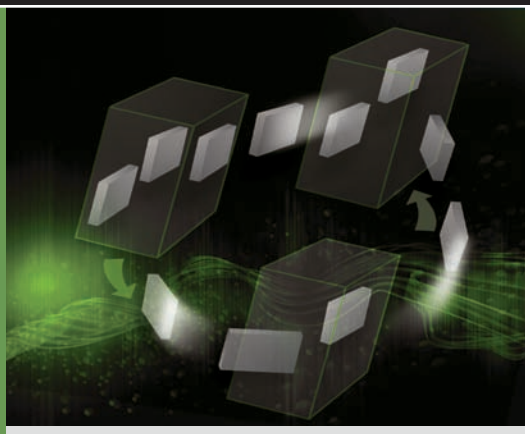

AN INTEGRATED VIRTUALIZATION SOLUTION FOR MICROSOFT EXCHANGE

Building a simple, flexible, resilient infrastructure can be essential to successful Microsoft® Exchange Server 2007 deployments. By using a virtualized solution based on VMware® Infrastructure 3 software, Dell™ PowerEdge™ servers, and Dell/EMC CX3-20 storage arrays, organizations can create a scalable and highly available Exchange implementation.

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For many organizations, e-mail systems form a critical part of their communications infrastructure—one in which any outage, regardless of length or cause, can impair the organization's ability to operate effectively. But the expense and complexity of implementing and supporting a highly available and disaster-tolerant Microsoft Exchange infrastructure can be a constant challenge.

Virtualizing Exchange using the VMware Infrastructure 3 platform can help enterprises overcome this challenge.[1] In addition to simplifying IT by enabling organizations to use their server, storage, and networking resources efficiently while helping control costs, features such as VMware VMotion™ technology, VMware Distributed Resource Scheduler (VMware DRS), and VMware High Availability (VMware HA) provide the tools to create a truly flexible and resilient IT infrastructure that can respond quickly to changing needs.

In conjunction with Dell and EMC, VMware has created a virtualization solution for Exchange Server 2007 based on VMware Infrastructure 3, Dell PowerEdge servers, and Dell/EMC CX3-20 Internet SCSI (iSCSI) storage arrays that is designed for small and midsize organizations and provides a flexible, robust platform for a wide variety of application and workload environments. In December 2007, EMC engineers used the Microsoft Exchange Server Jetstress and Microsoft Exchange Load Generator (LoadGen) tools to compare the performance, latency, and processor utilization of this virtualized solution with those of a comparable non-virtualized configuration. The results illustrated the minimal impact of virtualizing the Exchange environment compared with a traditional non-virtualized deployment, helping demonstrate the feasibility of using this type of solution in enterprise data centers.

ADVANTAGES OF VIRTUALIZING EXCHANGE SERVER 2007

A virtualized deployment of Exchange Server 2007 can offer a number of advantages in enterprise environments. For example, because Exchange Server 2007 is less I/O-intensive than Exchange Server 2003, it can provide near-native performance in a properly sized and configured VMware virtual machine (VM) on similar hardware. Virtualization can also help organizations reduce deployment costs through server virtualization; accelerate deployment times through VM templates; take advantage of cost-effective iSCSI technology; use VMware VMotion, VMware DRS, and VMware HA to help increase flexibility and uptime; and simplify disaster recovery.

[1] Because Exchange is a core part of daily operations for many enterprises, administrators should understand the current support policies in place from Microsoft before deploying a virtualized Exchange infrastructure. Microsoft does not typically test or support Microsoft software running with non-Microsoft hardware virtualization software, although for customers with Premier-level support, they will use "commercially reasonable efforts" to investigate issues with these implementations. Many VMware partners also provide end-to-end support for Microsoft software running in VMware environments. For more information, visit support.microsoft.com/kb/q897615 and www.vmware.com/support/policies/ms_support_statement.html.

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Near-native performance

Exchange Server 2003 was extremely disk I/O intensive, and implementing a proper storage design often required administrators to dedicate a large number of high-performance disk spindles exclusively to Exchange. Exchange Server 2007 has significantly reduced disk I/O demands compared with Exchange Server 2003, most notably because it is designed to run on a 64-bit platform. This architectural change increases the amount of memory available to the database buffer cache, helping reduce disk access for reads and increase write buffering. Exchange Server 2007 has also increased the maximum number of databases, which enables increased checkpoint depth per user and helps reduce the necessity to read from disk by using the dirty pages in memory.

Other I/O-specific changes in Exchange Server 2007 include increased write size (from 4 KB to 8 KB) and increased I/O coalescing (from 64 KB to 1 MB), typically resulting in larger but fewer writes than were necessary in Exchange Server 2003. VMware Infrastructure 3 supports the use of 64-bit Microsoft Windows Server® 2003 operating systems, and these and other architectural changes have helped substantially increase the performance of Exchange Server 2007 in a VMware VM compared with Exchange Server 2003.

Reduced deployment costs through server consolidation

Exchange Server 2007 runs exclusively on 64-bit hardware and can require up to five distinct server roles—Mailbox, Client Access, Hub Transport, Edge Transport, and Unified Messaging—depending on the functionality needed in a particular environment. New 64-bit servers can contain powerful dual-core and quad-core processors and handle up to 64 GB of RAM. In the Exchange environments of small and midsize organizations, these powerful servers often use only a small portion of their full compute resources. Running multiple VMware VMs on these 64-bit systems can help maximize resource utilization and help increase return on investment for this server hardware, and represents an opportunity to take advantage of VMware virtualization as part of the upgrade cycle for testing, evaluating, and deploying Exchange Server 2007. Because VMware Infrastructure 3 enables administrators to run more workloads on a single server than they typically could on a non-virtualized server, it can help organizations increase server utilization.

Reduced deployment times using virtual machine templates

VMware virtualization enables enterprises to build a set of common VM images that administrators can easily update and quickly provision, helping reduce the time required to deploy new VMs, including Exchange VMs. The ability to rapidly and consistently deploy VMs can help streamline testing and development cycles, accelerate production deployments, assist in troubleshooting, and allow easy adjustments to changing workloads in the environment.

Using VMware VM templates can help organizations significantly reduce the time required to deploy server images. This approach helps free up valuable IT resources for work on other important tasks.

Cost-effective iSCSI connectivity

Deploying Fibre Channel storage area networks (SANs) can be an expensive proposition for small and midsize organizations. VMware Infrastructure 3 supports iSCSI SANs using a number of different storage initiator choices. Combined with the performance and reliability of Dell/EMC CX3-20 iSCSI storage arrays, the virtualized Exchange solution can provide cost-effective, reliable storage for Exchange Server 2007. The disk storage for Exchange Server 2007 in the virtualized Exchange solution has been designed to scale in 500-user increments and has been tested and validated for performance comparable to non-virtualized configurations on similar hardware.

VMware VMotion, VMware DRS, and VMware HA

The cost and complexity of clustering software such as Microsoft Cluster Service can make that software unsuitable for many small and midsize organizations—potentially leaving essential enterprise systems without a high-availability solution. VMware Infrastructure 3 integrates several features that organizations can use to provide high availability in a virtualized Exchange Server 2007 environment:

- **VMware VMotion:** Can migrate live, running VMs from one physical server to another with no loss of service
- **VMware DRS:** Dynamically load balances VMware VMs across the entire pool of server resources; the use of functional server roles in Exchange Server 2007 can work well with the DRS feature because DRS typically functions most efficiently when distributing multiple small VMs
- **VMware HA:** Can automatically restart VMs on another server following a hardware failure

Simplified disaster recovery

Many disaster recovery solutions require similar server hardware at the disaster

"A virtualized deployment of Exchange Server 2007 can offer a number of advantages in enterprise environments."

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recovery site to help avoid potential driver and software incompatibility problems. Systems deployed on VMware VMs can help eliminate this hardware requirement, and can be brought online on virtually any supported host server running virtually anywhere in the world. VMware Infrastructure 3 can help simplify Exchange disaster recovery by helping reduce both hardware compatibility constraints and the number of servers required at the disaster recovery site. And because each VM is encapsulated as a small set of files, this approach can also help simplify replication.

VIRTUALIZED EXCHANGE SERVER 2007 ARCHITECTURE

This virtualized Exchange Server 2007 solution has been designed and optimized for small and midsize organizations. It comprises four key layers: VMware Infrastructure 3, Dell/EMC CX3-20 iSCSI storage, Dell PowerEdge servers, and Microsoft Exchange Server 2007. In addition to the advantages of VMware Infrastructure 3 and Exchange Server 2007 discussed in the preceding sections, the Dell/EMC CX3-20 storage and Dell PowerEdge servers that make up the middle layers of the virtualized Exchange solution provide their own advantages.

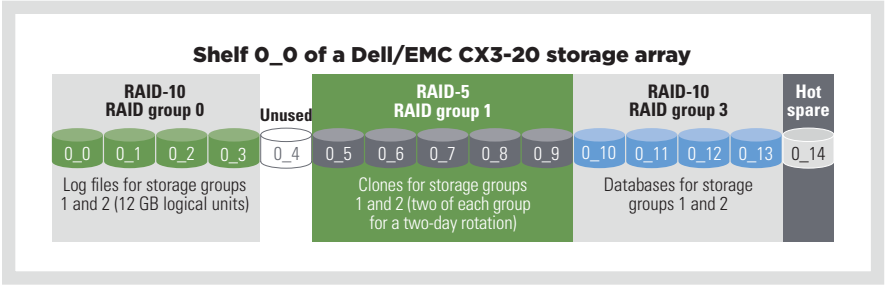

Figure 1. *Building blocks for 500 users using two Microsoft Exchange storage groups with two EMC Replication Manager clones*

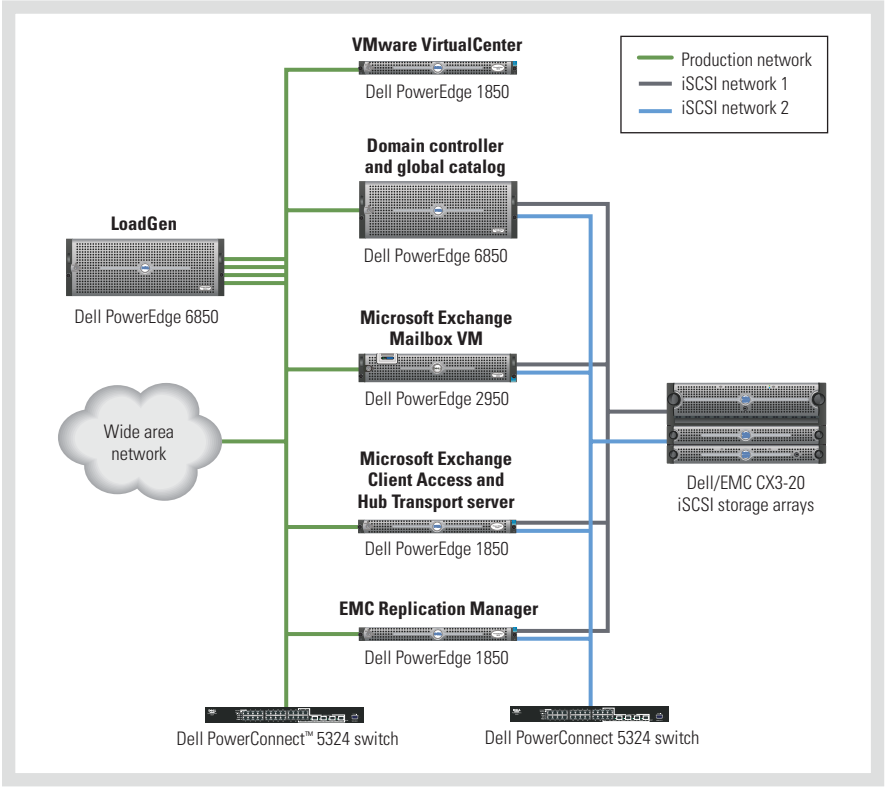

Figure 2. *Dell PowerEdge servers used in the virtualized Microsoft Exchange Server 2007 test environment*

On top of the virtualization layer is the core storage—the Dell/EMC CX3-20 iSCSI storage array. This dual-protocol system supports both Fibre Channel and iSCSI connectivity and includes dual redundant storage processors with battery-backed cache. Support for data in-place upgrades allows the storage array to scale easily as the environment grows.

The storage architecture is based on a building-block design that can scale as the environment grows and requires additional space and fault tolerance (see Figure 1). The building blocks help minimize design and operations complexity in increments of four-disk RAID-10 building blocks, with a 0.5 I/Os per second (IOPS) user profile and a maximum mailbox size of 250 MB. As the user workload grows, adding performance, scale, and capacity is typically simple and predictable.

Integrating with the Dell/EMC CX3-20 storage for rapid Microsoft Volume Shadow Copy Service (VSS)–based clone backups is EMC® Replication Manager software, which automates and manages the backup and recovery process. The virtualized Exchange Server 2007 solution uses EMC Replication Manager 5.0 software to help easily automate the process of creating disk-based replica copies of Exchange databases.

Dell PowerEdge servers make up the next layer, between the storage and Exchange software, and are designed for high performance, ease of use, and overall efficiency. The common platform used by the PowerEdge server family helps simplify management and maintenance while helping reduce cost and complexity, and administrators can quickly deploy and integrate the servers with VMware Infrastructure 3 and Dell/EMC storage.

Figure 2 shows the PowerEdge servers used in the virtualized Exchange Server 2007 test environment. Organizations that are already running a VMware environment and using the Microsoft Active Directory® directory service likely already have most of this infrastructure in place. The primary

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	Thread count	Performance (IOPS)	Database read latency (ms)*	Database write latency (ms)*	Log write latency (ms)*
Non-virtualized configuration	14	1379.992	19, 20, 19, 19	6, 6, 6, 6	2, 2, 2, 2
Virtualized configuration	14	1366.697	19, 19, 18, 19	7, 7, 7, 7	3, 3, 3, 3

*Latency results are given for each of the four storage groups used in the tests.

Figure 3. *Jetstress performance and latency test results comparing non-virtualized and virtualized Exchange configurations*

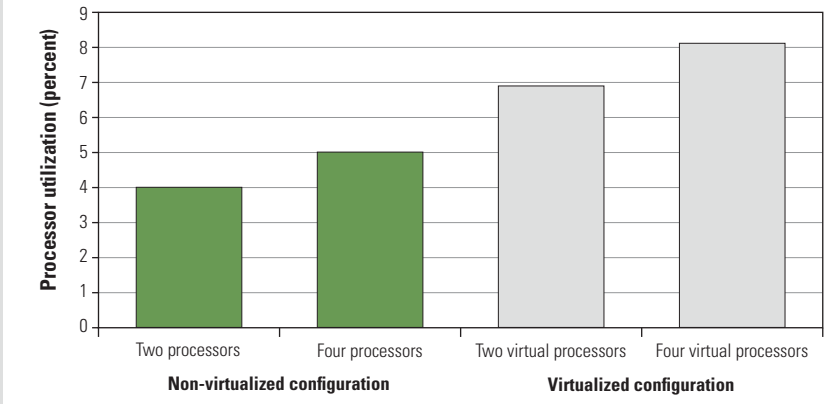

Figure 4. *LoadGen processor utilization test results comparing non-virtualized and virtualized Exchange configurations*

system used for testing in this environment was a Dell PowerEdge 2950 server with two dual-core Intel® Xeon® processors at 2.4 GHz and 16 GB of RAM, with the virtualized configuration utilizing two virtual processors and 12 GB of RAM and the non-virtualized configuration utilizing the same server and storage hardware. (For testing purposes, the test team limited the processors and RAM in the physical systems using the `maxmem` and `numproc` switches in the boot.ini file to match the processor and RAM resources of the Exchange VM.) The test team used a second PowerEdge 2950 server to test VMware VMotion, VMware DRS, and VMware HA functionality while under stress from LoadGen testing.

TEST RESULTS: PERFORMANCE, LATENCY, AND UTILIZATION

Figure 3 shows the results of Jetstress testing of the 1,000-user storage design in the virtualized Exchange Server 2007 solution using Dell PowerEdge 2950 servers and Dell/EMC CX3-20 iSCSI storage. The test team measured performance and latency for Exchange Server 2007 running on both a VMware VM and in a non-virtualized configuration using identical server and storage hardware. The tests returned similar results in both the virtualized and non-virtualized configurations.

Figure 4 shows the results of LoadGen testing of the 1,000-user storage design, which compared processor utilization in the non-virtualized configuration using two or four processors and the virtualized configuration using two or four virtual processors. These tests showed no significant advantage to using more than two virtual processors in the VM for this user profile, which helps demonstrate the minimal impact of virtualizing Exchange Server 2007.

The test team also evaluated VMware VMotion, VMware DRS, and VMware HA in the virtualized Exchange Server 2007 solution. Under a LoadGen workload, VMware VMotion and VMware DRS were able to move the Exchange VM to a second PowerEdge 2950 server transparently to the Microsoft Office Outlook® clients. VMware HA was able to rapidly restart the Exchange Server 2007 Mailbox server role on the second PowerEdge 2950 server following a simulated failure of the primary server.

EFFICIENT, FLEXIBLE EXCHANGE SERVER 2007 DEPLOYMENT

Architectural enhancements in Exchange Server 2007 have helped significantly enhance its performance in a virtualized environment. For organizations well versed in VMware Infrastructure 3 and beginning to test and evaluate Exchange Server 2007, plan a new implementation, or migrate from a previous version of Exchange, these enhancements provide an opportunity to extend their virtualized infrastructure using the virtualized Exchange Server 2007 solution described in this article. By virtualizing Exchange Server 2007, organizations can gain advantages not typically available in non-virtualized deployments, including dynamic resource optimization, simplified and accelerated evaluation and deployment cycles, efficient utilization of high-performance 64-bit hardware, and simplified disaster recovery—all of which can translate into real-world enterprise objectives of reduced IT costs, enhanced use of IT resources, and increased reliability in messaging environments.

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ACCESSING E-MAIL WITH DELL ON-DEMAND DESKTOP STREAMING

By Ananda Sankaran
Bharath Vasudevan

The Dell™ On-Demand Desktop Streaming™ solution can enhance IT manageability, reliability, and security, but may limit software features not designed for networked storage. This article outlines four approaches organizations can take to help accommodate end-user requirements for offline storage of e-mail when using a platform such as Microsoft® Exchange.

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Flexible computing solutions such as desktop streaming, application streaming, virtual remote desktop, virtual client desktop, and dedicated remote desktop are increasingly becoming attractive for IT departments because of their centralized management capabilities and reduced total cost of ownership. These solutions can help ease the traditional requirements for deploying and maintaining software on individual local hard drives, helping increase the manageability, reliability, and security of IT operations related to these systems.

The Dell On-Demand Desktop Streaming solution utilizes Dell OptiPlex™ client desktops, Dell PowerEdge™ servers, and Citrix® Provisioning Server for Desktops software to enable diskless client systems to boot from a networked server.[1] For common enterprise e-mail platforms such as Microsoft Exchange, accessing e-mail in an On-Demand Desktop Streaming environment using traditional applications like the Microsoft Office Outlook® e-mail client can introduce several challenges. This article highlights one of these challenges and outlines several approaches organizations can take to help overcome it.

E-MAIL ACCESS CHALLENGES IN A STREAMING ENVIRONMENT

Standard-mode deployments of the Dell On-Demand Desktop Streaming solution include a read-only gold virtual disk (vDisk) image on the server, which is presented as a local hard drive to client systems booting from that server. Because the image is read-only, client disk writes are temporarily cached on the server; these writes are not persistent, so noncommitted data is lost at the end of each boot session. End-user data that requires persistent storage, such as files and personal e-mail folders, must be stored on the network and accessible to clients—for example, by using standard networked attached storage (NAS) systems that offer storage space as home drives. Administrators can use such systems in the standard-mode deployment to store persistent end-user data, as shown in Figure 1. The NAS system depicted in the figure is for sample architectural reference only; a variety of commercial external storage NAS solutions are available that incorporate various types of storage hardware and can be deployed in the solution to store user data.

E-mail platforms such as Microsoft Exchange typically provide end users with a mailbox hosted on a

[1] For more information on Dell On-Demand Desktop Streaming and its components, see "Simplifying IT with Dell On-Demand Desktop Streaming," by Aaron Prince and Bharath Vasudevan, in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20080175-Prince.pdf.

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server. Administrators designate a mailbox quota for users, who would then be unable to send or receive messages if they exceeded this quota. Users often overcome this limitation by archiving or filing excess e-mail in offline e-mail folders stored as files on their local hard drive. These files may also be backed up to other persistent storage such as optical media, hard drives, or tape systems that can be centrally managed by IT departments.

Because the local hard drive is nonpersistent in standard-mode deployments of the On-Demand Desktop Streaming solution, it cannot be used for storing offline e-mail folders; these folders must be stored and accessed from a network location such as a NAS system. However, Microsoft Office Outlook only supports storing these personal folders—stored as .pst files—on local hard drives, not on networked storage.[2] Similarly, when Outlook is configured in cached mode, an offline e-mail folder is created on the local hard drive as an .ost file, with the user's mailbox hosted on the e-mail server cached in this file and periodically synchronized with the server. Outlook does not support .ost files hosted on networked storage. Other Microsoft Windows® OS–based network methods such as folder redirection and domain profiles are also generally unsuitable for storing e-mail folders, because they are typically based on NAS systems as well.

Because these folder files cannot be stored on networked storage in an environment using Microsoft Exchange and Outlook, organizations using the On-Demand Desktop Streaming Solution must consider alternative methods of storing offline user e-mail. They should also keep in mind that cached-mode operation of Outlook is not supported with standard-mode deployments.

SOLUTIONS FOR E-MAIL ACCESS IN A STREAMING ENVIRONMENT

Organizations can consider four possible methods of accessing e-mail in Dell On-Demand Desktop Streaming environments: using private-mode deployments, implementing an e-mail archiving solution, using e-mail Web access, and increasing user mailbox size.

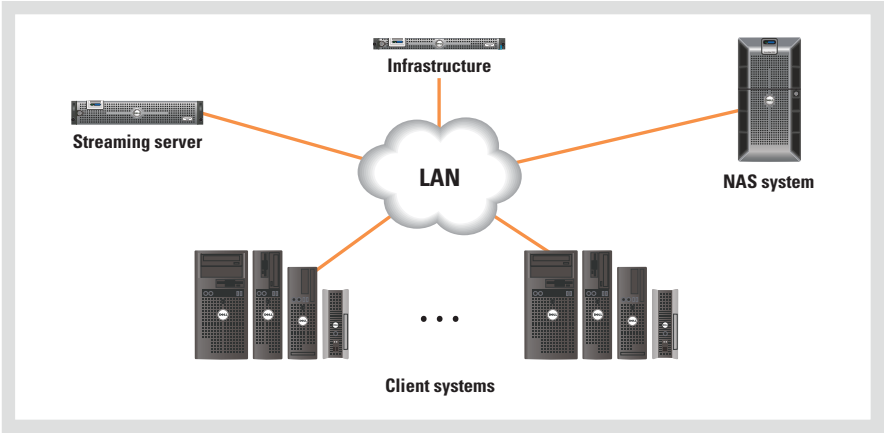

Figure 1. *Dell On-Demand Desktop Streaming environment using a NAS system to store persistent end-user data*

Using private-mode deployments

In private-mode deployments of the On-Demand Desktop Streaming solution, each client system has its own image stored on the streaming server, which is then streamed and presented as the hard drive to the client. Client disk writes, including writes to .pst folder files, are stored on this server image—meaning that offline user e-mail folders stored on the client hard drive are stored in the image. This approach offers a number of advantages, including increased data security and reliability. For example, storing user e-mail data on an image in the data center rather than on a local hard drive helps protect against physical theft and enable centralized backup and restore operations.

This approach does have drawbacks, however. For example, administrators can no longer take advantage of the simplified single-image management of standard-mode deployments, meaning they must perform maintenance activities such as upgrades and patches on each client image individually, as they would with traditional clients using local hard drives. In addition, if multiple users share a single client, their offline e-mail data would be stored in the same image. Administrators must therefore set up security and access permissions to help ensure proper segregation on the image, giving users access to only their own e-mail data.

Administrators should also keep in mind that offline user e-mail data does not automatically migrate across client systems: if a user requires access to e-mail data on a different system, then the data from the first system must be copied to the second system directly or over a temporary network share. They should also consider the overall performance of the solution: because the server must stream a separate image to each client, the caching advantages of using a single image are lost, and the significant amount of client e-mail data stored on each image could lead to an increase in data flowing across the network to the server.

In addition, when using a private-mode deployment, administrators must still deploy antivirus and anti-spyware software that can continuously scan the user's image for threats. Running these constant I/O operations simultaneously for numerous clients may have adverse effects on server resources. Organizations should design their streaming server and network infrastructure suitably to handle these situations.

[2] For more information, visit support.microsoft.com/kb/297019.

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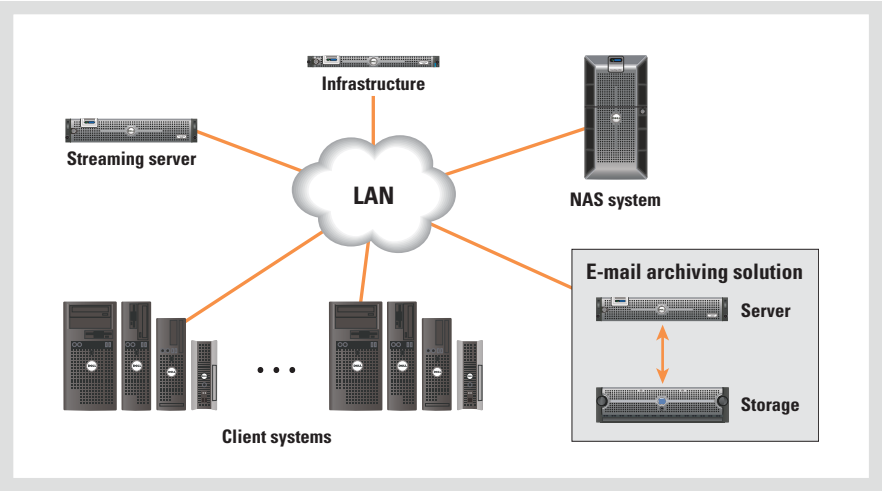

Figure 2. *Dell On-Demand Desktop Streaming environment integrated with an e-mail archiving solution*

Implementing an e-mail archiving solution

E-mail archiving solutions such as Symantec Enterprise Vault and EMC® EmailXtender® software are becoming increasingly important to many enterprises. These solutions enable users to extend the size of their mailboxes by offering an offline storage repository for storing and archiving user e-mail that exceeds the quota assigned to user mailboxes in the e-mail server. The archiving solution repository is separate from the mailbox server and typically includes its own hardware and software components, and can provide end users with seamless access to offline e-mail storage directly from their client systems even when the server is not available. Organizations can support a standard-mode deployment of the On-Demand Desktop Streaming solution with a suitable e-mail archiving solution for hosting offline user e-mail (see Figure 2).

Archiving solutions typically offer several features and advantages in addition to providing an offline repository for user e-mail. For example, they can help organizations comply with legal and regulatory requirements by providing mechanisms to manage, store, and retain user e-mail data based on specific policies. Features such as journaling allow classification and storage based on enterprise policies, and allow users to manage and store messages based on personal policies. E-mail archiving solutions can also provide the advantages of centralized physical security and reliability to help protect against data loss.

Limitations of e-mail archiving solutions can include the additional cost, planning, and maintenance associated with a separate data center solution. Implementing this type of solution simply to overcome the offline e-mail storage problem in a standard-mode On-Demand Desktop Streaming deployment may not be cost-effective.

Using e-mail Web access

A final option to still allow access to e-mail in a standard-mode On-Demand Desktop Streaming environment involves accessing e-mail differently. In addition to console-based clients, many e-mail solutions typically provide Web browser–based access to user mailboxes; Microsoft Exchange, for example, provides Outlook Web Access, which enables users to connect to the Exchange server through a Web browser, log in, and access their mailbox. In a standard-mode On-Demand Desktop Streaming deployment, users can typically access e-mail from any streaming client system on the network; user e-mail resides centrally on the mailbox server, with no user e-mail data stored on the client image. Users' ability to store e-mail data on the client image can be restricted by not installing e-mail management client applications such as Outlook on the client image.

Because e-mail Web access solutions typically do not require the installation and maintenance of e-mail client applications on the shared client image, they can help administrators avoid the challenge of maintaining individual mailboxes. Additional advantages of this method can include reduced associated licensing and maintenance costs: applications like Outlook Web Access are typically distributed as part of server software such as Microsoft Exchange rather than as part of client application packages such as Microsoft Office. In this method, user access to e-mail can become OS agnostic, typically allowing users to access e-mail through a standard Web browser from any client system. Higher-education environments often utilize Web access to accommodate the needs of mobile students and support the variety of OS environments that may be used on campus.

Web access solutions may limit user experience, however, by not including all the features available on a console-based e-mail client application, and they still require users to manage their mailbox size themselves. Because of these limitations, this approach is typically best suited for deployments where end users require e-mail access but do not incur heavy usage. This approach can be combined with an increased mailbox size to provide additional options for managing e-mail in On-Demand Desktop Streaming environments.

Increasing user mailbox size

Perhaps the simplest approach to allowing storage of personal e-mail folders when using a single shared client image is increasing end-user mailbox sizes. By allowing all user e-mail data to be stored in the mailboxes hosted on the e-mail server while typically remaining accessible

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from any client on the network, this approach helps avoid the need for users to store e-mail as personal folders on the client image.

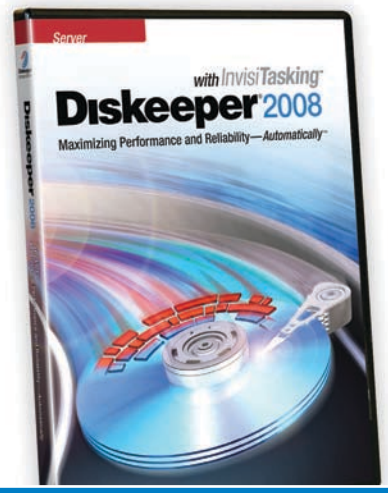
Advantages of this approach include centralized management of e-mail data and increased physical security. However, this approach can increase the cost per mailbox for IT operations because of the additional storage hardware required to support the increased mailbox size and associated maintenance costs. In addition, organizations may need to modify existing IT procedures and policies related to mailbox quotas to support this approach.

FLEXIBLE DESKTOP STREAMING ENVIRONMENT

The Dell On-Demand Desktop Streaming solution can provide significant advantages to IT departments, including increased manageability, reliability, and security. However, this client computing model can also introduce new challenges for traditional client-server applications, including the storage of user e-mail as offline folders on the local hard drives of client systems. In addition to the approaches outlined in this article—using private-mode deployments, implementing an e-mail archiving solution, using e-mail Web access, and increasing user mailbox size—other options may also help address this problem depending on the requirements of the deployment. Organizations should carefully assess application and environment requirements before deployment to help ensure that their approach meets the needs of both end users and the enterprise IT department.

Ananda Sankaran is a lead engineer on the Dell End-to-End Solutions team. His current interests include messaging and unified communications, flexible computing, databases, enterprise storage, and application sizing. He led the release of the Dell SQL Server 2005 Advisor and Dell Exchange 2007 Advisor tools. Ananda has a master's degree in Computer Science from Texas A&M University.

Bharath Vasudevan is the product manager for database programs at Dell. He previously led the solutions engineering team that delivered commercial solutions for e-mail, unified communications, and flexible computing solutions. He has a master's degree in Electrical and Computer Engineering from Carnegie Mellon University.



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COMPREHENSIVE DATA PROTECTION WITH SYMANTEC BACKUP EXEC 12

By Charles Butler

Symantec® Backup Exec™ software is designed to provide simplified, comprehensive backup and recovery for Microsoft® Windows® environments. The new Symantec Backup Exec 12 introduces multiple enhancements, including enhanced granular recovery and continuous protection, comprehensive support for the Microsoft Windows Server® 2008 OS, and innovative integration with other Symantec products.

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Symantec Backup Exec 12 is designed to provide efficient, easy-to-manage backup and recovery protection from servers to desktops and notebooks, offering market-leading data protection for environments based on Microsoft Windows operating systems. With granular recovery features and continuous data protection for critical Microsoft applications, Backup Exec 12 helps ensure that critical data is efficiently protected and can be quickly recovered, down to individual e-mail messages, folders, and documents. And its high-powered remote agents help provide scalable data protection even for servers not running Microsoft operating systems.

In addition to offering simplified, comprehensive backup and recovery for Windows environments, Symantec Backup Exec 12 includes enhanced granular recovery and continuous protection features, comprehensive support for the Windows Server 2008 OS, innovative integration with other Symantec products, and other features such as an enhanced Agent for Windows Systems, enhanced support for Linear Tape-Open (LTO) tape drives, and an integrated trial of agents and options at no additional cost.

SIMPLIFIED, COMPREHENSIVE BACKUP AND RECOVERY

By offering a comprehensive data protection and recovery solution in a single product suite, Backup Exec 12 helps reduce the complexity of dealing with the backup and recovery of a critical asset for most enterprises—their data. Whether that data resides on a Windows-based file server, a desktop or notebook, or a critical Microsoft Exchange, Microsoft SQL Server®, or Microsoft Office SharePoint® Server application server, Backup Exec 12 can offer comprehensive protection and recovery for both data and systems.

To help meet growing enterprise needs, Backup Exec 12 provides traditional tape-based as well as disk-based continuous data protection—helping eliminate backup windows, accelerate data recovery, and enable end users to recover their own files without IT staff intervention. Administrators can use Backup Exec 12 to quickly recover data, including critical information such as individual e-mail messages, folders, and documents, from a single backup. An optional centralized administration console provides scalable management of distributed backup and remote servers. And in addition to sophisticated database and groupware agents that help provide granular recovery and online protection, Backup Exec 12 also includes entry-level system recovery and open file protection.

Other key features of Backup Exec 12 also help simplify backup and recovery tasks. For example, administrators can use the enhanced user interface and calendar view to quickly track and monitor backup and recovery jobs. Backup Exec 12 also

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provides the Pre-Install Environment Checker, which highlights potential problems before the software is installed. The Job Test Run feature enables Backup Exec 12 to identify potential problems that cause job failures and then notify administrators so that they can take appropriate corrective action. The automatic discovery of new resources enables administrators to create a job for detecting new, unprotected resources that may be at risk and in need of backup. These tools help reduce the time and resources needed to install and run Backup Exec, while helping improve overall data protection.

ENHANCED GRANULAR RECOVERY AND CONTINUOUS PROTECTION

Symantec Backup Exec 12 incorporates patent-pending Granular Recovery Technology (GRT) for critical Microsoft applications, including Exchange, Active Directory®, SharePoint Server, and Windows SharePoint Services software—enabling organizations to recover granular data quickly and efficiently from a single-pass backup (see Figure 1). This innovative technology helps eliminate the need to run Exchange mailbox backups to recover granular data, and allows rapid, simple recovery of Active Directory, SharePoint Server, and SharePoint Services data, including documents, user attributes, and properties. End users can simply browse, select, and restore individual items in the database without requiring IT staff intervention. In Backup Exec 12, not only are mailbox or Messaging Application Programming Interface (MAPI) backups not required for granular recovery, but administrators can now easily store GRT-enabled backups on a remote or removable disk or on a storage area network to help further optimize their backup and recovery strategy.

Backup Exec also provides continuous data protection, which complements GRT by helping provide fast, reliable disk-based data protection that continuously backs up transaction logs and assigns user-designated recovery points to help eliminate the daily backup window. In addition, each recovery point can be easily opened and browsed for rapid restoration of a specific document or e-mail. Continuous data protection provides protection for Windows-based file servers, Exchange servers, and SQL Server servers, desktops, and notebooks. And, with Symantec Backup Exec Retrieve for file servers, end users can quickly retrieve their own files—without IT staff intervention.

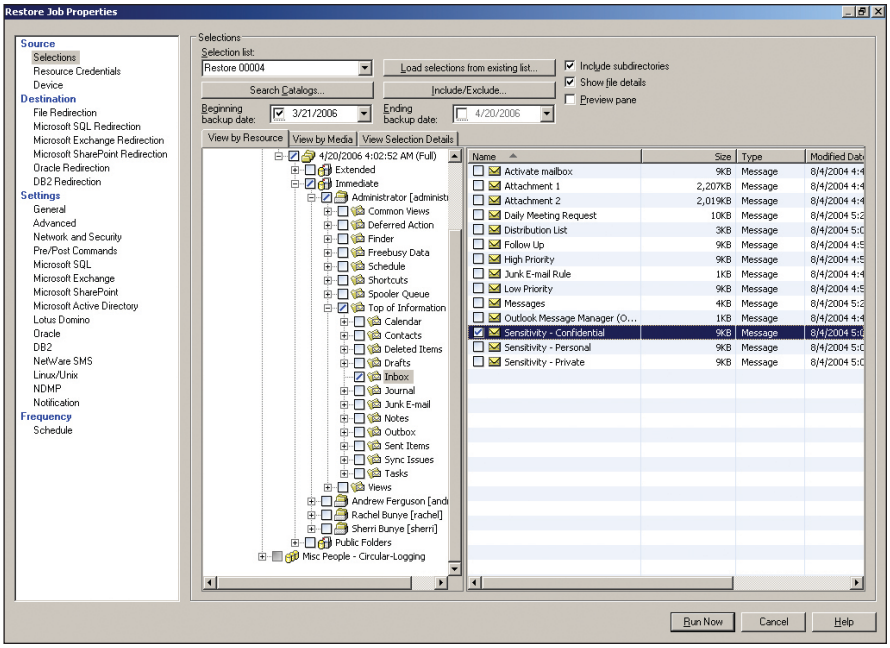

Figure 1. *Granular Recovery Technology in Symantec Backup Exec 12*

SUPPORT FOR MICROSOFT WINDOWS SERVER 2008

Symantec Backup Exec has provided backup and recovery for environments running Microsoft operating systems and applications for over 15 years through a direct partnership between Symantec and Microsoft. Backup Exec 12 continues to do so by introducing comprehensive support for Microsoft Windows Server 2008.

Backup Exec 12 is Windows Server 2008 certified by Microsoft and takes advantage of capabilities and technologies introduced in Windows Server 2008 to provide comprehensive support for its components, including protection for Transactional NT File System (NTFS), system state, and Active Directory; online protection for Microsoft Virtual Server virtual machines through Volume Shadow Copy Service (VSS); automated basic system recovery of Windows Server 2008 systems, including Microsoft BitLocker™ encrypted volumes; and comprehensive support for open files through VSS as well as clusters and cluster databases—all from a single data protection solution designed to protect entire Windows-based infrastructures from Windows 2000 through Windows Server 2008.

INTEGRATION WITH OTHER SYMANTEC PRODUCTS

Symantec Backup Exec 12 is designed to integrate with Symantec Endpoint Protection, Symantec Backup Exec System Recovery, Symantec Protection Network, and Symantec Enterprise Vault™ software to help simplify and enhance organizations' ability to secure, back up, and archive critical data. Integration with Symantec Endpoint Protection, for example, helps provide up-to-the-minute security warnings and proactive ThreatCon backup protection, while the enhanced Backup Exec System Recovery Option provides advanced disaster recovery protection,

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including support for Windows Server 2008. Integration with Symantec Online Storage provided by Symantec Protection Network offers a secure, easy-to-manage option for off-site storage.

The new Symantec Backup Exec 12 Agent for Symantec Enterprise Vault software offers a comprehensive data protection package for critical Enterprise Vault installations (see Figure 2). The ability to automatically place Enterprise Vault databases and Vault Stores into backup mode, coupled with automatic detection of many aspects of the Enterprise Vault infrastructure to help complete database and file system backup, make this a sophisticated and straightforward single-agent approach to protection. Backup Exec 12 uses the capabilities and technologies of Enterprise Vault to provide comprehensive protection of Enterprise Vault infrastructures, including the following:

- Integration with Enterprise Vault to allow Backup Exec 12 to understand what parts of Enterprise Vault exist on each system where the agent is installed
- Implicit protection of Vault Store databases and associated partitions—when a Vault Store is selected for backup, the associated partitions are automatically selected as well, helping keep Vault Store databases and partitions in sync
- Automatic enabling of Enterprise Vault backup mode when backups start, and automatic disabling of backup mode when backups complete
- Comprehensive restore capabilities, from entire Vault Stores and partitions down to individual files or indexes

OTHER KEY ENHANCEMENTS

Symantec Backup Exec 12 also includes an enhanced Agent for Windows Systems, enhanced support for LTO tape drives, and an integrated trial of agents and options at no additional cost. The Agent for Windows Systems incorporates the Remote Agent for Windows Servers, continuous data protection, the Advanced Open File Option to help protect open files, and the Intelligent Disaster Recovery Option (now included with Backup Exec Media Server) for basic tape-based disaster recovery. The agent expands Windows-based data protection and helps optimize data transfers for 32- and 64-bit remote Windows-based servers, including local registry and system state information.

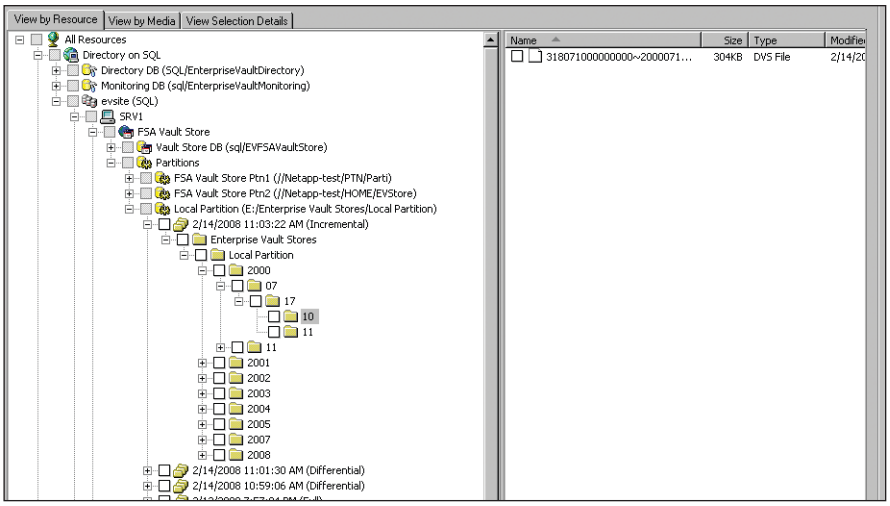

***Figure 2**. Symantec Backup Exec 12 integration with Symantec Enterprise Vault*

Backup Exec 12 also supports LTO-4 hardware encryption by managing the encryption keys through the tape drive, enabling data to be quickly decrypted and easily recovered to the Backup Exec media server. In addition, it supports high-speed block-size backups using LTO-3 and LTO-4 high-performance tape drives, helping reduce overall backup times.

Finally, administrators can use the Backup Exec 12 console to easily download and evaluate Backup Exec agents and options in their Backup Exec 12 environment for 60 days at no additional cost. Then, before the trial period expires, they can simply purchase and install the license keys for the agents or options they want to continue using—typically with no reinstallation or new configuration necessary.

COMPREHENSIVE DATA PROTECTION

The innovative architecture of Symantec Backup Exec, which incorporates Microsoft design standards and is Microsoft certified for the Windows 2000 Server, Windows Server 2003, and Windows Server 2008 operating systems, is designed to provide comprehensive backup and recovery for Microsoft Windows environments. By providing key enhancements such as Granular Recovery Technology and continuous data protection, integration with other Symantec products, and the option to try out agents and options for 60 days at no additional cost, Backup Exec 12 offers a powerful, easy-to-manage way to protect critical enterprise data.

Charles Butler is a principal product manager in the Data Protection Group at Symantec. He has a B.S. in Electrical and Computer Engineering from the University of Colorado at Boulder and an M.B.A. from St. Edward's University.

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ACCELERATING BLADE SERVER MIGRATION WITH SYMANTEC BACKUP EXEC SYSTEM RECOVERY 8

By Charles Butler
Chad Fenner

The Dell™ PowerEdge™ M-Series modular blade enclosure and blades can offer significant advantages, including high efficiency and rapid deployment. For enterprises planning to migrate from stand-alone servers to blade servers, Symantec® Backup Exec™ System Recovery 8 provides powerful, versatile features to help ensure a smooth, rapid transition.

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Because the high density and efficiency of modular blade enclosures can help significantly reduce total cost of ownership compared with stand-alone rack and tower servers, physical consolidation on blade servers is becoming increasingly popular. Designed for the fastest deployment of any Dell server ever produced, the Dell PowerEdge M-Series modular blade enclosure and blades can rapidly integrate into virtually any data center. Integrated into the enclosure is new hardware such as a front interactive LCD that allows administrators to easily configure settings such as IP addresses to help accelerate initial deployment or migration.

To provide a comprehensive deployment and migration solution, Dell also partners with vendors such as Altiris and Symantec on tools such as Altiris® Deployment Solution™ for Dell Servers software and Symantec Backup Exec System Recovery Server Edition. In combination with the PowerEdge M1000e enclosure, these tools offer multiple ways to help simplify the deployment and migration of PowerEdge M-Series blades. By allowing administrators to quickly and easily restore systems to dissimilar hardware, Symantec Backup Exec System Recovery 8 provides a key tool to help organizations accelerate a migration to blade servers.

SYMANTEC BACKUP EXEC SYSTEM RECOVERY 8

Symantec Backup Exec System Recovery 8 provides a comprehensive disk-based, bare-metal system recovery solution for servers, desktops, and notebooks running Microsoft® Windows® operating systems (including the Windows Server® 2008 OS) that enables enterprises to rapidly recover from system loss or disasters—even to dissimilar hardware platforms or virtual environments, or to remote, unattended locations. It is designed to capture a recovery point of the entire live Windows system—including the OS, applications, system settings, configurations, and files—without disrupting end-user productivity or application usage. This recovery point can then be conveniently saved to various media or disk storage devices, including storage area networks, network attached storage, direct attach storage, RAID arrays, CDs, and DVDs. When systems fail, administrators can quickly perform a full system restore, even to bare-metal systems, without the need for manual, lengthy, error-prone reinstallations of operating systems, applications, system settings, and preferences.

Backup Exec System Recovery is well suited for both disaster recovery and system migration and is designed to scale to meet growing enterprise needs. As a disaster recovery tool, it enables administrators

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to recover physical systems to the same hardware or different hardware following partial or complete system loss. As a migration tool, it enables them to accelerate blade server deployments by migrating stand-alone rack and tower servers to blade servers such as the Dell PowerEdge M-Series enclosure and blades.

Backup Exec System Recovery 8 also introduces flexible off-site protection and enhanced recovery capabilities, supporting off-site copying to an FTP site or secondary disk drive as well as simple, seamless conversion of physical systems to virtual environments. Its innovative integration with other Symantec products helps increase the power and flexibility of these tools, offering event-triggered backups based on Symantec ThreatCon security monitoring, central backup management for Altiris Notification Server™ with the Backup Exec System Recovery Integration Component for Altiris, and features that complement Symantec Backup Exec for Windows Servers.[1]

The powerful Windows recovery capabilities in Backup Exec System Recovery can also auto-detect hardware and load the appropriate drivers to boot the system, helping eliminate the need to manually build recovery floppy disks, and its intelligent USB drive identification enables it to run backup jobs to a given USB device even if the drive letter changes. The customizable Symantec Recovery Disk can automatically harvest system drivers not already included on the disk and allow administrators to add drivers for a customized recovery environment tailored to meet their specific hardware needs.

Three features of Backup Exec System Recovery provide key additional functionality to enable flexible system recovery, rapid object recovery, and scalable centralized management and help simplify both data recovery and blade server migration: the Symantec Restore Anyware™ technology included with Backup Exec System Recovery, and the Granular Restore Option and Backup Exec System Recovery Manager available as separate add-ons.

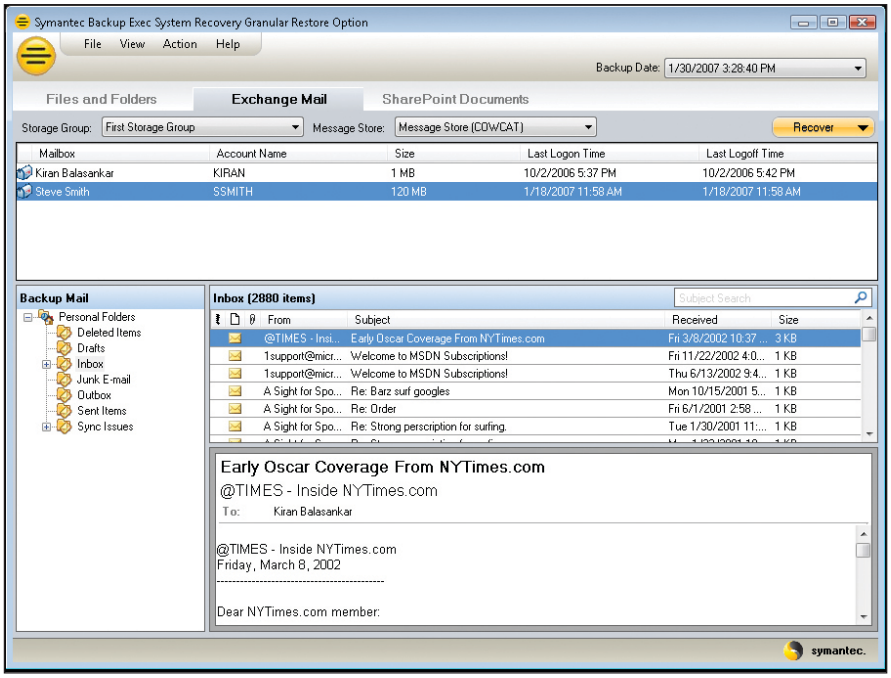

Figure 1. *Symantec Backup Exec System Recovery 8 Granular Restore Option for Microsoft Exchange*

Flexible system recovery: Restore Anyware

The Symantec Restore Anyware technology in Symantec Backup Exec System Recovery allows administrators to quickly and easily recover systems to dissimilar hardware or virtual Windows environments, helping dramatically reduce recovery times and save on hardware investments. These hardware-independent restore capabilities provide high levels of flexibility to restore systems virtually anytime, from virtually anywhere, to virtually any device within their existing IT infrastructure.

By combining hot imaging with the ability to recover systems to different hardware platforms, Restore Anyware helps overcome the barriers of incompatible storage controllers and hardware abstraction layers. Its integrated network interface card (NIC) support helps ensure that NICs function properly after a recovery point has been restored to a dissimilar system. In addition, Restore Anyware enables end users to migrate their system to new hardware without requiring a new installation—a key capability when upgrading hardware or repurposing systems for a different role.

Rapid object recovery: Granular Restore Option

The Symantec Backup Exec System Recovery Granular Restore Option enables administrators to rapidly restore individual objects from recovery points for Microsoft Exchange servers (including Exchange Server 2007 servers), Microsoft Office SharePoint® servers, and file servers. The integrated multi-tab interface provides convenient access to recovery points and allows administrators to search multiple recovery points simultaneously (see Figure 1). The Granular Restore Option also helps avoid the need for Exchange mailbox backups, allowing administrators to rapidly recover critical Exchange mailboxes, folders, messages, and attachments and even forward them directly through the Microsoft Office Outlook® e-mail client.

[1] For more information on Symantec Backup Exec, see "Comprehensive Data Protection with Symantec Backup Exec 12," by Charles Butler, in *Dell Power Solutions*, May 2008, DELL.COM/Downloads/Global/Power/ps2q08-20080217-Symantec.pdf.

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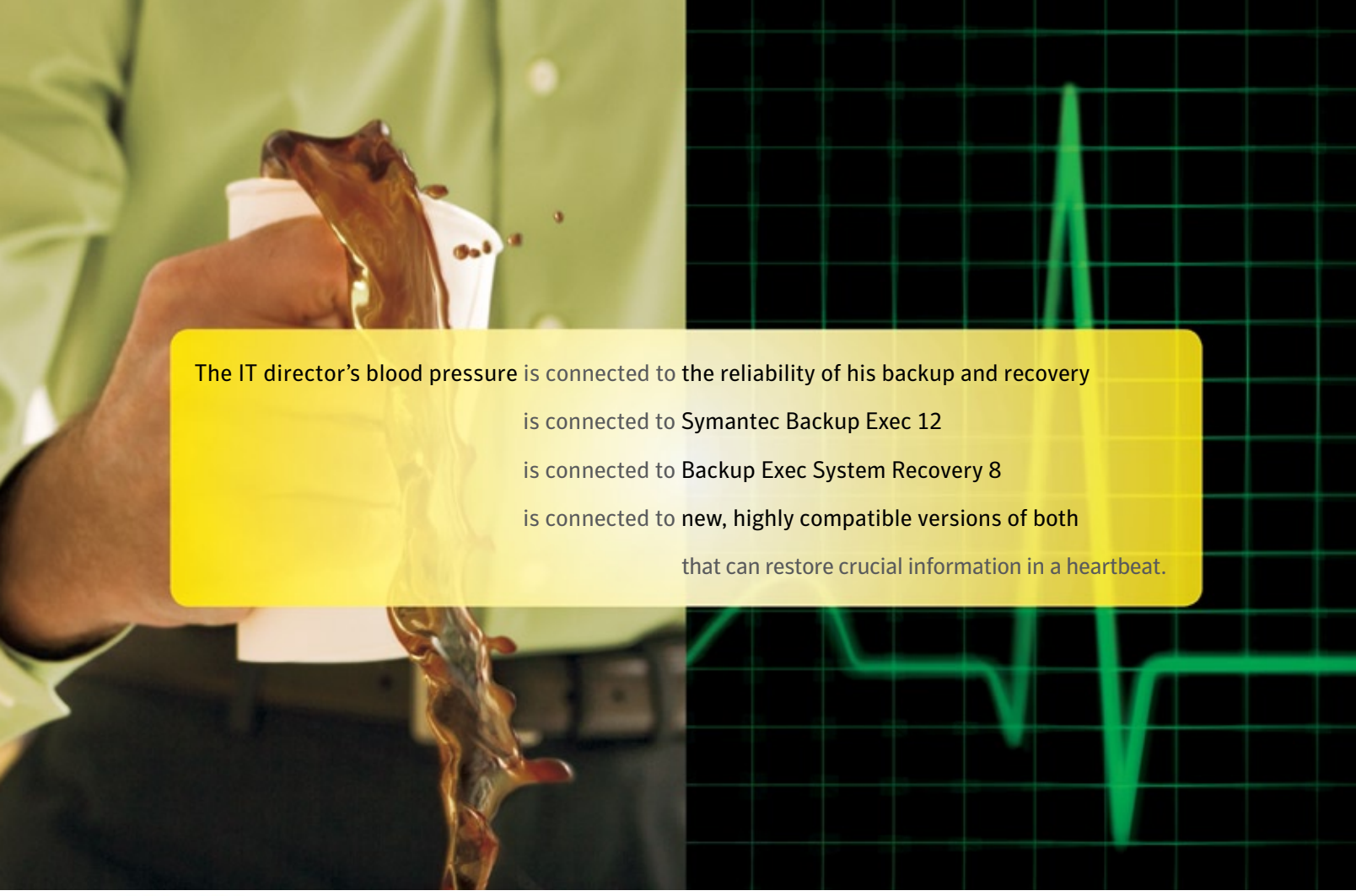

The IT director's blood pressure is connected to the reliability of his backup and recovery is connected to Symantec Backup Exec 12 is connected to Backup Exec System Recovery 8 is connected to new, highly compatible versions of both that can restore crucial information in a heartbeat.

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Symantec Backup Exec™ 12

- Gold Standard in Windows® data protection with day-one Microsoft® Windows Server 2008 support
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Symantec Backup Exec™ System Recovery 8 Server Edition

- Restores even disparate systems in minutes
- Includes flexible offsite protection to an FTP or disk
- Granular Restore Option recovers individual Exchange messages from a single interface

For trialware and more information visit symantec.com/confidenceahead

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Confidence in a connected world. symantec™

Scalable centralized management: Backup Exec System Recovery Manager

Symantec Backup Exec System Recovery Manager allows administrators to manage multiple Backup Exec System Recovery installations from a centralized console, where they can monitor the current protection status of their managed systems from a simplified, consolidated home page view. Administrators can use this console to detect issues for quick problem analysis and view historical trends.

Administrators can use Backup Exec System Recovery Manager to view the real-time status of backup jobs; filter these jobs by computer name, job type, job name, and IP address; and examine errors to troubleshoot problems. They can also define recovery point policies for groups of servers, desktops, or notebooks with similar requirements; drag and drop to deploy those policies; and generate predefined reports in comma-separated values (CSV), HTML, XML, and Microsoft Office Excel® spreadsheet formats for distribution to IT management. Backup Exec System Recovery Manager supports role-based administration as well, to provide varying levels of management as needed.

ACCELERATED BLADE SERVER MIGRATION

Symantec Backup Exec System Recovery Server Edition—with its Restore Anyware feature—allows administrators to quickly and easily create complete system images of traditional rack and tower servers and deploy them on blade servers with dissimilar hardware. The disk-to-disk technology used in Backup Exec System Recovery can also help administrators meet ambitious system migration time objectives.

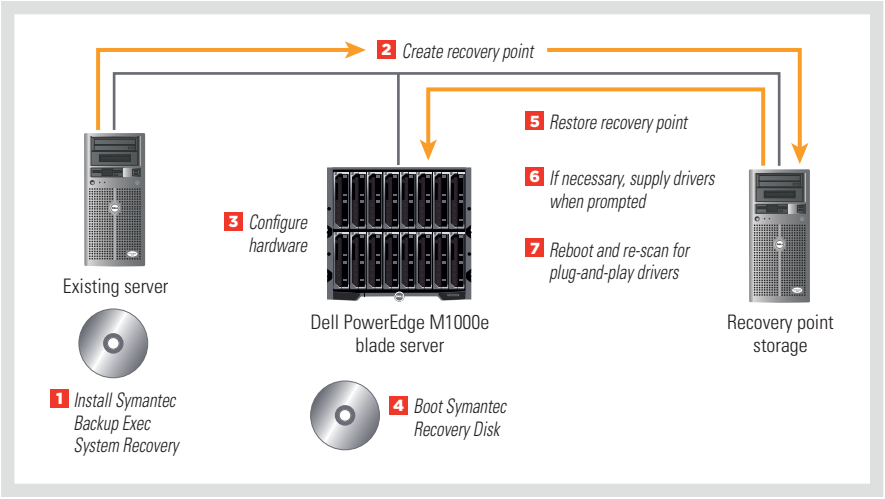

Figure 2. *Blade server migration process using Symantec Backup Exec System Recovery Server Edition*

Figure 2 illustrates how administrators can use Backup Exec System Recovery to create a recovery point from an existing server and restore it on a PowerEdge M-Series blade in a PowerEdge M1000e enclosure. By eliminating the software and OS reinstallation steps performed in the traditional system migration process, Backup Exec System Recovery can help significantly simplify blade server migrations while preserving the system and software configuration settings of the environment being migrated.

POWERFUL, VERSATILE SYSTEM RECOVERY

The powerful bare-metal imaging and recovery features in Symantec Backup Exec System Recovery are designed to protect physical servers, enable rapid recovery from system failure, and accelerate system migration processes for organizations of all sizes. For enterprises planning to consolidate stand-alone rack and tower servers to efficient, rack-dense blade servers such as the Dell PowerEdge M-Series enclosure and blades, Backup Exec System Recovery offers a versatile tool to help ensure a smooth, rapid transition.

Charles Butler is a principal product manager in the Data Protection Group at Symantec. He has a B.S. in Electrical and Computer Engineering from the University of Colorado at Boulder and an M.B.A. from St. Edward's University.

Chad Fenner is a senior product manager for blade servers at Dell. He has a bachelor's degree from Trinity University in San Antonio, Texas.

> **"Backup Exec System Recovery is well suited for both disaster recovery and system migration and is designed to scale to meet growing enterprise needs."**

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SECURE, UNIFIED WEB APPLICATION DELIVERY WITH F5 BIG-IP AND DELL BLADE SERVERS

By Scott Siragusa
Dan Kim

The Dell™ PowerEdge™ M1000e modular blade enclosure offers the power and flexibility to meet the most demanding workloads. Dell and F5 Networks provide a comprehensive delivery system for Web applications designed for high performance and scalability as well as tight security to help safeguard critical data.

Related Categories:

Blade servers

Security

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As enterprises continue to Web enable their core applications, the need for high availability, scalability, security, performance optimization, and simplified management has intensified. Blade servers—modular, ultra-dense servers using a single chassis with high redundancy—enable economies of scale in data centers while helping drastically reduce requirements for power, space, and dedicated hardware management.

However, using the advantages of blade servers for Web application delivery also requires an approach that can unify independent application and server resources and present them as one. Combining Dell PowerEdge M1000e modular blade enclosures with F5® BIG-IP® Local Traffic Manager™ (LTM) and BIG-IP Application Security Manager™ (ASM) systems offers a secure, unified way to deliver Web applications—helping simplify IT by allowing comprehensive control with flexible scalability for enhanced enterprise agility.[1]

DEPLOYING SCALABLE, HIGHLY AVAILABLE WEB APPLICATIONS

Maintaining consistent availability is generally a key concern for enterprises deploying Web servers, from e-commerce companies relying on Web applications for revenue to services organizations relying on information delivery over the Internet. Traditionally, these enterprises have implemented simple load-balancing clusters to help ensure the availability of Web servers. However, as usage increased and large deployments became common, increased network traffic, limited health-checking capabilities, and increased security concerns left organizations searching for a more comprehensive solution than these clusters could provide.

F5 BIG-IP LTM systems can detect a variety of device failures to help ensure mission-critical resources respond appropriately to maintain availability, while simultaneously accelerating performance through features like compression, RAM caching, Secure Sockets Layer (SSL) offload, and TCP optimizations. Advanced content and application checks such as Extended Content Verification (ECV) and Extended Application Verification (EAV) simulate an end-user request and monitor the true availability of application content. These advanced health-checking capabilities can help organizations achieve high levels of availability for their critical applications while helping reduce operational complexity and costs. If one

[1] For more information on the PowerEdge M1000e, see "The Next-Generation Dell PowerEdge M1000e Modular Blade Enclosure," by Chad Fenner, in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20080206-Fenner.pdf.

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service is nearing the limits of its capacity, scaling it can be as simple as adding another instance of the service to the network and then to the BIG-IP load-balancing pool. By combining LTM with Dell PowerEdge M1000e blade servers, organizations can create a highly scalable, highly available environment to help them meet growing organizational demands on Web and application resources.

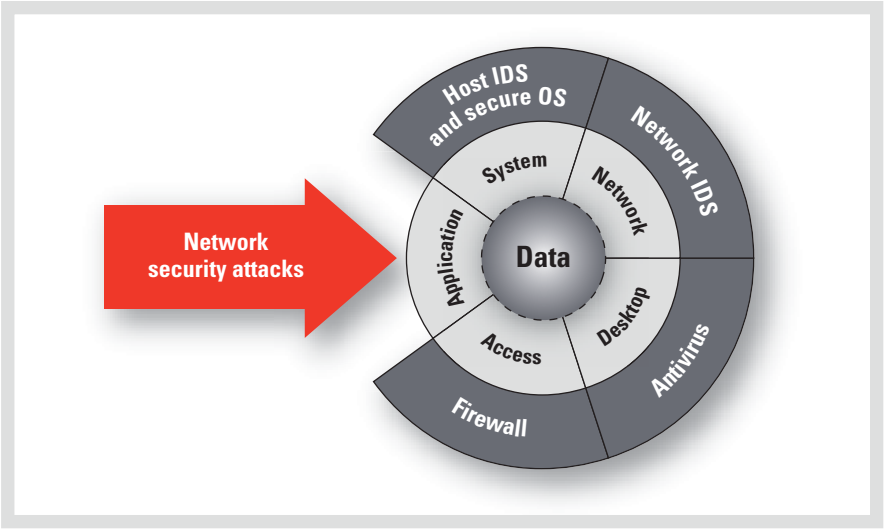

Figure 1. *Enterprise applications are a key vector for network security attacks*

DEFENDING AGAINST SECURITY THREATS

Web site security is becoming increasingly complex, and increasingly crucial to Web server deployments. Some of the most serious—and most common—network security threats come from attacks targeting vulnerabilities in Web traffic or enterprise applications (see Figure 1). These attacks typically ignore conventional firewalls, intrusion detection systems (IDSs), and intrusion prevention systems (IPSs), and are often difficult and costly to prevent.

BIG-IP LTM systems enable organizations to encrypt Web traffic by integrating SSL encryption and decryption capabilities. Offloading processor-intensive SSL transactions from front-end servers can help significantly increase the performance of Web server clusters, freeing Web sites to handle additional user requests. This solution helps maximize application availability, simplify maintenance, and reduce administration overhead. By offloading SSL and persistence functions, administrators can create a comprehensive proxy environment with increased application performance. Figure 2 illustrates a typical deployment of BIG-IP LTM systems and Dell PowerEdge M1000e blade servers in a secure, highly scalable, highly available environment.

LTM systems are also available with a Federal Information Processing Standard (FIPS) 140-2 Level 3 certified cryptographic/SSL accelerator. FIPS products from F5 Networks meet the high levels of security standards required by government agencies, financial services, and health care organizations by integrating a tamper-resistant key protection module and sophisticated key management capabilities. Centralizing this feature on an LTM system rather than deploying it on each Web server individually can provide significant savings on management costs.

MEETING SECURITY STANDARDS

The Payment Card Industry (PCI) Security Standards Council—founded by American Express, Discover Financial Services, JCB, MasterCard Worldwide, and Visa International—created the PCI Data Security Standard (DSS) to manage the ongoing evolution of security in this industry. This standard applies to organizations that process, store, and transmit cardholder and transaction data, and includes 12 basic requirements organized into six core areas.[2]

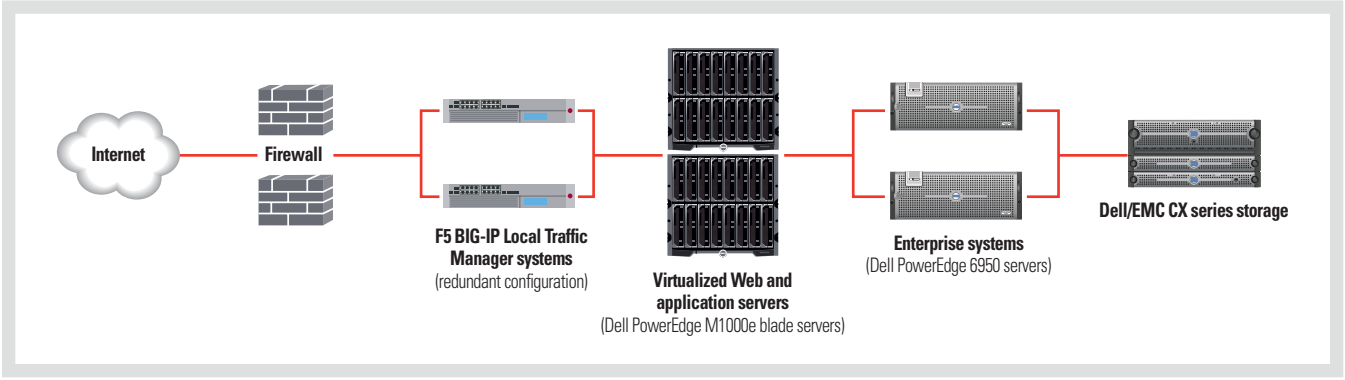

Figure 2. *F5 BIG-IP Local Traffic Manager systems with Dell PowerEdge M1000e blade servers help provide a secure, highly scalable, highly available environment*

[2] For more information, visit www.pcisecuritystandards.org/tech.

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F5 solutions can help organizations in all six DSS core areas and 10 out of 12 requirements. Most notably, requirement 6.6 in the DSS specification explicitly states the need for either an annual code review of applications or a Web application firewall to address security vulnerabilities in Web applications—a key feature available as a stand-alone appliance or product module for F5 BIG-IP.

BIG-IP ASM systems are designed to provide comprehensive protection for Web applications and operational infrastructure. These systems use an auto-adaptive approach to application delivery security in which the security policy is automatically updated based on observed traffic patterns. This simplified approach to configuration helps simplify implementation and maintenance and reduce overall total cost of ownership.

ASM also includes features beyond Web application security. As an underlying base, it provides Web application firewall functionality such as protection against cross-site scripting, buffer overflow, SQL or OS injection, cookie poisoning, forceful browsing, and manipulation of invalidated input, as well as content scrubbing and resource cloaking. By providing comprehensive security for International Organization for Standardization (ISO) Open System Interconnection (OSI) model Layer 2 (data link) through Layer 7 (application), ASM offers a holistic approach to application delivery security. From robust distributed denial-of-service (DDoS) attack protection, Layer 4 (transport) filtering, and Layer 7 DoS attack protection to Layer 7 application security, ASM offers a comprehensive approach to application delivery security.

The latest ASM version introduces a host of advanced security features such as XML firewall, FTP security, evasion attack protection, and active code protection. The new Real Traffic Policy Builder™ engine provides security heuristics to not only inspect bidirectional traffic in real time, but also parse JavaScript, Flash, and active code. In addition, this adaptive learning and tuning engine can help significantly reduce the administrative overhead for managing policy definitions. Organizations can deploy ASM as a stand-alone device or as a module on an LTM system.

> **"Together, F5 Networks and Dell can provide comprehensive solutions to help make Web applications secure, fast, and highly available for organizations of all sizes to help them maximize return on investment."**

In addition to providing a highly secure application firewall, ASM is also designed for high performance. By taking advantage of the F5 Traffic Management OS (TMOS™) unified architecture, ASM can use compression, RAM caching, SSL offload, TCP optimizations, and other performance optimizations to help accelerate firewall and application performance. Basing a Web application delivery infrastructure on ASM and Dell PowerEdge M1000e blade servers can help organizations create a highly scalable, high-performance environment while simultaneously helping ensure security.

CREATING A UNIFIED WEB APPLICATION DELIVERY FRAMEWORK

F5 Networks is the global leader in application delivery networking, and the Dell PowerEdge M1000e modular blade enclosure provides a highly redundant, highly energy-efficient server chassis while enabling maximum flexibility and modularity. By adding intelligence and manageability into the network to offload applications, F5 BIG-IP systems help optimize applications and allow them to work faster and consume fewer resources than they would otherwise. The F5 extensible architecture helps intelligently integrate application optimization, protect the application and the network, and deliver application reliability—all on one universal platform. Together, F5 Networks and Dell can provide comprehensive solutions to help make Web applications secure, fast, and highly available for organizations of all sizes to help them maximize return on investment.

Scott Siragusa is the senior strategic partner manager on the Dell/F5 Partner Team specializing in application delivery and security solutions. He has more than 9 years of experience in marketing, solution architecture, and business development with Dell and F5 Networks.

Dan Kim is a product marketing manager for F5 Networks specializing in application delivery and security solutions. He has been with F5 Networks for over 7 years and in the network and IT industry for almost 10 years.

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UPDATING DELL SERVER FIRMWARE IN ALTIRIS PREBOOT ENVIRONMENTS

By Eric Szewczyk
Trenton Potgieter

Altiris® Deployment Solution™ for Dell Servers now enables administrators to update Dell™ PowerEdge™ server firmware in a preboot environment rather than using a traditional OS update agent. Using this approach can help reduce incompatibilities and alleviate common concerns about deploying updates in production environments.

Related Categories:

Altiris

Blade servers

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One of the best ways to help ensure that hardware performs optimally and to maximize return on investment is to deploy feature and function updates provided by hardware vendors as well as bug fixes included in driver, BIOS, and firmware updates. Dell provides these updates for its servers as Dell Update Packages (DUPs)—self-contained files designed to execute in either Microsoft® Windows® or Linux® OS environments.

While some organizations spend a great deal of time, effort, and money to help ensure the successful deployment of firmware updates in their data centers, others question whether updates are even necessary—typically because they do not want to invest resources in deploying updates, are not experiencing compatibility or performance problems that an update might resolve, or do not want to risk disrupting a production system by running a noncritical process. In addition, if they have a large number of servers that do not run Windows or a mainstream Linux distribution—for example, Dell PowerEdge R805 and PowerEdge R905 servers running the integrated VMware® ESX Server 3i virtualization platform, or other servers running a custom Linux or UNIX® distribution—their environment may not be compatible with standard software management agents, or may not be able to execute DUPs in that OS. Enterprise IT policies may also limit the number of agents that can be installed on a server, or may lock down the OS and limit what processes can run effectively inside it.

Despite these concerns, keeping servers updated can offer several advantages, including enhanced performance, reduced incompatibilities, increased stability, and enhanced features and configuration options; deploying updates may also be required to maintain warranty support. To help reduce incompatibilities and alleviate common concerns about updates, Altiris Deployment Solution for Dell Servers now enables administrators to update Dell PowerEdge server firmware from an independent Linux preboot environment designed to provide successful update deployment while minimizing risks to the OS and system stability.

APPLYING FIRMWARE UPDATES IN A PREBOOT ENVIRONMENT

Altiris Deployment Solution for Dell Servers has previously enabled administrators to apply DUPs through an agent installed in a Windows or Linux environment. Using this traditional method, administrators would apply firmware updates to the hardware components by running processes that began in a production OS and ended with a reboot. In fact, DUPs were previously only designed and certified by Dell to execute in this manner.

Removing the OS from the update process altogether, and instead deploying updates in a Preboot Execution Environment (PXE) that supports the latest DUPs for BIOSs and firmware, provides a clear way

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to help avoid incompatibilities and other potential problems. With the release of Altiris Deployment Solution for Dell Servers 3.0 (Service Pack 1), Dell now supports executing DUPs in the Linux preboot environment without the presence of an agent, and administrators can use Altiris Deployment Solution for Dell Servers to apply DUPs in an independent Linux preboot environment. In this approach, servers PXE boot, execute the DUPs, and then boot back into the production OS while tracking the change history for that server and without leaving a footprint.

This update method can offer several advantages, including the following:

- Updating sensitive server components without affecting the production OS, which helps increase availability and performance, minimize potential risks of downtime, and avoid the perceived risk of a residual memory or disk footprint
- Offering a mechanism to update sensitive server components on diskless servers, such as Dell PowerEdge R805 and PowerEdge R905 systems capable of running an embedded OS
- Helping ensure that server component firmware is updated first as the initial step in the hardware provisioning process, before the OS is loaded and, more importantly, before the system is placed into production
- Enabling service providers to offer update services that can help dramatically reduce concerns about modifying production systems—for example, by not requiring agent installation or removal

USING ALTIRIS DEPLOYMENT SOLUTION FOR DELL SERVERS

Altiris Deployment Solution for Dell Servers comprises two parts: the core Altiris Deployment Solution component and a Dell Deployment add-on available at no additional cost. The Dell Deployment add-on provides a Dell-specific interface in the console and integrates Dell OpenManage™ Deployment Toolkit utilities with standard Altiris functions. The result is a collection of predefined Dell jobs that administrators can drag and drop onto managed systems to perform remote functions such as provisioning the BIOS, Dell Remote Access Controller (DRAC), baseboard management controller (BMC), and RAID components; deploying the OS; deploying popular software applications; and updating the firmware in either a pre-OS or post-OS environment (see Figure 1).[1]

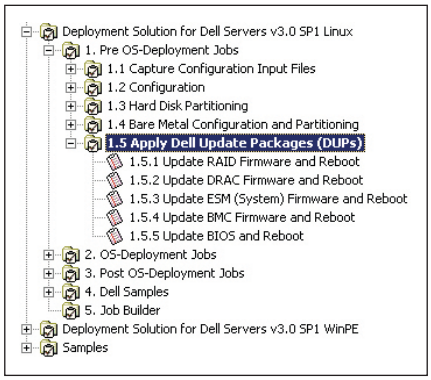

Figure 1. *Predefined jobs in Altiris Deployment Solution for Dell Servers for applying Dell Update Packages in a Linux preboot environment*

Before administrators can drag and drop these predefined Dell jobs onto the managed system, they must first copy the jobs to the Altiris Deployment Server. If this server can connect to the Internet, administrators can use the Dell-specific configuration pages to retrieve DUPs for Linux from support.dell.com. If this server cannot connect to the Internet, then they can retrieve DUPs from a repository on the Dell OpenManage Server Update Utility DVD using the same Dell-specific configuration pages. (Administrators could also use the Dell configuration dialog page in the Altiris console to retrieve DUPs for Windows from the Dell OpenManage Server Update Utility DVD and execute them in the Windows OS; however, the execution of DUPs in the preboot environment is currently only supported in Linux.)

When a Dell server is PXE booted, the Altiris PXE Server checks the Media Access Control (MAC) address of the specified network interface card against its cached entries. If the MAC address is not present, then the server is treated as unmanaged and displays the Altiris PXE menu along with the PXE image files that can be loaded. Administrators can then select "Dell DUP Linux" in the PXE boot menu. After the preboot environment is loaded, the server appears in the console as a managed system, and administrators can drag and drop predefined jobs onto the system to update the server's firmware in a zero-footprint environment. As an alternative, they can preprovision the system in the Altiris Deployment Solution console based on lookup fields consisting of the serial number (Dell service tag), asset tag, or MAC address. This approach provides additional automation and helps avoid the need to perform certain tasks manually.

ENHANCING SERVER FIRMWARE UPDATES

Altiris Deployment Solution for Dell Servers is designed to simplify the process of applying Dell Update Packages for Dell PowerEdge servers while helping minimize risk regardless of the production OS used by a given server. By taking advantage of this approach to firmware updates, enterprises can help maximize the stability and performance of Dell servers in their environment.

For an expanded version of this article, including detailed step-by-step instructions, visit www.altiris.com/delldeploy. For more information on Altiris and Dell, visit www.altiris.com/dellwhitepapers and www.altiris.com/dell.

Eric Szewczyk is a Dell Alliance technical strategist for Altiris, now part of Symantec, and is an Altiris Certified Engineer (ACE).

Trenton Potgieter is a solution architect for Dell Infrastructure Consulting Services.

[1] For more information on these capabilities, see "Simplified Management with Altiris Deployment Solution for Dell Servers 3.0," by Eric Szewczyk, in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20070310-Altiris.pdf.

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SIMPLIFYING NETWORK CONNECTIVITY WITH REMOTEPHY TECHNOLOGY IN DELL BLADE SERVERS

By David Christensen

The new Broadcom® RemotePHY™ technology offered in Dell™ PowerEdge™ M600 and PowerEdge M605 server blades helps simplify the integration of blade server enclosures into data centers wired with 10/100 Mbps copper Ethernet.

Related Categories:

Broadcom

Blade servers

Dell PowerEdge blade servers

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The introduction of blade servers, combined with the amplifying effects of server virtualization, has allowed enterprise data centers to achieve extremely high-density computing. Even as computing power has increased, system cabling has been simplified, and the number of failure points within the system has decreased, the design of blade servers has still required some trade-offs that affect how enclosures are deployed within existing network infrastructures, especially when legacy networking equipment is involved. This article discusses why such situations exist today and how enterprises can use Broadcom RemotePHY technology to integrate the Dell PowerEdge M1000e modular blade server enclosure and PowerEdge M600 and PowerEdge M605 server blades into their data centers to help achieve optimal efficency.[1]

Among the many benefits of blade computing, one strong motivation for moving to a Dell modular blade enclosure is the ability to reduce cable sprawl. Common computer system connections including power, KVM (keyboard, video, mouse), and networking are routed over the backplane in the enclosure, connecting each blade to the outside world. Networking is routed over the backplane using the IEEE 802.3-2005 1000Base-X protocol, which is typically found in fiber-optic-based network controllers but is also well suited to backplane implementations without using the optical interconnects. Each server blade has two or more such network connections to a modular I/O bay, which typically contains an Ethernet switch that allows the blades to communicate with each other and with the rest of the enterprise network.

UNDERSTANDING PASS-THROUGH MODULES

While a network connection from the server blade to an Ethernet switch is suitable in many situations, some organizations must directly connect a particular server blade to an external network device such as a router that provides Internet access, or to a network security appliance. In these situations, an Ethernet pass-through module is used to perform a media-conversion function from the 1000Base-X signaling used over the backplane to a 1000Base-T physical layer (PHY) transceiver built into the pass-through module. As far as the blade server is concerned, it is directly connected to the external device at a 1,000 Mbps link speed.

[1] For more information about PowerEdge M-Series blade servers, see "The Next-Generation Dell PowerEdge M1000e Modular Blade Enclosure," by Chad Fenner, in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20080206-Fenner.pdf; and "Exploring the Dell PowerEdge M1000e Network Fabric Architecture," by John Loffink, in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20070500-Loffink.pdf.

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Figure 1 shows a simplified representation of the Dell PowerEdge M1000e modular blade enclosure with a Dell Ethernet pass-through module installed. Because two different link connections are involved with a pass-through module, the following terminology is used in the remainder of this article:

- **Media Access Control (MAC):** The Broadcom BCM5708S Gigabit Ethernet controller used on the blade server
- **Serializer/deserializer (SerDes) link:** The internal 1000Base-X link between the blade and the pass-through module; typical Gigabit Ethernet adapters use a SerDes to connect the MAC with the fiber-optic module, but when using a blade architecture, the fiber-optic module on both sides of the Ethernet link can be eliminated, allowing the SerDes interface for both Ethernet adapters to be directly connected
- **Copper link:** The external 1000Base-T link between the pass-through module and the external network infrastructure
- **Copper PHY:** The Broadcom BCM54981 Gigabit Ethernet transceiver built into the pass-through module

Previously, when an Ethernet pass-through module was used in a blade enclosure, the link speed available through the external copper port exactly matched the link speed of the enclosure backplane. Because the MAC operated at 1,000 Mbps, the copper PHY was forced to operate at 1,000 Mbps as well. This fixed link speed increased the difficulty of integrating blade servers into existing data centers that used 10 Mbps or 100 Mbps network infrastructures. External Ethernet switches could be used to connect the 1,000 Mbps copper PHY to the lower-speed network, but this work-around typically added expense to the overall solution and increased cable sprawl rather than reducing it.

"Broadcom has developed RemotePHY technology to help avoid the need for additional switches and allow individual server blades to connect to external network devices at speeds other than 1,000 Mbps."

OVERCOMING HISTORICAL LIMITATIONS WITH BROADCOM REMOTEPHY TECHNOLOGY

Broadcom has developed RemotePHY technology to help avoid the need for additional switches and allow individual server blades to connect to external network devices at speeds other than 1,000 Mbps. The RemotePHY feature is currently supported on the Broadcom BCM5708S Gigabit Ethernet controller (available in Dell PowerEdge M600 and PowerEdge M605 server blades) and on the Broadcom BCM54981 Gigabit Ethernet transceiver (available in the Dell Ethernet pass-through module). The Broadcom networking drivers for Linux® and Microsoft® Windows Server® 2003 operating systems used on these Dell server blades are RemotePHY aware and can automatically detect and enable support for RemotePHY when the Dell Ethernet pass-through module is detected.

RemotePHY functionality allows the blade server to communicate directly with the copper PHY in the pass-through module using an in-band signaling mechanism supported by the IEEE 802.3-2005 Ethernet specification. This communications channel allows blades to configure the copper PHY as directed by the administrator, including setting auto-negotiation parameters or forcing the link speed to a specific value—the same functionality typically provided on a traditional rack or tower server. Once a copper link has been established to an external network device, the RemotePHY feature also provides a mechanism for reducing the fixed 1,000 Mbps SerDes signaling rate to a 10 Mbps or 100 Mbps data rate on the copper link.

The end result is that the pass-through module operates as if the copper PHY were directly connected to the blade server, allowing the blade to connect directly not only to Gigabit Ethernet devices, but also to legacy 10 Mbps or 100 Mbps network equipment as well—thereby helping eliminate the need for an external Ethernet switch as intermediary.

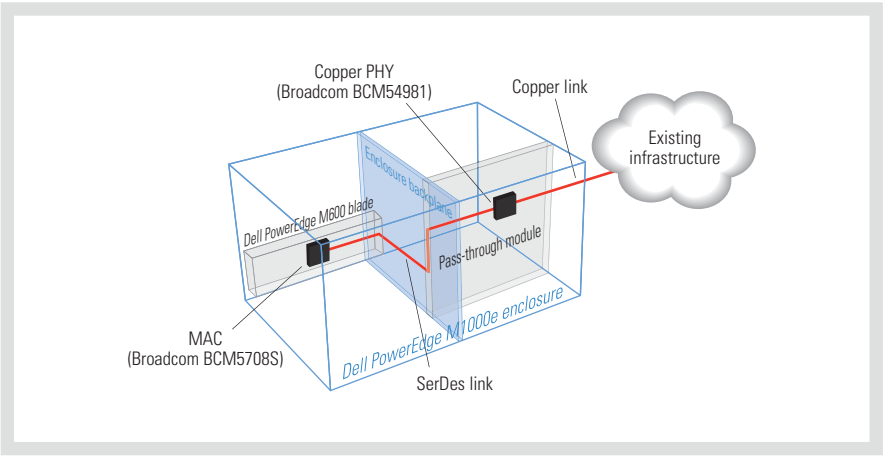

Figure 1. *Dell PowerEdge M-Series blade server architecture*

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> **"RemotePHY functionality allows the blade server to communicate directly with the copper PHY in the pass-through module using an in-band signaling mechanism supported by the IEEE 802.3-2005 Ethernet specification."**

EXPLORING HOW REMOTEPHY TECHNOLOGY WORKS

RemotePHY technology is built on two standard components of the IEEE 802.3-2005 1000Base-X specification: an electrical signaling specification and a standards-compliant extension to the Ethernet auto-negotiation protocol. The first allows a 10 Mbps or 100 Mbps data rate to be transmitted over a fixed 1,000 Mbps connection, while the second provides a message-passing mechanism between the Ethernet MAC and the remote copper PHY over the blade enclosure backplane.

Electrical signaling

RemotePHY technology continues to use the IEEE 802.3-2005 1000Base-X specification, which operates at 1,000 Mbps over the blade enclosure backplane. To accommodate the 10 Mbps or 100 Mbps connections that may occur on the copper link, the data transferred over the backplane is expanded or elongated by a factor of 100 or 10, respectively, allowing a slower data rate to be transmitted over a faster data path.

Auto-negotiation

The extensions to the IEEE 802.3-2005 auto-negotiation protocol are more complicated than the use of electrical signaling. For 1000Base-X devices, auto-negotiation is mandatory. Each side of the link sends its link partner a base page (BP) that is encoded as a 16-bit word that indicates the features supported by the device: half- or full-duplex operation, symmetric or asymmetric pause frame generation, remote fault indication, and an acknowledgment bit. The most significant bit of the BP is the next page (NP) bit, which indicates whether additional 16-bit pages are available.

Note: Although the current 1000Base-X auto-negotiation process does not negotiate the link speed, Broadcom has released an extension known as the Multirate Backplane Ethernet (MRBE) specification, which allows link speed to be negotiated between supported devices such as the BCM5708S. The RemotePHY feature is designed to be fully compatible with MRBE.

When two RemotePHY-compatible devices are engaged in auto-negotiation, the NP bit of the BP is set, allowing additional information to be exchanged between the two PHYs in the form of message pages (MPs) and unformatted pages (UPs). The RemotePHY specification defines the format for these MP and UP exchanges, which start with an exchange of message page 5 (MP-5), which is defined in the 802.3 specification as an organizationally unique identifier (OUI) tag code. The presence of the Broadcom OUI, along with additional mode bits that are sent in subsequent UPs, allows the link partners to negotiate which of these RemotePHY services are supported:

- The MAC can control the copper PHY auto-negotiation settings for the copper link.
- The copper PHY can report the results of the copper link auto-negotiation to the MAC.
- The MAC can send a register write request to the copper PHY.
- The MAC can request a register read from the copper PHY.
- The copper PHY can send the results of a register read to the MAC.

Through a combination of these services, the MAC can configure the copper PHY as if it were locally connected to the MAC, including setting auto-negotiation parameters, forcing the link speed, and setting half- or full-duplex operation.

STANDARDIZING SIMPLIFIED NETWORK CONNECTIVITY

To promote adoption of RemotePHY technology, Broadcom has published the combined MRBE and RemotePHY specification on its Web site at www.broadcom.com/MRBE. Broadcom's goal is to simplify IT operation through application of industry standards to blade server environments.

David Christensen is an applications engineering manager for the Broadcom Ethernet controller business unit. David has a B.S. degree in Computer Science from California State University, Fullerton, and has worked at a variety of software engineering and product support roles at AST Computer, Phoenix Technologies, and Broadcom over his 17-year career in the PC industry.

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HOW THIN PROVISIONING WITH DELL EQUALLOGIC iSCSI STORAGE ARRAYS SIMPLIFIES MANAGEMENT

By Kevin Wittmer

Thin provisioning is designed to address the storage management and capacity planning challenges posed by fast-growing enterprise applications. This article explores how a thin provisioning strategy using Dell EqualLogic™ PS Series Internet SCSI (iSCSI) storage arrays can help increase storage utilization rates, improve staff productivity, and reduce costs.

Related Categories:

Dell EqualLogic storage

Internet SCSI (iSCSI)

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Storage area networks (SANs) have greatly simplified the management of storage resources. By creating a centralized pool of storage resources that can be allocated as needed, organizations have often been able to reduce both management and capital costs. However, as the critical applications that organizations depend on for success continue to grow more quickly and less predictably than ever before, even the most capable IT teams may struggle to efficiently allocate storage resources and plan for future capacity needs.

To help meet these challenges, many organizations are turning to thin provisioning, a storage virtualization technology designed to simplify both storage management and capacity planning. Thin provisioning can help organizations increase utilization rates and improve staff productivity, which in turn can help reduce power consumption and overall storage provisioning costs. This article examines the concepts behind thin provisioning and how this approach directly addresses the storage management challenges that many organizations face. In addition, it explores how the advanced thin provisioning tools of Dell EqualLogic PS Series Internet SCSI (iSCSI) storage arrays can help IT managers execute a thin provisioning strategy and increase the performance and efficiency of their storage resources.[1]

CHALLENGES AND COSTS OF TRADITIONAL PROVISIONING

Today, organizations have more options and tools for storage management than ever before. SANs in particular help reduce maintenance and administration costs by enabling administrators to centralize and virtualize their storage resources. And yet for many enterprises, overall storage expenditures are still rising, even as the cost per gigabyte of hard disks continues to drop.

The skyrocketing capacity requirements of today's information-intensive organizations are driving increased demand for storage. However, it can be painful for IT decision makers to sign a purchase order for additional arrays when gigabytes or even terabytes of storage capacity may be going unused.

Underutilization of storage capacity is a significant problem that cuts across all industries. Figure 1 shows a common business situation, in which a significant portion of purchased storage is not in active use. Low storage utilization rates drive up both capital and maintenance costs. Underutilization is also an ongoing drag

[1] For more information about Dell EqualLogic PS Series arrays, see "Inside the EqualLogic PS Series iSCSI Storage Arrays," by John Joseph, Eric Schott, and Kevin Wittmer, in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20080249-EqualLogic.pdf.

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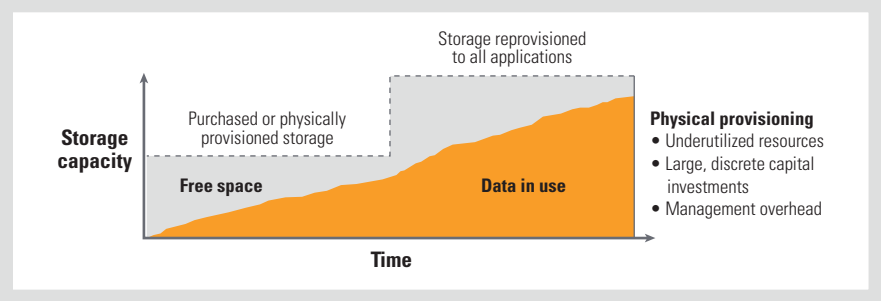

Figure 1. *Comparing available capacity to actual use under traditional physical provisioning*

on the bottom line when unused storage is kept constantly available—taking up real estate in the data center, consuming power, and increasing the load on data center cooling equipment. Finally, underutilization drives enterprises to purchase storage in large chunks before the business expands to fill the capacity. Assuming current price trends continue, 1 GB of storage will cost less in a year than it does today. As a result, acquiring storage capacity before it is actually needed may raise the total cost of ownership (TCO) of an organization's storage infrastructure considerably.

How does so much unused storage space accumulate? The answer lies in a combination of technical and business pressures that lead organizations to overprovision, creating storage volumes larger than are immediately necessary.

On the business side, end users consistently ask for more space than they actually need. Excess space serves as a hedge against unexpected growth. Also, in many organizations it can be a successful strategy to ask for a single large chunk of capacity instead of filing a series of smaller requests, any one of which could be denied because of changing business priorities.

Overprovisioning is also an attractive strategy for IT administrators, notwithstanding the long-term costs it incurs. Despite advances in storage management tools, increasing the size of a volume that has already been allocated can be time-consuming and labor-intensive—and often results in downtime for the applications that depend on that volume. Providing small slices of capacity on an as-needed basis also requires a labor-intensive administrative feedback loop through which business stakeholders can request and receive additional space in a timely manner. Instead, IT teams often allocate the entire amount of storage that will be needed over the lifetime of a given project, even if all of the storage is not needed at first.

THIN PROVISIONING MODEL

Thin provisioning is a model for automatically allocating physical storage resources as needed to address the root technical pressures behind overprovisioning—nearly eliminating the time IT administrators spend manually provisioning and allocating storage capacity to applications. Thin provisioning works with all applications—but is used optimally when an agreement can be made about storage consumption needs between the application administrator and the storage administrator—to ensure physical storage is always available as needed. Thin provisioning can take storage virtualization to the next logical step.[2]

Currently, to allocate space on a SAN, an IT administrator creates a volume and makes it available to the server for which the storage is intended, along with its location and size. When an administrator defines a classic logical volume, the SAN controller responds by reserving physical space on the array of disk drives that it manages. Every byte of storage determined by the volume size is backed up with a physical location, whether it is used or not. Unused space is effectively wasted because it cannot be reclaimed for other volumes and applications.

Using thin provisioning, an administrator creates virtual logical volumes and assigns them to servers and applications. However, physical storage resources are only committed to the volumes when data is actually written to the storage space (see Figure 2 example). The storage that is not being used remains available for use by other volumes. Using this technique, the administrator can provision as many volumes as necessary in any size desired—each volume claims physical resources only when needed.

For example, imagine that an administrator must support three major applications. Each application is expected to eventually need 1 TB of storage, but is only likely to need 300 GB for the first year of

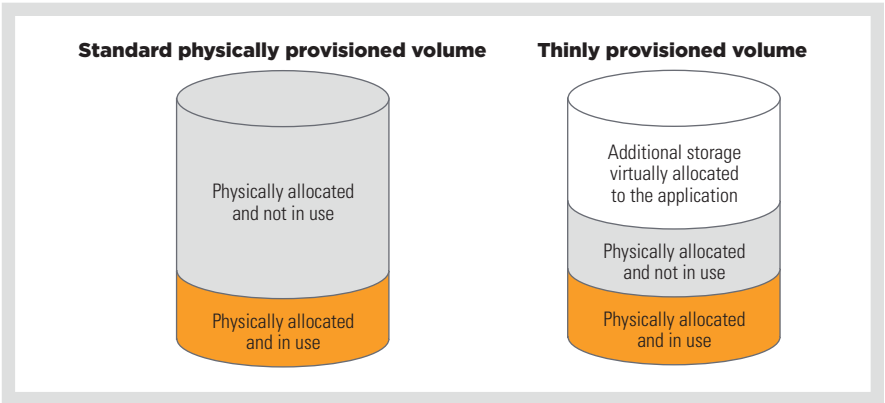

Figure 2. *Committing storage resources with standard physical provisioning versus thin provisioning*

[2] For more information about server and storage virtualization, see "Flexible Virtualization with EqualLogic PS Series iSCSI Storage Arrays," by Timothy Sherbak, in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20080250-EqualLogic.pdf.

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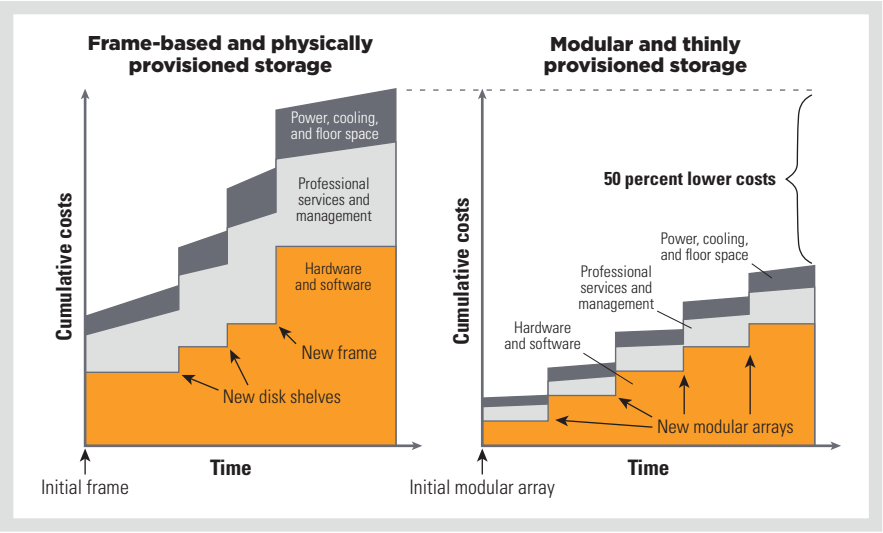

Figure 3. *Avoiding cumulative costs with incremental resource allocations through thin provisioning*

operation. Using physical provisioning, it is likely that the administrator would allocate a total of 3 TB of storage, even if it were not immediately needed. However, with thin provisioning, the administrator creates three 1 TB logical volumes, but needs to provide only enough physical storage to cover the space that the applications actually use between storage purchase cycles—whether those last three months, six months, or a year.

THIN PROVISIONING BENEFITS

Administrators can use thin provisioning to help increase the utilization of their organizations' storage resources. Given the modest utilization rates that are typical at many enterprises, even a moderate improvement can produce dramatic results. In the preceding example, the administrator could support the three applications for the first year with 1.5 TB of storage, which leaves considerable room for growth. This simple change could cut the number of hard disks needed by half or more, generating corresponding savings in power consumption and cooling. When the organization does need to acquire additional storage, it is possible that the devices will cost less per gigabyte, contributing to a reduction in TCO of the system in its final state. Adding the storage resources in increments also helps simplify budget allocations by allowing organizations to make small incremental additions instead of large capital expenditures, enabling a just-in-time purchasing model (see Figure 3 example).

Thin provisioning helps simplify management and improve productivity because IT staff members need to monitor fewer storage devices than with physical provisioning. Also, thin provisioning helps reduce or eliminate time spent reprovisioning volumes to deal with changing storage requirements—which in turn enhances the productivity of end users, because minimized reprovisioning helps reduce server and application downtime.

ADVANTAGES OF DELL EQUALLOGIC PS SERIES iSCSI STORAGE ARRAYS

As organizations explore thin provisioning, Dell EqualLogic PS Series iSCSI storage arrays provide a cost-effective, flexible platform that helps maximize the benefits of the technology. Thin provisioning is a standard feature on PS Series arrays—no per-volume licenses are required. As a result, administrators are free to use the technology to tailor their IT infrastructure to meet the specific needs of their organization without incurring additional costs. PS Series arrays also offer administrators a high level of flexibility by supporting both thinly provisioned and physically provisioned volumes on the same storage array. This approach allows administrators to cost-effectively test and determine the most appropriate strategy while preserving options to apply either the thin provisioning model or the physical provisioning model to a given volume—and back again. The PS Series also supports flexibility by offering administrators the ability to freely convert the provisioning type from physical to thin, or back, at any time.

Dell EqualLogic PS Series arrays include simple, powerful tools to help administrators manage their storage resources. To set up and manage thinly provisioned volumes, administrators simply define four parameters:

- **Volume size:** The logical size determined by the administrator based on the current and future maximum sizes needed by applications. This volume size can be increased in the same manner as traditional physically provisioned volumes.
- **Minimum volume reserve:** The smallest amount of storage that can be allocated to a thinly provisioned volume—generally 10 percent of the actual volume size.
- **In-use volume reserve warning level:** When the amount of physical storage used on the volume reaches this level, the PS Series group generates an alert.
- **Maximum in-use space:** The maximum amount of physical storage (as a percentage of the volume size) that the PS Series group allows the volume to use.

The PS Series management interface provides a simple graphical display that clearly depicts the parameters of thinly provisioned volumes and how these parameters relate to each other, enabling administrators to quickly and easily adjust the parameters. Once the essential parameters have been established, PS Series arrays automatically maintain the logical volumes, adding resources from the free storage pool as necessary.

Relieved from the labor-intensive work of provisioning and maintaining storage volumes, IT administrators can focus on

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strategic management of their organizations' storage resources. PS Series iSCSI storage arrays feature a series of notification options that keep administrators apprised of available space levels, facilitating long-term capacity planning and alerting administrators to unusual usage patterns that might require tactical adjustments. The notifications are customizable, enabling administrators to tailor the level, frequency, and delivery method according to the needs of their organizations. When it does become necessary to add additional storage resources, the peer provisioning features of the PS Series make the process fast and easy.

PS Series storage arrays automatically act as a peer network, working together to balance loads and distribute data to maximize performance and data availability. When a new PS Series device is added to an existing infrastructure, no manual configuration is necessary. Dell EqualLogic peer provisioning management algorithms automatically recognize and configure the new device, adding it to the storage network, where it immediately begins to participate as a full peer.

Thin provisioning enables IT managers to reduce time spent maintaining individual storage volumes and increase time managing their storage environment and improving overall performance. Organizations can cut costs and enhance efficiency by enabling increased storage utilization and incremental storage investments in step with business growth. Dell EqualLogic PS Series iSCSI storage arrays provide IT administrators with simple tools for managing their thin provisioning implementation, while the peer provisioning features provide a deep, powerful foundation for a next-generation storage infrastructure.

Kevin Wittmer leads product marketing for the Dell EqualLogic product family. He has more than 21 years of experience developing and bringing to market enterprise storage products. He is currently the vice chair for the Storage Networking Industry Association (SNIA) IP Storage Forum board of directors, and previously served on the board of directors for the SATA International Organization (SATA-IO). Kevin has a B.S. in Electrical Engineering from Rensselaer Polytechnic Institute and an M.S.E.E. and M.B.A. from Worcester Polytechnic Institute.

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IMPLEMENTING ENTERPRISE-WIDE DATA PROTECTION WITH DELL EQUALLOGIC SANs AND MICROSOFT DPM 2007

By Kevin Wittmer
Jason Buffington

In 24/7 production environments, advanced backup and recovery features can be critical to minimizing downtime. Combining Microsoft® System Center Data Protection Manager 2007 and Dell EqualLogic™ PS Series Internet SCSI (iSCSI) storage arrays can provide an efficient and cost-effective way for enterprises of all sizes to implement comprehensive, enterprise-wide data protection.

Related Categories:

Backup
Dell EqualLogic storage
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Comprehensive data protection can be critical for organizations of all sizes to help protect against viruses, data corruption, site disasters, accidental deletions, or unnatural events, while long-term data retention is often required to satisfy both regulatory and enterprise policies. Recently, data protection has become intertwined with the concept of business continuity, because although preventing data loss is important, operations depend on data *recovery*—the ability to restore data after corruption or failure, and return it to production as quickly as possible.

In the past, organizations typically performed data backups at night or over the weekend, often requiring several hours of system downtime. Similarly, recovering data was slow and difficult, often significantly impeding businesses operations. Now, however, advanced data protection technologies and Internet SCSI (iSCSI)–based storage area networks (SANs) make it possible for almost any organization to back up and recover data quickly, efficiently, and with minimal or no downtime. Given the reduced complexity and cost, organizations of all sizes can create the type of enterprise-class data protection strategy that was previously reserved only for the largest and wealthiest companies.

Dell and Microsoft have worked to make advanced features and functionality available cost-effectively to organizations of all sizes. By combining comprehensive data protection applications such as Microsoft System Center Data Protection Manager (DPM) 2007 with SAN arrays such as the Dell EqualLogic PS Series, organizations of all sizes can take advantage of these technologies to help simplify and accelerate backup and recovery processes, ultimately helping ensure a rapid, timely recovery from data loss or other disaster.

UNDERSTANDING TRADITIONAL BACKUP AND RECOVERY

Despite the often-encountered shortcomings of tape media, tape backup remains an important option for helping prevent data loss. Backup copies are typically cost-effective, and tapes can be physically moved to another location with relative ease. However, because performing traditional backups can interrupt business processes, efficiency and speed are key features of next-generation data protection software. Many backup applications provide incremental backups, recopying only changed files, which can help provide significant savings in bandwidth and computing resources and minimize backup windows. In addition, the more granular the protection of changed data can be, the faster systems can typically return to production after restoring data.

Backup integrity and accuracy are also important—in many organizations, a significant percentage of backups and restores from tape are unsuccessful, and

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corrupted or incomplete backups offer little protection against primary data failure. Administrators must perform data consistency checks to authenticate the validity about backups, adding to the management effort. Automation can help dramatically simplify the highly complex and hard-to-manage backup processes.

Disk-to-disk-to-tape backups are becoming the standard method for enhancing backup processes because of the robustness, performance, and cost-effectiveness of SATA-based disk subsystems. These backups can later be offloaded to tape for long-term retention—helping minimize the amount of time the primary disk is out of production. In addition, a secondary disk provides a significantly superior restore experience—particularly in the case of single-file or object-level restores, which most organizations consider the majority of their recovery exercises.

While these features can help simplify and accelerate backup processes, traditional backup methodologies using general-purpose software may not be adequate for many organizations. A key feature of general-purpose backup software is typically the claim to back up all applications and devices—but with that breadth, quality can suffer, particularly by providing inadequate protection for advanced workloads like distributed Microsoft Office SharePoint® Server farms or advanced Microsoft Exchange deployments. In addition, tape backup with a general-purpose platform is simply not suitable for certain business workloads and many application types. With e-mail, database, and collaboration applications broadly distributed across multiple physical platforms, organizations often cannot simply back up a database as a file.

Equally challenging, databases and other applications are usually in continuous operation, requiring administrators to avoid shutting down databases for backup and necessitating the development of scripts to facilitate non-interruptive backups. And while consistent backup of advanced workloads can be a challenge, restoring data—which is usually more important—is even more difficult. Many legacy backup mechanisms use outdated or unsupported mechanisms for restoring data.[1] As the criticality of data continues to rise within organizations of all sizes, it becomes critical that the next generation of data protection solutions address not only performance and flexibility, but also supportability to help ensure long-term success.

DEPLOYING HIGH-AVAILABILITY SANs

SANs provide a critical foundation for enterprise-wide data protection. As the core of many business operations, data typically must reside on highly available resources, and a reliable, fault-tolerant SAN designed with fully redundant, hot-swappable components and RAID functionality helps keep production data safe while providing a solid foundation for backups. Consolidating data onto this type of SAN not only allows data sharing across multiple servers, but also provides SAN-based data protection features such the following:

- **Snapshots:** Snapshots are volume- or logical unit (LUN)–level point-in-time copies that preserve data status when the snapshot is taken. Snapshots help provide rapid recovery following a failure, and running backups from snapshots enables administrators to offload backup processes from production systems.
- **Replicas:** Replicas are block-level copies, often transferred to a secondary system. Data protection can include making an initial replica that is copied to a remote site, after which only incremental changes need to be copied remotely to help keep data current.

Snapshots and replicas can also enable server-less backup, in which backup operations are offloaded from the application server to dedicated backup servers. These SAN copy features are intended for short-term data resiliency—backups are still essential for long-term data retention and recovery.

Snapshot-based backups to a SAN are perhaps the best way to create online backups that are consistent with running applications, but can be extremely complex to integrate and manage. Enabling snapshot-related applications to work together has typically required administrators to create complicated scripts designed to manually integrate these applications—and if they add an e-mail store or disk to the environment, they must modify these scripts accordingly.

In response to this type of backup challenge, OS vendors often include advanced capabilities designed to simplify backup processes and make backups application-consistent to ease restore processes. For example, in Microsoft Windows Server® platforms, Volume Shadow Copy Service (VSS) is designed to enable online, application-consistent backups. VSS provides a framework for different components to work together, helping coordinate different events between the backup software, Microsoft Windows® OS–based applications, and storage arrays to help ensure smooth operation. Its primary components are *VSS requestors* (storage management applications that initiate VSS operations, such as Dell EqualLogic Auto-Snapshot Manager and DPM 2007), *VSS writers* (applications being backed up or recovered, such as Microsoft Exchange, Microsoft SQL Server®, and Microsoft Office SharePoint® software), and *VSS providers* (hardware providers or storage arrays, such as Dell EqualLogic PS Series SANs).

Combining SAN copies with application-aware features such as VSS helps provide efficient, consistent data protection and recovery. By selecting products in each category that are designed to integrate with VSS, administrators can deploy turnkey backup solutions that use application-consistent snapshots—without requiring

[1] For more information, visit support.microsoft.com/kb/904845 and support.microsoft.com/kb/895847.

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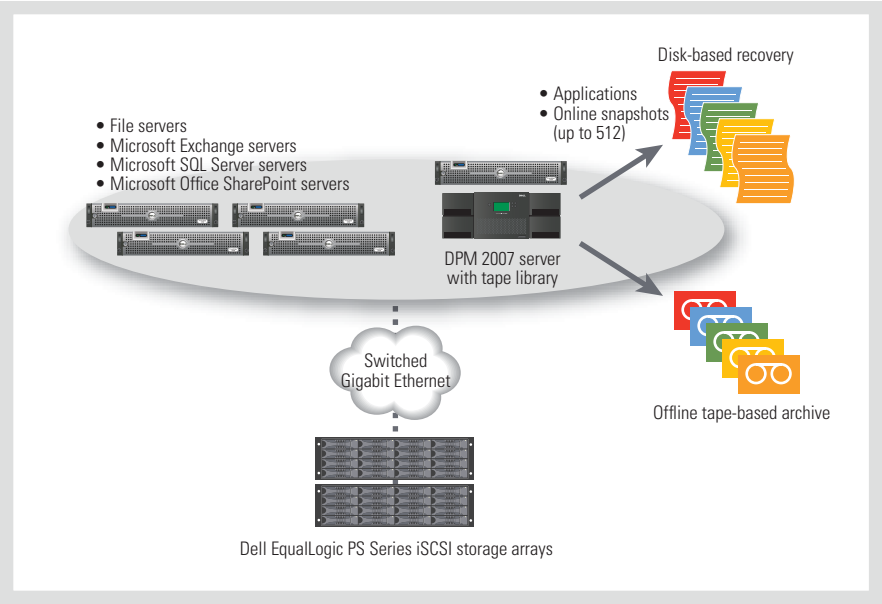

Figure 1. *Microsoft System Center Data Protection Manager 2007 and Dell EqualLogic PS Series storage help provide efficient, comprehensive data protection*

manual integration, and while systems remain online.

USING ADVANCED DATA PROTECTION APPLICATIONS

Traditional backup and recovery methods are generally not well suited for environments requiring continuous business operation. But advanced technologies like DPM 2007 provide disk-based backup that enables application owners to manage their own backup and recovery solutions for their workloads, empower end users to restore data themselves without administrator intervention, and equip organizations of all sizes to achieve near-continuous protection of their applications and server platforms in an attainable way. The advantages of this type of application include frequent and accelerated backups, reduced backup windows, rapid recovery, and the opportunity to perform tape processing during standard business hours.

Next-generation data protection also helps reduce bandwidth and storage needs by only copying block-level changes, rather than copying entire files that may contain only a few changes. Because this approach helps reduce the amount of data to copy, these applications can also run faster and more frequently than traditional backup applications, helping reduce lost work and lost productivity—if data is lost at 4 P.M., administrators can typically restore from a backup taken within the last hour, rather than one taken the previous day.

Equally important, these technologies typically are application and file-system aware. The applications can present administrators and end users with familiar objects during a restore process, rather than requiring them to first struggle through a lengthy process to return data to a usable format.

INTEGRATING SANs WITH ADVANCED DATA PROTECTION

While applications such as Microsoft DPM 2007 help protect file systems, e-mail, databases, and other application data, they usually do not do so for system disks. However, advanced SAN-based features can handle that task—snapshots help provide rapid system-level recovery, while replication can provide fast and easy restore processes following a site disaster. While direct attach storage limits the scalability, performance, and availability of services such as DPM 2007, these applications can benefit from SANs that offer seamless scalability such as Dell EqualLogic PS Series storage arrays, which can expand capacity simply by allocating additional disk space to the DPM 2007 storage pool.

Perhaps even more exciting is the DPM ability to use SANs in the recovery of large data sets, whereby if the production server and DPM server share the same SAN, then DPM can automate recovering a large data LUN by invoking the SAN to clone and remount its backup LUN to production for near-immediate data availability. Together, applications such as DPM 2007 and storage such as Dell EqualLogic SANs help provide the advanced protection and rapid recovery that enterprise data protection strategies require (see Figure 1).

Consolidating storage on a SAN also helps simplify management and provides a highly scalable platform for online and backup data. In addition, SAN boot capabilities help extend this data protection—rather than needing to back up individual system disks on every server, administrators can protect multiple system disks on a consolidated SAN, helping eliminate servers as a point of failure.

CREATING EFFICIENT, COST-EFFECTIVE DATA PROTECTION

While backups remain a critical data protection task, traditional methods typically cannot support the applications and requirements of many organizations. Combining advanced data protection solutions such as Microsoft System Center Data Protection Manager 2007 with SANs such as Dell EqualLogic PS Series storage arrays can bring advanced data protection and storage technologies to organizations of all sizes—helping administrators implement the necessary system uptime, data availability, rapid recovery, and comprehensive data protection required in 24/7 IT environments.

Kevin Wittmer leads product marketing for the Dell EqualLogic product family.

Jason Buffington is a senior technical manager for Microsoft storage solutions.

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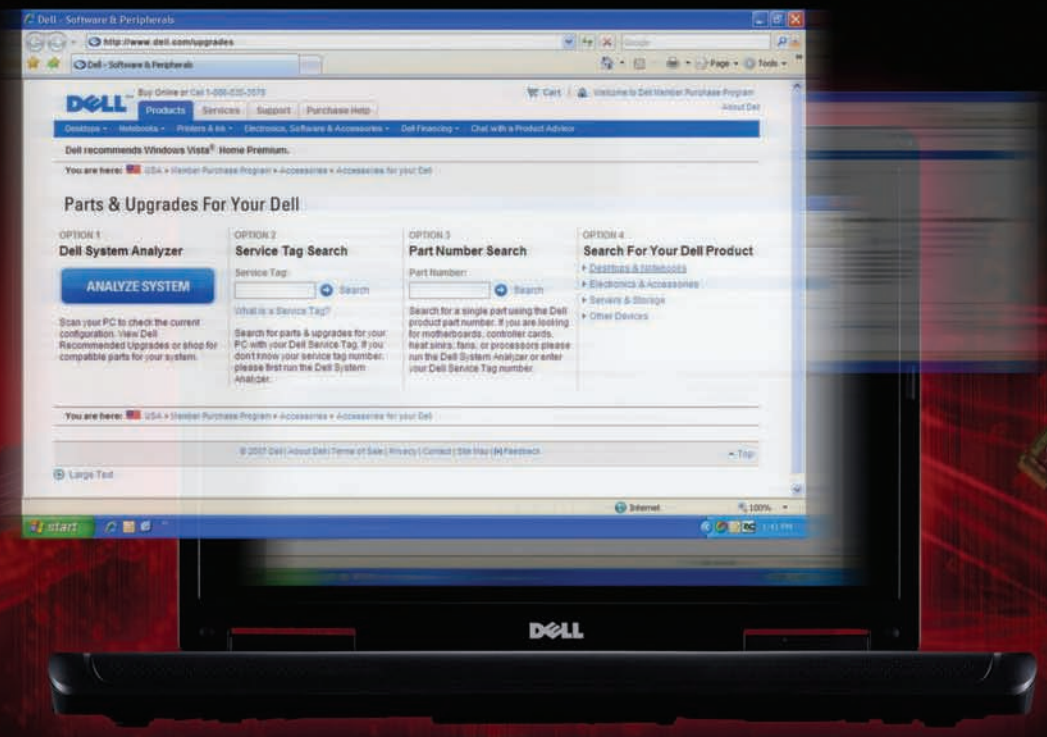

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CONFIGURING iSCSI REMOTE BOOT ON DELL POWEREDGE SERVERS WITH INTEL ADAPTERS

By Travis Vigil
Jordan Plawner

Booting servers from an Internet SCSI (iSCSI) storage area network further enhances the enterprise advantages of iSCSI, helping significantly reduce the time needed to deploy new or replacement servers. This article provides hands-on guidance for configuring iSCSI remote boot on Dell™ PowerEdge™ servers with Intel® Ethernet adapters.

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Ongoing demand for data center resources continues to generate tremendous growth potential for servers and storage, and in many data centers such rapid growth is straining the capacities of environmental control, power, and space. In response to this demand, many organizations are using Internet SCSI (iSCSI) technology in storage area networks (SANs), which can provide significant advantages in enterprise environments—including increased flexibility, scalability, and resource utilization compared with direct attach storage, and simplified management and a reduced cost of entry compared with traditional Fibre Channel SANs.[1]

Organizations can further take advantage of the benefits of iSCSI by adding iSCSI boot capabilities to an existing iSCSI SAN. By allowing administrators to simply configure new or replacement servers to use an appropriate boot image stored on the SAN, rather than completely re-imaging these servers, iSCSI boot can help significantly reduce the time needed to deploy new servers or recover from an unplanned server replacement. When performing server recovery operations or adding, moving, or changing servers, using iSCSI to boot Dell PowerEdge servers with Intel Ethernet server adapters from a centralized image on a Dell PowerVault™, Dell EqualLogic™, or Dell/EMC SAN can help significantly reduce server downtime while simplifying IT management.[2] Administrators can configure and manage iSCSI boot settings using a simple Intel preboot menu in their Dell PowerEdge server.

CONFIGURING iSCSI SAN BOOT

Dell PowerEdge servers equipped with Intel Ethernet adapters and running the Microsoft® Windows Server® 2003 OS with Service Pack 1 (SP1) or later—together with Microsoft iSCSI Software Initiator 2.02 or later—enable comprehensive support for iSCSI boot. Because native support greatly simplifies the task of connecting to iSCSI SANs, upgrading to these versions is highly recommended.

Before a server can perform an iSCSI boot, it must be configured to boot from an OS image

[1] For more information on the advantages of iSCSI, see "iSCSI: Changing the Economics of Storage; Part 1—Understanding iSCSI in Enterprise Environments," by Travis Vigil, in *Dell Power Solutions*, May 2007, DELL.COM/Downloads/Global/Power/ps2q07-20070335-Vigil.pdf.

[2] For more information on iSCSI remote boot, see "Optimizing iSCSI SANs with Intel PRO Server Adapters and iSCSI Remote Boot," by Jordan Plawner, in *Dell Power Solutions*, August 2007, DELL.COM/Downloads/Global/Power/ps3q07-20070441-Intel.pdf; and "Accelerating Application Traffic with Intel 10 Gigabit Ethernet Server Adapters," by Jordan Plawner and Travis Vigil, in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20070597-Intel.pdf.

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Figure 1. *Intel iSCSI Port Configuration menu*

Figure 2. *Intel iSCSI Boot Configuration menu using centralized DHCP configuration*

Figure 3. *Intel iSCSI Boot Configuration menu set up for manual server configuration*

stored at a designated IP location on the iSCSI SAN. On a Dell PowerEdge server using an Intel server adapter, administrators start this process by pressing Ctrl+D at the boot prompt to configure the option ROM through the Intel preboot menu. After selecting the Intel Ethernet interface port to be used as either the primary or secondary iSCSI boot initiator, they can next select "iSCSI Boot Configuration" in the iSCSI Port Configuration menu to configure IP addressing as well as the target and initiator information (see Figure 1).

Centralized DHCP configuration is selected by default in the iSCSI Boot Configuration menu for ease of deployment (see Figure 2). The DHCP server is responsible for assigning the IP address to the host initiator, the target name, the IP address, and a well-known TCP port and boot logical unit (LUN). Using a centralized DHCP iSCSI configuration helps simplify physical deployment by allowing boot information to reside on the DHCP server. Administrators should typically make topology changes to the iSCSI boot configuration at a single location for multiple boot hosts, rather than at each individual server. However, they can choose to manually configure individual servers by deselecting "Use dynamic IP configuration (DHCP)" (see Figure 3).

After saving the IP and iSCSI configurations, administrators can next select "iSCSI CHAP Configuration" in the iSCSI Port Configuration menu to configure login security settings, after which the setup is complete. When the server is next powered up or restarted, it boots its preconfigured BIOS and runs the iSCSI initiator firmware to connect to a bootable target partition on the SAN. The server treats the remote SAN partition as a bootable disk to connect and load the OS image from the designated target location, and typically boots as quickly as it could if the SAN partition were a local disk.

ENHANCING DATA CENTER MANAGEMENT

Centralizing data and OS images on a SAN can be a critical part of building scalability and flexibility into the infrastructure of even the smallest data centers. By taking advantage of iSCSI technology to simplify the process of booting servers from a SAN, organizations can increase flexibility while easing deployment, server replacement, and disaster recovery processes throughout the data center.

Travis Vigil is a product marketing strategist for Dell storage solutions. He has nearly 10 years of experience with technology companies including Intel and Dell. He has a B.S. from Stanford University and an M.B.A. from Northwestern University's Kellogg School of Management.

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INTRODUCING THE DELL PERC 6 FAMILY OF SAS RAID CONTROLLERS

By Bhanu Prakash Dixit
Sanjay Tiwari
Kedar Vaze
Joe H. Trickey III

The Dell™ PowerEdge™ Expandable RAID Controller (PERC) 6 family of enterprise-class Serial Attached SCSI (SAS) RAID controllers is designed for enhanced performance, increased reliability and fault tolerance, and simplified management—providing a powerful, easy-to-manage way to create a robust infrastructure and help maximize server uptime.

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As enterprise data requirements continue to increase, deploying powerful, easy-to-manage RAID solutions can become essential for organizations seeking to simplify their IT environments while increasing controller and storage reliability and server uptime. The Dell PowerEdge Expandable RAID Controller (PERC) line of storage controllers has evolved to address these data storage requirements, providing innovative features to help support complex server-based storage environments, increase server uptime, and reduce administrative burdens.

The PERC 6 family of Serial Attached SCSI (SAS) RAID controllers supports SAS devices and Dell-qualified Serial ATA (SATA) devices. It consists of three PCI Express (PCIe)–based, 3 Gbps SAS RAID controllers: the PERC 6/E adapter (which fits in a standard x8 PCIe slot supporting Dell PowerVault™ direct attach storage), the PERC 6/i adapter (which fits in a standard x8 PCIe slot supporting internal storage for Dell PowerEdge servers and Dell Precision™ workstations), and the PERC 6/i integrated card (which supports internal storage for Dell PowerEdge servers).

Each PERC 6 controller offers a 256 MB double data rate 2 (DDR2) cache memory, with the PERC 6/E supporting upgrades to 512 MB to allow quick access to additional data and help increase performance. PERC 6 controllers also include a battery backup unit to help maintain data consistency and protect data in the controller cache during a system power and/or controller failure. PERC 6 controllers support RAID levels 0, 1, 5, 6, 10, 50, and 60.

The evolution of the PERC 6 from the PERC 5 reflects the Dell focus on simplifying IT, advancing green technology, and designing total data solutions. PERC 6 controllers take advantage of the PCIe architecture and include an enhanced controller chip design to help substantially increase throughput and remove the controller as a performance bottleneck (see Figure 1). The optimization of the RAID design, which incorporates the I/O processor and I/O controller on a single RAID-on-a-chip (ROC) solution, enables a significant reduction in power consumption for PERC 6 controllers compared with equivalent PERC 5 controllers. In addition, using a true PCIe solution by removing the PCI Extended (PCI-X) bridge helps significantly increase performance under sequential workloads. Figure 2 provides a comprehensive comparison of PERC 5 and PERC 6 features and specifications.

PERC 6 controllers are designed to provide enhanced performance, simplified management, increased reliability and fault tolerance, optimized

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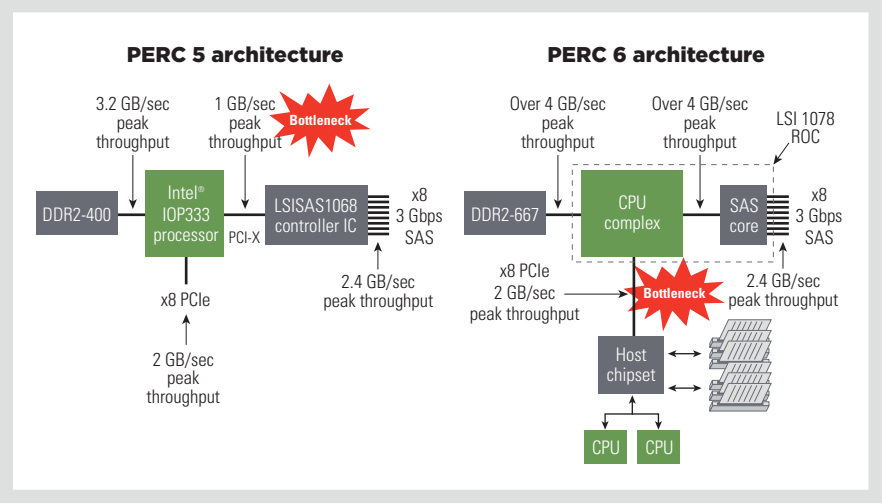

Figure 1. *Dell PERC 5 and PERC 6 controller architectures*

deployment with Dell PowerVault storage, and flexible RAID configuration and management tools. The controllers support Microsoft® Windows Server® 2003 with Service Pack 1 (SP1) (32-bit and 64-bit), Microsoft Windows Server 2008 (32-bit and 64-bit), Red Hat® Enterprise Linux® 4 Update 5 and Red Hat Enterprise Linux 5 (32-bit and 64-bit), Novell® SUSE® Linux Enterprise Server 10 (64-bit), Microsoft Windows® XP with SP2 (32-bit and 64-bit), and Microsoft Windows Vista® (32-bit and 64-bit) operating systems.

ENHANCED PERFORMANCE

The PERC 6 is designed to increase performance in each of the four key areas that can affect controller performance: hardware features, caching policies, read and I/O policies, and software features. Each is important and should be considered when evaluating a RAID controller in a host server along with other server features that may affect performance, such as the OS and hard drives.

Organizations should also keep in mind that different applications display different workload characteristics, and that these workload footprints can affect server performance. However, many applications can be categorized as having a *sequential* read/write profile or a *random* read/write profile. Sequential read/write applications typically include media streaming, backup and restore, and network attached storage and near-line storage applications. Workstation and file servers also handle large data file read/write requests, making sequential data performance a critical performance requirement in enterprise environments. For these applications, storage subsystem performance is typically measured by sequential throughput, in megabytes per second.

Random read/write applications typically include transaction processing applications such as databases, Web-based e-commerce applications, and other multitasking business solutions. For these applications, storage subsystem performance is typically measured in I/Os per second.

Hardware features

The PERC 6 continues the Dell focus on designing RAID solutions based on the latest interface technologies, from PCI to PCIe, from parallel to serial. Employing a ROC integrated circuit (IC) featuring a high-speed, 64-bit, error-correcting code (ECC)–protected DDR2 SDRAM interface; a hardware RAID assist engine for parity

	PERC 5	PERC 6
RAID levels	0, 1, 5, 10, and 50	0, 1, 5, 6, 10, 50, and 60
Enclosures per port	Up to three	Up to three
Ports	2 x 4 wide ports	2 x 4 wide ports
Write policies	Write-through and write-back	Write-through and write-back
Read policies	Normal, read-ahead, and adaptive	Normal, read-ahead, and adaptive
Virtual disks per controller	Up to 64	Up to 64
Cache memory size	256 MB	256 MB (up to 512 MB for PERC 6/E)
PCIe link width	x8	x8
256 KB, 512 KB, and 1,024 KB stripe sizes		✔
SATA NCQ support		✔
Global, dedicated, and affinity hot spares	Global and dedicated hot spares only	✔
Online capacity expansion	✔	✔
Hot-swappable drives	✔	✔
Mixed-capacity physical disk support	✔	✔
Hardware exclusive OR (XOR) assistance	✔	✔

Figure 2. *Feature comparison of Dell PERC 5 and PERC 6 controllers*

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calculations; and support for an Intelligent I/O (I2O) message unit helps maximize performance. The controller is powered by a state-of-the-art LSI 1078 ROC controller, which includes both instruction and data cache to help provide an additional performance boost. This solid hardware foundation is designed to simplify integration of new RAID firmware features and performance increases in future release updates.

Caching policies

Flexible caching policies in PERC 6 controllers allow administrators to tune cache writing schemes to help optimize performance or maximize data protection, including choosing between *write-through* caching and *write-back* caching. With write-through caching enabled, the controller transfers a block of data directly to the disk, and does not send an acknowledgment of data transfer completion to the host system until the data is committed to the disk subsystem. With write-back caching enabled, the controller sends a data transfer completion signal to the host when the controller cache has received all data in a transaction, and the controller then writes the cached data to the storage device when system activity is low or when the write buffer approaches capacity; the cached data is not written to the storage device immediately.

Write-through caching typically provides a data security advantage over write-back caching, while write-back caching typically provides a performance advantage. The risk of using write-back caching is that the cached data can be lost if a power failure occurs before the data is written to the storage device. This risk can be mitigated by using the battery backup units on PERC 6 controllers.

Read and I/O policies

Read policies determine the type of read option for a logical drive and can be set to normal (the default setting), read-ahead, or adaptive. The normal setting specifies that the controller reads only the requested data and does not read ahead for the current logical drive. The read-ahead setting specifies that the controller reads sequentially ahead of requested data and stores the additional data in cache memory, anticipating that the data will be needed soon; this policy typically supplies sequential data faster than the normal (no-read-ahead) setting, but is not as effective when accessing random data. The adaptive setting specifies that the controller begins using read-ahead if the two most recent disk accesses occurred in sequential sectors. If all read requests are random, the algorithm reverts to the normal setting; however, requests are still evaluated for possible sequential operation.

I/O policies are used to enable read buffering in cache memory and apply to reads on a specific logical drive. This setting does not affect the read-ahead cache. The cached I/O setting specifies that the controller buffers reads in cache memory, while the direct I/O setting specifies that reads and writes are not buffered in cache memory. This setting does not override the read policy settings; data is transferred to cache and the host concurrently. If the same data block is read again, it comes from cache memory.

"As enterprise data requirements continue to increase, deploying powerful, easy-to-manage RAID solutions can become essential for organizations seeking to simplify their IT environments while increasing controller and storage reliability and server uptime."

Software features

Enabling disk caching can have a significant impact on system performance, but the potential for data loss increases if power to the disk drives is lost while data written to the disk is still in the cache. Native command queuing (NCQ) for SATA and tagged command queuing (TCQ) for SAS hard drives helps increase performance by allowing individual hard disks to optimize the order in which read and write commands are executed.

SIMPLIFIED MANAGEMENT

PERC 6 controllers integrate technologies and applications designed to simplify management for IT administrators. For example, SAS disk connectivity capabilities have made it increasingly common to connect a large number of disks to a PERC controller, and PERC 6 controllers include features that can automatically track disk order and organization through disk roaming. PERC 6 controllers also support moving physical disks from one cable connection or backplane slot to another on the same controller; the controllers can automatically recognize the relocated physical disks and logically place them in the appropriate virtual disks that are part of the disk group.

Other advanced online capabilities allow administrators to migrate disks from one controller to another. The Advanced Import feature enables administrators to import, or *migrate*, disk arrays created by a different PERC controller while the server remains online. The controllers can even import partial, or *degraded*, arrays and provide array preview capabilities before import to further enhance data serviceability.

Dell PERC 6 controllers utilize Smart Cache Technology that offers administrators pre-tuned cache ratios for read and write operations that automate cache

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> **"PERC 6 controllers are designed to provide enhanced performance, simplified management, increased reliability and fault tolerance, optimized deployment with Dell PowerVault storage, and flexible RAID configuration and management tools."**

allocations based on the characteristics of the storage environment. This auto-tuning feature helps administrators avoid the time-consuming effort of manually tuning the controller cache in a test environment.

Administrators can also perform real-time RAID-level migration by converting one RAID level to a different RAID level. Figure 3 lists possible RAID-level migrations and the number of drives required at the beginning and end of the process. RAID-level migration and expansion cannot be performed on RAID-10, RAID-50, or RAID-60 configurations.

INCREASED RELIABILITY AND FAULT TOLERANCE

Beyond industry-standard RAID levels, PERC 6 controllers offer myriad features to help protect data, including advanced media error protection, enhanced rebuild capabilities, consistency check and background initialization, and other key features such as Self-Monitoring, Analysis, and Reporting Technology (SMART), failed physical disk detection, and hot spares.

Advanced media error protection

PERC 6 controllers provide advanced media error monitoring and repair technologies designed to prevent data loss and enable safe data retrieval. For example, a typical response to a media error in a RAID controller would be to read the data from the redundant disk and continue on. However, when a PERC 6 encounters media errors during normal read and write operations, it can immediately attempt to repair the data. This on-the-fly media error repair capability helps increase data reliability by fixing data written to bad media sectors, thus helping reduce the potential for data loss.

Preemptive media error monitoring through disk scanning services is typically essential for enterprise-class RAID controllers. While a typical approach to this monitoring would employ a background consistency check to scan for media errors, the Patrol Read feature of PERC 6 controllers implements verify commands to help validate media—a method that can help significantly increase efficiency, particularly when encountering multiple media errors on drives in an array.

Enhanced rebuild capabilities

When an array is in degraded mode following a disk failure, the risk for potential data loss increases—particularly if the controller encounters media errors on optimal disks in the array during a rebuild. In contrast to controllers that might immediately stop the rebuild, the PERC 6 continues the rebuild to the end, allowing administrators to access all valid data on the virtual disk even though data has been lost on the virtual disk stripe where the media error occurred.

Consistency check and background initialization

The consistency check operation helps verify the correctness of data in logical drives that use RAID levels 1, 5, 6, 10, 50, and 60 (RAID level 0 does not provide data redundancy). For example, in a system with parity, checking consistency means computing the data on one drive and comparing the results to the contents of the parity drive. Dell recommends that administrators perform a consistency check at least once a month to help maintain optimum array status.

Background initialization is a consistency check that is forced when creating a logical drive, and automatically begins five minutes after the drive has been created. This operation checks for media errors on physical disks and helps ensure that striped data segments are the same on all physical drives in an array.

Source RAID level	Target RAID level	Required number of source physical disks	Required number of target physical disks
RAID-0	RAID-1	1	2
RAID-0	RAID-5	1	3
RAID-0	RAID-6	1	4
RAID-1	RAID-0	2	1
RAID-1	RAID-5	2	3
RAID-1	RAID-6	2	4
RAID-5	RAID-0	3	3
RAID-5	RAID-6	3	4
RAID-6	RAID-0	4	4
RAID-6	RAID-5	4	3

Figure 3. *Possible RAID migrations supported with Dell PERC 6 controllers*

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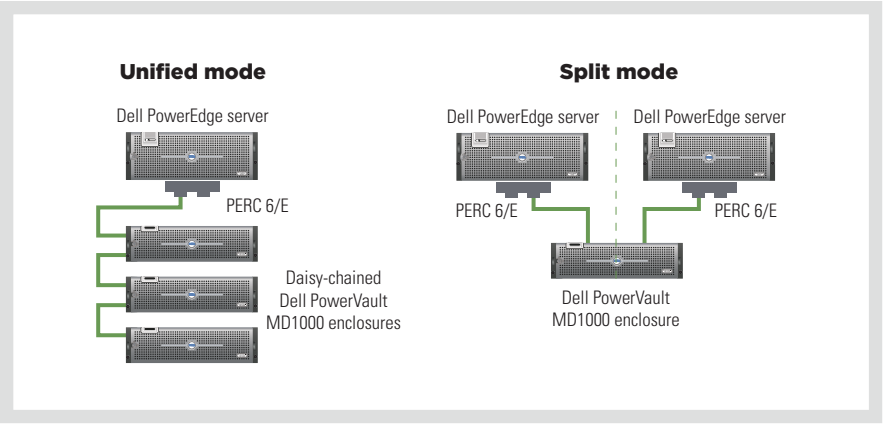

Figure 4. *Unified and split modes for Dell PowerVault MD1000 enclosures with Dell PERC 6/E controllers*

The background initialization rate is controlled by the BGI rate set using Dell OpenManage™ Server Administrator (OMSA) Storage Management.

Other key data protection features

Other key data protection features of PERC 6 controllers include the following:

- **SMART:** The SMART feature monitors the internal performance of motors, heads, and physical disk electronics to help detect predictable physical disk failures.
- **Failed physical disk detection:** The controllers can automatically detect and rebuild failed physical disks when a new drive is placed in the slot where the failed drive resided or when an applicable hot spare is present. Automatic rebuilds can be performed transparently with hot spares.
- **Hot spares:** The controllers support global hot spare, dedicated hot spare, and affinity configurations, which administrators can set up using the Dell BIOS Configuration Utility as well as OMSA Storage Management. Global hot spares can typically be used in any degraded RAID array when the hot spare has sufficient capacity to fit into the RAID container. Dedicated hot spares are reserved for a particular disk group. The affinity option prioritizes a hot spare to the enclosure that it is located in.
- **Transportable battery backup unit (TBBU):** The TBBU is a cache memory module with an integrated battery pack that enables administrators to transport the cache module with the battery into a different controller. The TBBU helps protect the integrity of cached data by providing backup power during a power outage. After power is restored to the controller, the cache is flushed and the protected data is written to the disk drives.
- **Physical disk hot swapping:** Administrators can manually substitute a replacement unit in a disk subsystem for a defective one while the subsystem is performing its normal functions.
- **Heartbeat status LED and dirty cache LED:** The heartbeat status LED on the controllers indicates activity on the chip, while the dirty cache LED indicates that the cache has data that has not yet been written to disk.

OPTIMIZED DEPLOYMENTS WITH DELL POWERVAULT STORAGE

Dell PowerVault storage is engineered to work optimally with Dell PowerEdge servers and PERC controllers. Combining the PERC 6/E with the Dell PowerVault MD1000 disk expansion enclosure can provide a high-performance, enterprise-class direct attach storage solution. Administrators can use OMSA Storage Management software to manage both the external array and internal storage within the server itself, helping streamline and simplify storage management through a single interface while helping reduce resource load on the system.

Administrators can customize the PowerVault MD1000 along with the PERC 6/E to meet different enterprise needs and help increase storage provisioning flexibility by using one of two backplane modes (see Figure 4):

- **Unified mode:** Unified mode allows administrators to access all 15 hard drives from a single controller, and supports daisy-chaining up to two additional enclosures per channel—supporting a total of up to 90 hard drives when using six enclosures and two channels in each controller.
- **Split mode:** Split mode allows two controllers to share the same enclosure, with one having access to eight hard drives and one having access to the other seven hard drives. This configuration does not support daisy-chaining additional enclosures.

"Integrating PERC 6 controllers into environments using Dell PowerEdge servers, Dell PowerVault storage, and Dell Precision workstations can help administrators create a robust and highly available environment designed to maximize server uptime."

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By taking advantage of the support for daisy-chaining in unified mode, administrators can configure a specific combination of storage resources initially, and then add storage volumes quickly and easily as data requirements increase.

FLEXIBLE RAID CONFIGURATION AND MANAGEMENT TOOLS

In keeping with the Dell focus on simplifying IT, PERC 6 controllers share a common firmware code base, host drivers, and management software. The storage management software enables administrators to configure and manage multiple PERC 6 RAID systems, create and manage multiple disk groups, and perform online maintenance. By supporting multiple configuration and management options designed for flexibility and simplicity, PERC 6 controllers can help meet wide-ranging application and deployment requirements.

Administrators can choose from two primary management applications depending on their needs: OMSA Storage Management or the Dell BIOS Configuration Utility. OMSA Storage Management (see Figure 5), a storage management application for Dell PowerEdge servers, provides enhanced features for configuring locally attached RAID and non-RAID disk storage. It enables administrators to perform controller and enclosure functions—such as creating data redundancy, assigning hot spares, and rebuilding failed physical disks—for supported RAID and non-RAID controllers and enclosures from a single graphical user interface (GUI) or command-line interface (CLI) without requiring use of the controller BIOS utilities. The wizard-based GUI includes features for both novice and advanced administrators as well as detailed online help files, while the CLI is designed for comprehensive functionality and supports scripting.

The Dell BIOS Configuration Utility (see Figure 6) is embedded in PERC 6 controllers and enables administrators to configure and maintain RAID disk groups and virtual disks and manage RAID systems. It operates independently of the system OS. Administrators would typically use this utility for initial setup, and then configure advanced features through OMSA Storage Management.

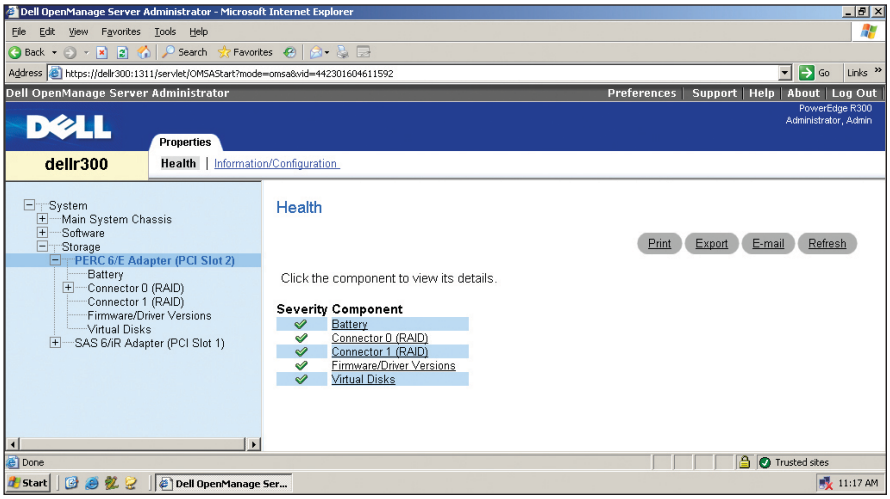

Figure 5. *Dell OpenManage Server Administrator Storage Management*

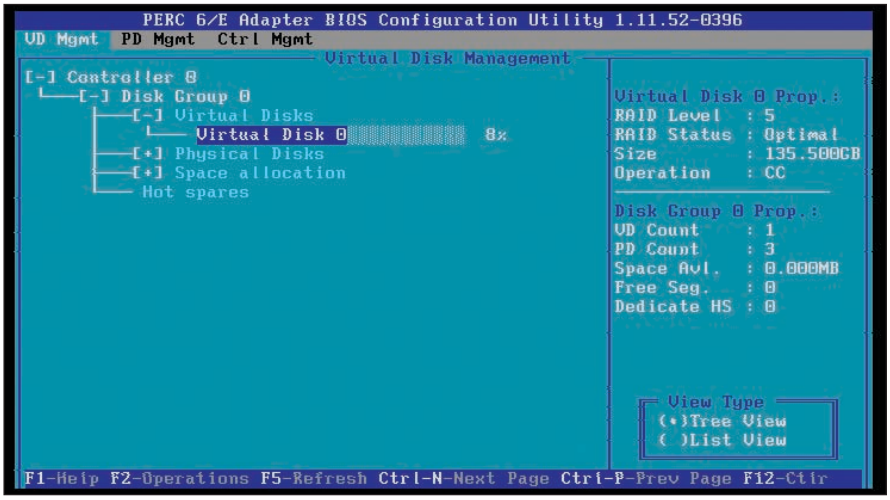

Figure 6. *Dell BIOS Configuration Utility*

SIMPLIFIED RAID CONFIGURATION AND MANAGEMENT

The Dell PERC 6 family of SAS RAID controllers is designed to provide enhanced performance, increased reliability and fault tolerance, and simplified management for supported Dell platforms. Integrating PERC 6 controllers into environments using Dell PowerEdge servers, Dell PowerVault storage, and Dell Precision workstations can help administrators create a robust and highly available environment designed to maximize server uptime.

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SIMPLIFYING IMAGE MANAGEMENT WITH DELL IMAGEDIRECT

Image management can be complicated, costly, and time-consuming. The Dell™ ImageDirect service helps IT organizations streamline the process of securely creating, deploying, and managing software builds on Dell Latitude™ laptops, Dell OptiPlex™ desktops, and Dell Precision™ workstations—boosting productivity while helping lower total cost of ownership.

Ensuring a consistent software build throughout an organization can be tricky. Many IT departments support a wide range of client configurations that can include a variety of hardware platforms and applications to help meet the needs of diverse functional groups in several different languages. To support such a complex array of configurations, administrators must create and deploy a different software build, or *image*, for each unique combination.

Furthermore, administrators must regularly maintain each image with the latest updates such as software security patches and new driver versions, which can number in the thousands annually. They must also incorporate OS and application upgrades into existing images and test them to help ensure that all components work together properly.

Hardware upgrades can be the most challenging aspect of image management. When migrating from one platform to another, administrators must modify images accordingly—which sometimes requires upgrading application software as well as drivers and settings—and then test the modified images to help ensure that they will function as expected when deployed to client systems. This complex, ongoing process of creating, deploying, and managing images throughout an organization can take a tremendous toll on an IT department's time and resources.

TAKING A COMPREHENSIVE APPROACH

To help simplify image management, Dell launched Dell ImageDirect, a Web browser–based service that enables organizations to securely create, deploy, and manage software builds for Dell Latitude laptops, Dell OptiPlex desktops, and Dell Precision workstations at no additional cost. In particular, ImageDirect allows administrators to upload existing images, create images with uploaded applications, access and manage current images, incorporate critical patches and OS updates, and download and test images to help ensure that they work seamlessly.

In addition, the ImageDirect service can be fully integrated into the Dell manufacturing process, allowing custom images managed using ImageDirect to be automatically loaded onto Dell Latitude, Dell OptiPlex, and Dell Precision systems at the factory.

The ImageDirect service is designed to dramatically simplify common image management tasks such as creating images, managing patch and driver updates, and transitioning to different hardware platforms. Key features include the following:

- **Easy-to-use interface:** ImageDirect employs an intuitive, icon-based interface that guides administrators quickly through tasks such as uploading, creating, and managing images (see Figure 1).

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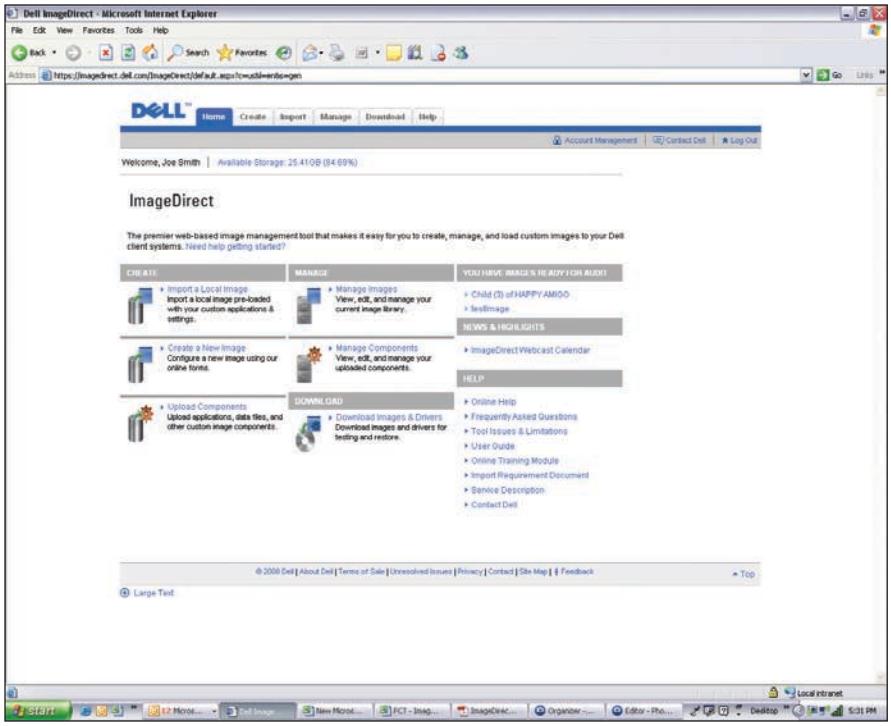

Figure 1. *Administrators access the Dell ImageDirect service through an intuitive Web browser–based interface*

SEAMLESS FACTORY INTEGRATION

The Dell ImageDirect service features an intuitive, step-by-step interface that guides administrators through the process of creating, deploying, and managing software builds on Dell Latitude laptops, Dell OptiPlex desktops, and Dell Precision workstations. Organizations can use Dell Custom Factory Integration services to automatically load custom software builds at the factory, or they can download and install the images manually. The ImageDirect tool and Web browser–based service are available at no additional cost.

To learn more about Dell ImageDirect or to sign up for an e-seminar, visit DELL.COM/ImageDirect. E-seminars are held twice weekly.

- **Cross-platform support:** ImageDirect supports Dell Latitude, Dell OptiPlex, and Dell Precision systems and over 60 previously released hardware platforms (except for Latitude 630c and OptiPlex 745c systems).
- **Proactive patch and driver management:** ImageDirect makes current patches and driver updates available—and prompts administrators to include them—to facilitate maintenance with the appropriate drivers and OS patches for each platform. In addition, because ImageDirect supports drivers and patches for previous-generation models, administrators can easily create and download images for legacy systems.
- **Streamlined hardware transitions:** ImageDirect streamlines the task of updating images required to support recent hardware releases by making the patches and driver updates available promptly. This convenience can lead to a significant reduction in the time it takes administrators to migrate from current platforms to new platforms.
- **Parent-child image structure:** ImageDirect adopts a parent-child image structure to help simplify managing images for different workgroups or departments. With this structure, child images inherit the attributes of the parent image, and changes to the parent image can automatically propagate to child images.
- **Multiple language support:** ImageDirect supports nine languages: Dutch, English, French, German, Italian, Japanese, simplified Chinese, Spanish, and Swedish.

For more information about using the ImageDirect service, see the "Seamless Factory Integration" sidebar in this article.

BOOSTING IMAGE MANAGEMENT EFFICIENCY AND PRODUCTIVITY

By enhancing the efficiency of creating, deploying, and managing software builds across a wide variety of client configurations, the Dell ImageDirect service can help organizations dramatically improve productivity. ImageDirect can also help lower overall total cost of ownership by streamlining key image management tasks for hardware transitions as well as patch and driver updates—thereby freeing precious IT resources to work on value-added activities that advance enterprise and IT goals. Plus, using Dell Custom Factory Integration services, organizations can specify custom images to be preloaded at the factory, helping avoid the need to manually image hardware on-site.

MORE ONLINE
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QUICK LINK

Dell ImageDirect:
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STREAMLINING CLIENT MIGRATION AND DEPLOYMENT

Client migrations can put an enormous strain on enterprise resources. The end-to-end Dell™ Client Migration Solution can help save time and money while relieving network congestion—using patent-pending automation technology to help cut costs by up to 62 percent, shave administrator time by up to 88 percent, and reduce required network bandwidth up to 70 percent for client deployments.

Because they are often labor intensive and difficult to coordinate, client system deployments and OS migrations can be particularly disruptive to business as usual. Planning, scheduling, and executing deployments and migrations is also logistically challenging, especially for a large number of busy and mobile clients. In addition, deploying applications and software builds, or *images*, to branch offices and other remote locations can put an excessive strain on enterprise networks.

Because client migrations are often outside the scope of normal business operations, many organizations have not optimized their client migration processes and do not have the infrastructure or tools in place to take advantage of automation. As a result, many steps—such as creating images, deploying applications, and migrating user data—are often executed manually. Unfortunately, the manual approach can be both time-consuming and error-prone.

For example, performing migrations to the Microsoft® Windows Vista® OS can be challenging when incompatible clients need to be replaced and applications require some form of remediation. Furthermore, the new security policies and different user access controls featured in Windows Vista may require extensive changes to client settings and configurations. Finally, the increased image sizes that often result from Windows Vista deployments may put an additional strain on corporate networks.

To help organizations simplify the task of replacing or refreshing hardware, Dell launched the Dell Client Migration Solution, a portfolio of assessment, design, implementation, and management services that combine industry-standard best practices and automation technology designed to execute client migrations quickly and cost-effectively. The results can be tremendous: research shows that companies that optimize their deployment practices enjoy significantly reduced costs to deploy PCs, as much as 62 percent less (over US$400 per PC) compared with companies using basic deployment practices.[1]

AUTOMATED DEPLOYMENT HELPS SIMPLIFY LOGISTICS, REDUCE DISRUPTION

At the heart of the Dell Client Migration Solution is the Dell Automated Deployment (DAD) technology, a set of patent-pending tools and processes. DAD uses a "load in factory, customize anywhere" approach to client migration that helps dramatically simplify logistics, minimize business disruption, and reduce the strain on enterprise resources.

DAD technology provides a superset of content—including images, applications, and the DAD tool—that is preloaded onto client systems at the factory. For hardware replacements, the content is loaded directly onto the client. For software refreshes, the content is loaded onto a portable hard drive.

[1] "Dell PC Deployment Optimization Model," IDC white paper sponsored by Dell, Doc #205282, January 2007, DELL.COM/Downloads/Global/Services/Main/IDC_Whitepaper.pdf.

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After a client system or hard drive arrives at its destination, the administrator is prompted by a simple "one touch" interview to select the appropriate user profile, and the DAD tool installs the corresponding image and applications. IT administrators can also select an update location on the network to have the client content synchronized with new updates. Finally, the DAD tool migrates end-user data and settings.

This automated deployment model can help achieve the following benefits:

- **Minimize server and network congestion:** Because images and applications are preloaded onto the client system at the factory, only content updates need to be downloaded over the network. As a result, DAD can help reduce the network bandwidth required for client deployments by an estimated 70 percent.
- **Increase flexibility and simplify logistics:** By customizing preloaded images and applications at the client destination, DAD helps eliminate the need for complicated staging centers. This approach also enhances flexibility in routing client systems, because specific hardware does not have to be assigned in advance to a particular individual.
- **Maximize multitasking:** Administrators can initiate a deployment and then quickly move on to the next client system. Because DAD automates application installation and migration of end-user data, it is expected to reduce the amount of time an administrator spends replacing or refreshing a client system by up to 88 percent.[2]
- **Minimize end-user disruption:** By helping dramatically reduce the time required to deploy client systems, DAD minimizes disruptions to end users—and ongoing business operations.
- **Minimize strain on the help desk:** By automating the deployment process, DAD helps avoid application installation errors and subsequent inquiries to the help desk—for example, if an administrator misses key steps. Also, DAD saves a backup copy of the client system's image before commencing the installation, to expedite recovery of user data or settings if necessary.

	Basic *No documented or repeatable process*	**Standardized** *Documented manual process*	**Rationalized** *Documented and mostly automated*	**Dynamic** *Fully automated for end users*
Deployment management	Client systems deployed individually	Project managed; deployment script for administrators	Deployment projects consolidated by locations; continuous business process improvements formalized	Central deployment management system linked to configuration management database and administrator dispatch
Staging and logistics	Multiple legs for warehousing and staging	Central staging with less than two-week supply chain	Staging only for remote users	Just-in-time ordering; product moves directly from original equipment manufacturer (OEM) to user
Imaging	No central image standard	Centralized image; may be deleted on arrival	Centralized image with quarterly updates	Cross-platform image; department overlays; loaded in factory
Applications	Loaded from CD or network share	Electronic software distribution system covering less than 25 percent of applications	50–90 percent packaged departmental applications	90 percent or more packaged integrated entitlement
User state migration	Files copied manually	In-house tool to move data; manual settings	Off-the-shelf tool to move data and change settings	Automated for end users to run
Day-after support for end users	No proactive process	On-site administrator to answer questions	User FAQ, augmented by help desk and on-call support	Remote issue resolution from a command center

Figure 1. *The Dell client optimization deployment model is designed to minimize infrastructure dependencies and enable out-of-band deployments for remote users*

EXPERT CONSULTING SERVICES HELP MINIMIZE COST AND RISK

The Dell Client Migration Solution helps calculate the current cost of deployment and recommends ways to streamline the process and improve the infrastructure to take advantage of the automated deployment model. Following industry-standard best practices, Dell Services experts create an optimized deployment model that can be tailored to the specific needs of an organization (see Figure 1). Dell Services then executes the deployment using DAD technology.

By simplifying client migration through best practices and automated deployment techniques, organizations can dramatically lower the cost of deployment, minimize end-user disruptions, and reduce business risk.

MORE ONLINE
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Dell Client Migration Solution:
DELL.COM/Services/Deployment

Dell Readiness Advisor tool for Microsoft Windows Vista:
support.dell.com/support/topics/global.aspx/support/product_support/en/vista_test

Dell Deployment Optimization Calculator:
roianalyst.alinean.com/calculators/dell/optimization/Dell_Deployment_Optimization.html

[2] Based on an internal assessment of select Dell customers compiled from October 2006 to October 2007.

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DEFENDING AGAINST SPAM WITH SYMANTEC VIRTUAL APPLIANCES

By Mathew Lodge
Doug Iler

The unpredictable and rapidly growing volume of spam e-mail can present a major management challenge in enterprise environments. Deploying Symantec® virtual antispam appliances on Dell™ PowerEdge™ servers can help organizations cost-effectively scale e-mail filtering capacity to meet the peaks and troughs of spam volume while reducing management time and costs.

Related Categories:

Symantec
Systems management
Virtualization

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Server virtualization has become a key technology for many enterprises, enabling efficient utilization of hardware resources and a host of other advantages. In the case of e-mail filtering, however, virtualized antispam software can be useful not only because of the general advantages of virtualized environments, but also because the filtering can actually function more effectively in those environments than it can as a dedicated appliance—providing a flexible way for enterprise IT administrators to meet the challenge of the unpredictable and rapidly growing volume of spam assaulting e-mail defenses. By using Symantec virtual antispam appliances, organizations can both cost-effectively scale their filtering capacity as needed and help reduce management time and costs.

UNDERSTANDING THE CHALLENGE OF SPAM

Symantec first introduced Dell hardware–based antispam appliances in early 2005, but has been in the antispam business since it purchased Brightmail in 2004, and is currently the market share leader in messaging security according to IDC.[1] This is important because it allows Symantec to collect spam data from an extremely large base of e-mail accounts—intelligence that is key not only to accurately identifying spam messages, but also to learning the traffic patterns and tactics of spammers. Symantec continuously harvests spam messages from 2–3 million "probe accounts"—dummy accounts set up to receive spam at Internet service providers and companies worldwide.

The trend in spam has been ever upward—there is more spam now than ever before—but its rise is not linear; spam comes in waves as spammers take advantage of news and events to get responses, and as they try different techniques and tactics to get around antispam filters. Figure 1 demonstrates this pattern, showing e-mail messages identified as spam as a percentage of all e-mail messages processed by Symantec over a one-year period, including variations in the seven-day moving average.

Spam is a form of e-marketing, and spammers try to exploit the same marketing opportunities as legitimate businesses. For example, in January 2008 e-mail servers were flooded with spam ads for a handbag that aimed to take advantage of Valentine's Day gift giving. The message was a scam; there was no handbag for sale, and the spammers used the same geotargeting technology utilized by legitimate businesses to send users who clicked on the links to a variety of destinations depending on their IP address. (Those in Europe and parts of Asia, for example, were routed to an online dating site.)

[1] "Worldwide Messaging Security 2007–2011 Forecast and 2006 Vendor Shares: DLP, Encryption, and Hosted Services Heating Up," by IDC, Doc #209602, December 2007.

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The key point is that the commercial reality behind spamming drives peaks and troughs of inbound Simple Mail Transfer Protocol (SMTP) traffic that are difficult to predict, making engineering antispam filtering capacity a significant challenge. Too little capacity, and the system may block or delay legitimate e-mail, or flood mailboxes with spam when the filter is turned off to clear the backlog. Too much capacity, and spam appliances may sit idle—not only wasting IT resources, but also consuming unnecessary energy. But when a spam peak arrives, what was idle capacity the previous week is now necessary to allow an organization's e-mail to continue flowing.

Traditionally, antispam organizations have been locked in an arms race with spammers on both effectiveness and accuracy: the antispam organizations have tried to ensure that spam filters could accurately identify as much spam as possible, even as spammers tried tactics such as image and PDF spam to get around filtering technology. However, the sheer volume and unpredictable variation in spam has also meant that effective antispam technology must be both powerful and easy to operationalize—in other words, requiring as little ongoing administration overhead as possible.

VIRTUALIZING ANTISPAM TECHNOLOGY

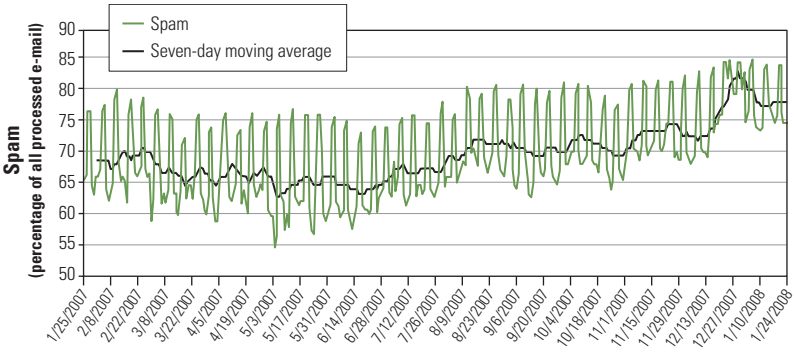
Some organizations using Symantec antispam technology have reported dissatisfaction with appliance-based antispam protection because the waves of spam do not map well to fixed units of appliance capacity. The increasing adoption of server virtualization offered an opportunity to address the problem of effectively operationalizing antispam technology, leading Symantec to introduce a new VMware® virtual appliance version of its Mail Security 8300 antispam appliance. By using a virtual appliance rather than a dedicated hardware appliance, organizations can add or subtract capacity as the level of incoming spam increases or decreases, helping avoid both insufficient capacity and wasted resources.

This virtual appliance is certified to run on the VMware ESX Server and VMware Server platforms. Unlike using virtual environments for development and testing, deploying production applications on virtualized servers is not simply a matter of building an image, booting the virtual instance, and hoping it will behave and perform the same way as one booted on a bare-metal OS. Most enterprises today are heavily dependent on e-mail, so antispam software is typically a key production application that they cannot afford to have compromised.

To help ensure performance is not compromised and with the assistance of VMware, Symantec has thoroughly tested its virtual antispam appliance and modified the code to help optimize performance in VMware environments and to work around known limitations and other issues. For example, virtualized I/O is typically more processor intensive than bare-metal I/O, and antispam technology is heavily dependent on I/O to help ensure peak message flow. In addition, the VMware approach to running operating systems not designed for virtualization is to dynamically patch the kernel code to force sharing of resources that the OS assumes it controls exclusively, such as I/O. To an application, this approach can mean that the OS behavior is different—often in ways that make little or no difference, but sometimes in ways that do. The Symantec virtual appliance is designed for production environments where reliability can be critical.

The Symantec virtual appliance is also designed for simple deployment and management in enterprise environments. The operational benefit of adding new virtual instances to help boost antispam capacity is wasted if each instance needs extensive configuration to provide consistent message handling across the group of virtualized instances. It is therefore key to ensure that the Symantec management application can synchronize antispam configurations and policies across multiple concurrently operating virtualized servers, and that reporting is available at a summary level, not just at the level of individual servers. After all, if administrators cannot see what volume and types of spam their environment is receiving as a whole, they would find it difficult to tell whether they need more or less antispam capacity.

Figure 2 shows a Symantec virtual appliance dashboard that illustrates several key points. First, the volume is volatile: over a 24-hour period, the volume varied from less than 20,000 to more than 30,000 messages per hour—more than 33 percent variation. Second, sender reputation is a key way to identify malicious e-mail and other spam, with 73.6 percent of the messages identified as threats based on reputation—a reminder of why intelligence about spammers is so important to effectiveness.



Source: "The State of Spam," by Symantec, February 2008, www.symantec.com/content/en/us/enterprise/media/security_response/whitepapers/Symantec_Spam_Report_-_February_2008.pdf.

Figure 1. *E-mail messages identified as spam over a one-year period*

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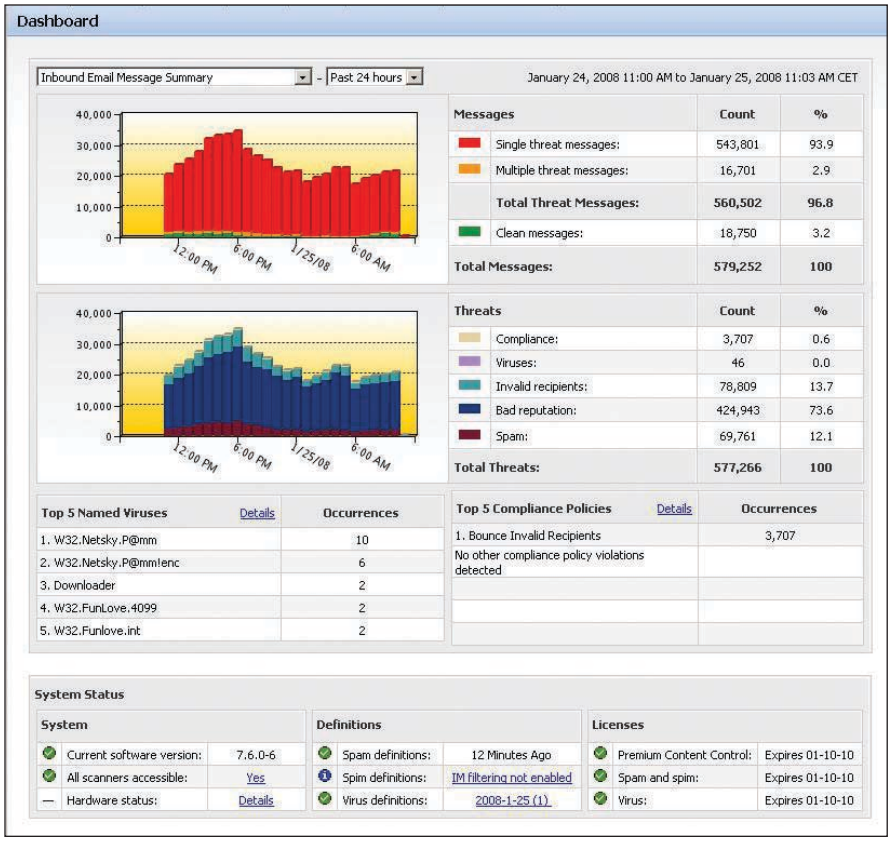

Figure 2. *Symantec Mail Security 8300 virtual appliance dashboard*

Finally, in this example environment, 96.8 percent of the messages were spam. This ratio is much higher than the average of 78.5 percent recorded by Symantec in January 2008,[2] and illustrates what a localized problem spam can be: with such change and variation in spam traffic, average figures (often used for forecasting) may not apply to specific environments.

Using a virtual antispam appliance offers several other advantages as well. Extra server capacity, for example, need not be dedicated to antispam technology—multiple applications can share the pool of virtualized servers, which cannot be done with single-purpose appliances. Virtual antispam appliances also offer licensing advantages. Per-server licensing of a dynamic application is impractical in virtualized environments, because administrators would need to know in advance how many server licenses they need to buy. Licensing per mailbox protected, or using another metric unrelated to the number of servers, can be essential.

Both physical and virtual appliances can offer significant advantages in enterprise environments, and Dell is working with partners like Symantec to take advantage of this technology. The Dell virtualization portal at DELL.COM/Virtualization, which features the Symantec Mail Security 8300 series, provides links to the Web sites of Symantec and other vendors where administrators can download preconfigured virtual appliances for a variety of VMware and other platforms to preview the features. Those who feel a hardware-based solution will suit their needs may choose to purchase a hardware version of the appliance. However, many may opt for a virtual appliance—like that provided by Symantec—to take full advantage of the dynamic flexibility offered by a virtualized infrastructure.

CREATING FLEXIBLE DEFENSES AGAINST SPAM

Antispam technology can be far more effective when virtualized than when running in a dedicated appliance because it can help overcome a major challenge for enterprise administrators—efficiently matching e-mail filtering capacity to spam volume, and avoiding both blocked inbound e-mail and potentially expensive wasted capacity. Symantec virtual antispam appliances provide synchronized antispam rules, filters, and other configuration data as well as clear summary reports across the virtualized environment, features that can be essential to realizing the advantages of virtualization. Deploying these virtual appliances offers a cost-effective, scalable way for enterprises to create flexible defenses against the ever-growing volume of spam.

Mathew Lodge is a senior director of product marketing for the Symantec antispam and e-mail archiving product set.

Doug Iler is a senior manager for enterprise virtualization solutions at Dell.

MORE ONLINE
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QUICK LINKS

Symantec Mail Security 8300 Virtual Edition:
www.symantec.com/business/products/overview.jsp?pcid=2242&pvid=1721_1

Symantec Security Response Weblog:
www.symantec.com/enterprise/security_response/weblog

Dell virtualization solutions:
DELL.COM/Virtualization

[2] "The State of Spam," by Symantec, February 2008, www.symantec.com/content/en/us/enterprise/media/security_response/whitepapers/Symantec_Spam_Report_-_February_2008.pdf.

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SIMPLIFIED DRIVE ENCRYPTION FOR DELL LATITUDE NOTEBOOKS

By Brian Berger

Dell™ Latitude™ D630 and Latitude D830 notebooks with Seagate® Momentus® hard drives and EMBASSY® management software from Wave Systems offer a comprehensive, simplified, hardware-based encryption solution to help protect critical data.

Related Categories:

Dell Latitude notebooks

Security

Wave Systems

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Deploying encryption in an enterprise environment can be critical to maintaining effective security, but can also be complicated to set up—requiring significant advance planning, coordination, and time. To help simplify this task, Dell Latitude D630 and Latitude D830 notebooks with Seagate Momentus FDE.2 hard drives and EMBASSY management software from Wave Systems allow administrators to rapidly set up and enable hardware-based drive encryption and bypass time-consuming procedures such as running the chkdsk utility—a process that can potentially take several hours on a typical 160 GB drive.

These data protection features are designed to be not only powerful, but also easy to use, comprehensively integrated, and scalable. The drive is designed to encrypt all files copied to it with a key stored in a secure area of the drive, without the performance overhead associated with software-based solutions for secure read and write operations. For end users, a provided password can be easily synchronized with an existing Microsoft® Windows® OS password, helping minimize the need for training and help-desk assistance and potentially making data protection as simple as closing the notebook after use. For administrators, robust reporting tools can provide detailed event logs indicating whether preboot authentication has been enabled, helping make supporting users at remote locations as easy as supporting those at an enterprise's headquarters, and helping prevent users or remote administrators from inadvertently compromising data security. And because the drive encryption is designed to be constantly enabled, these features also help simplify compliance with data protection laws and regulations.

ASSESSING THE NETWORK ENVIRONMENT

EMBASSY management software from Wave Systems works in tandem with Seagate Momentus FDE.2 drives in Dell Latitude D630 and Latitude D830 notebooks to help maximize security in environments based on Windows operating systems and the Microsoft Active Directory® directory service. EMBASSY Remote Administration Server (ERAS) is designed to integrate into existing Active Directory domains, essentially adding a second layer of protection to these Latitude notebooks by adding user-based authentication to the drive. A simple administration console allows administrators familiar with Microsoft Management Console (MMC) snap-ins for Active Directory to easily grant permissions to existing users and perform many other drive-related tasks.

Typically, a simple way to implement this technology in an existing infrastructure is to acquire Latitude

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D630 and Latitude D830 notebooks from Dell and select the encrypted hard drive option during purchase, which includes a Seagate Momentus FDE.2 drive and preconfigured EMBASSY Trusted Drive Manager (TDM) client components in the system. ERAS is also available through Dell. After adding the client to the domain, administrators can remotely initialize the drive and manage it through ERAS. For existing Latitude D630 and Latitude D830 notebooks as well as Latitude models D530, D531, D620, D631, and D820, administrators can replicate the contents of a standard drive to a Seagate Momentus FDE.2 drive and install the TDM software, enabling the system to communicate with ERAS for further configuration.

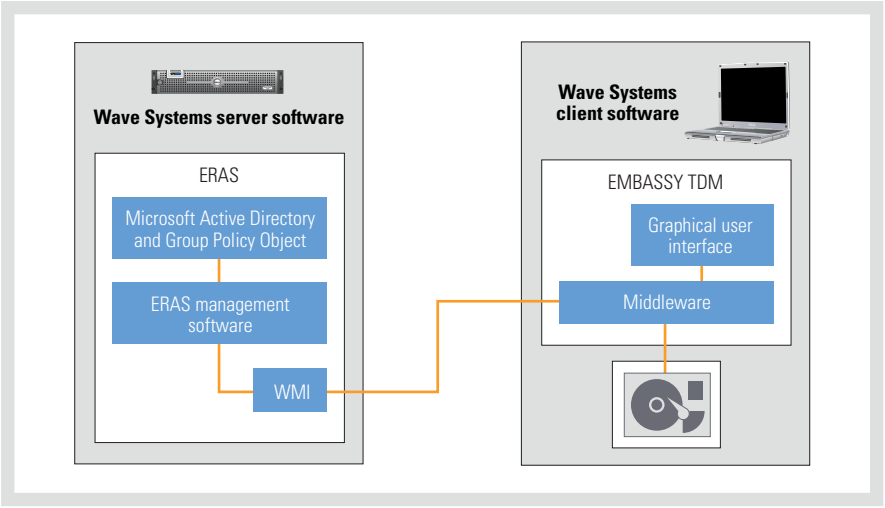

Figure 1. *EMBASSY software from Wave Systems for Dell Latitude D630 and Latitude D830 notebooks with encrypted Seagate Momentus hard drives*

CREATING A ROBUST MANAGEMENT INFRASTRUCTURE

ERAS enables administrators to manage Dell Latitude D630 and Latitude D830 notebooks with Seagate Momentus FDE.2 drives across a network within a domain (see Figure 1). Using ERAS requires the following:

- Any edition of the Microsoft Windows Server® 2003 OS with Service Pack 1 (SP1) or later
- A system running Windows Server 2003 or Windows XP with SP2 and the MMC snap-in (to utilize the remote console)
- MMC 3.0
- Microsoft Group Policy Management Console 3.0
- Microsoft SQL Server® 2005 Express Edition, Standard Edition, Workgroup Edition, or Enterprise Edition database platform
- Microsoft Internet Information Services (IIS) 6.0
- Microsoft .NET Framework 2.0
- Microsoft ASP.NET 2.0 Web Service extension enabled in the IIS Web services extension list
- Microsoft Windows Support Tools

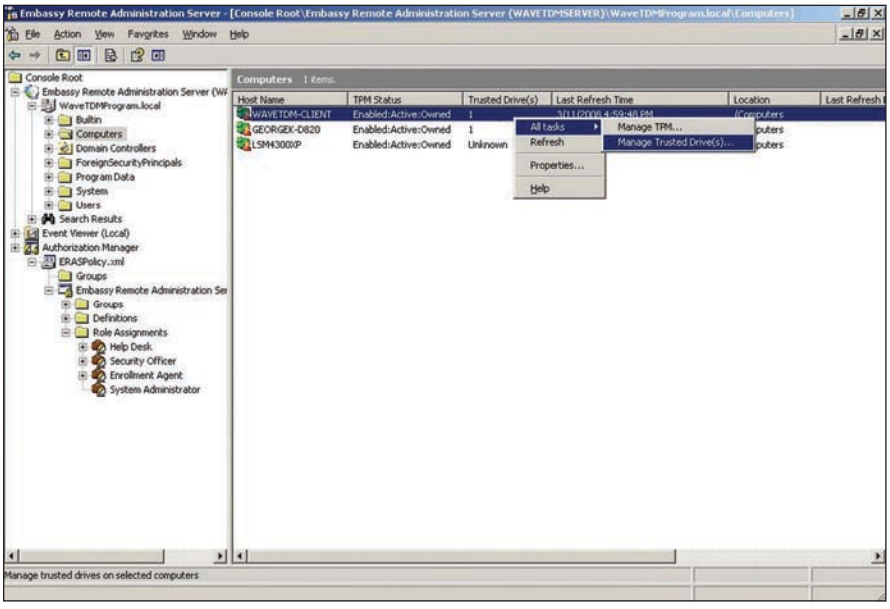

Figure 2. *Management console for EMBASSY Remote Administration Server from Wave Systems*

After ERAS has been installed on a Windows Server 2003 system, administrators should configure the server and client systems to belong to the same domain. Installing ERAS on the server requires a local administrator with administrative privileges in SQL Server and domain privileges to create the required accounts and user groups and make entries in Active Directory. Administrators can integrate ERAS with Active Directory or manage it through an XML ERAS policy file in conjunction with the SQL Server database. After the TDM software has been installed on the Latitude D630 or Latitude D830 notebook, administrators can use Group Policy to push a Windows Management Instrumentation (WMI) file down to these client systems, and then use the ERAS console to manage them (see Figure 2).

CONFIGURING AND MANAGING ENCRYPTED CLIENTS

ERAS is designed to support Dell Latitude D630 and Latitude D830 notebooks through their complete life cycle, from drive deployment to management to

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disposal. The first step in activating the drive encryption is to set up preboot authentication, which administrators can do by initializing the drive. Users must then log in during the preboot process to gain access to the drive. Administrators can provide multiple users with access to a given client system, or use the drive properties window in ERAS to perform other management functions.

Administrators can use the Security Control window in ERAS (accessed through the drive properties window) to access the cryptographic erase feature, which allows them to quickly erase drives remotely from the server to help prevent dissemination of confidential information on an encrypted Latitude D630 or Latitude D830 notebook. They can then rapidly re-image and redeploy the drive—a task that may take several hours with typical software-based disk encryption.

When end users forget their password, administrators can also use the ERAS Security Control window for password recovery to help regain drive access, a feature that does not require a connection to the network. The ERAS Help Desk feature also offers a way for end users to retrieve passwords by providing direct physical access to the server through a standard Web browser, a feature that can typically be used on any system connected to the domain (see Figure 3). For example, administrators might provide this designated access to an office manager when the normal IT staff members are not available.

> **"The drive is designed to encrypt all files copied to it with a key stored in a secure area of the drive, without the performance overhead associated with software-based solutions for secure read and write operations."**

Administrators can also use ERAS to manage embedded security technology for Trusted Platform Modules (TPMs). TPMs are chips integrated into select Dell systems that function like embedded smart cards, and can be used to generate encryption or authentication keys and help securely store certificates and other critical information. ERAS offers similar initialization and management features for TPMs as it does for the encrypted drives in Latitude D630 and Latitude D830 notebooks. By combining both technologies, ERAS helps provide a comprehensive solution for securing enterprise systems.

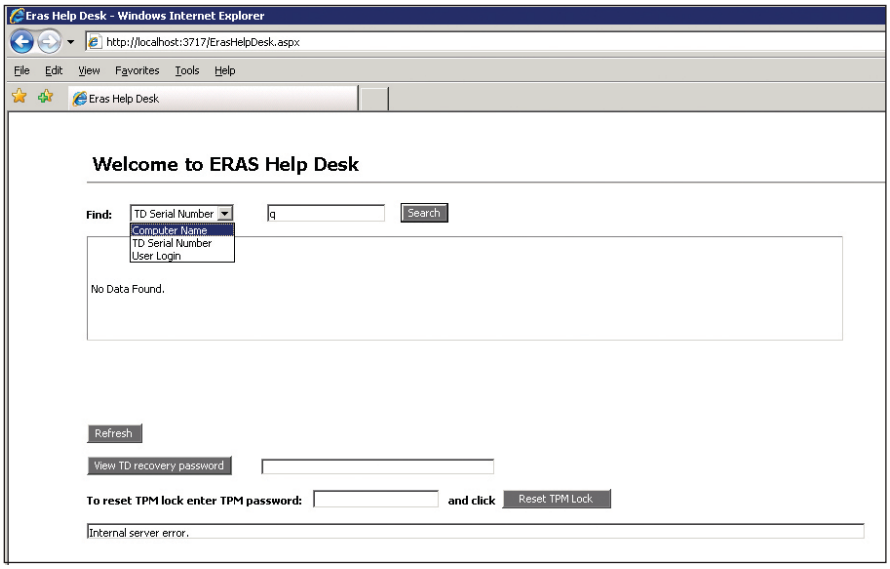

Figure 3. *Help Desk Web browser–based interface for EMBASSY Remote Administration Server from Wave Systems*

PROTECTING CRITICAL ENTERPRISE DATA

Deploying drive encryption has typically been a time-consuming task for enterprise IT administrators. Dell Latitude D630 and Latitude D830 notebooks with Seagate Momentus FDE.2 hard drives and EMBASSY management software from Wave Systems offer a comprehensive, simplified solution for securing client systems, enabling administrators to rapidly deploy and manage encrypted drives to help protect critical enterprise data.

Brian Berger is the executive vice president of marketing and sales for Wave Systems, where he is responsible for developing and implementing the company's trusted computing strategy. Brian is a director for the Trusted Computing Group and serves as chair of the organization's Marketing Working Group. He holds several patents, has a B.A. degree, and attended the Harvard Business School Executive Education program.

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Dell Latitude notebooks:
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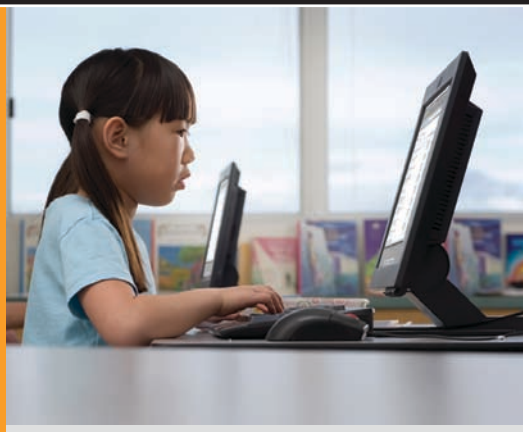

GIVING SCHOOLS ROOM TO GROW

Dell™ PowerEdge™ servers and Dell PowerVault™ storage arrays helped the Shanghai Community International Schools enhance high-capacity data storage and backup, reducing data recovery time by an estimated 98 percent and server administration time by approximately 60 percent.

CHALLENGE

Outdated, undersized storage unable to accommodate multimedia files hampered the educational mission of the Shanghai Community International Schools (SCIS), while time-consuming, failure-prone data backups required the schools to look for affordable, stable, and scalable storage that could be implemented during summer vacation.

SOLUTION

The SCIS IT staff worked with Dell to deploy high-capacity storage and backup platforms based on Dell PowerEdge servers and Dell PowerVault storage arrays at each campus.

BENEFITS

- The high-capacity storage and backup doubles the available storage and provides an estimated 98 percent reduction in recovery time.
- An updated infrastructure helps reduce server administration time by approximately 60 percent.
- A smaller server footprint enables up to 40 percent faster e-mail performance and an estimated 100 percent cost payback in six months.

Related Categories:
Case study, Dell PowerEdge servers, Dell PowerVault storage, Shanghai Community International Schools

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Computers and digital media have taken on an increasingly important role in education, encompassing presentations, Web pages, PDFs, spreadsheets, digital video, and podcasts. But although these multimedia resources help engage students, they can also require large amounts of storage space.

Unavailable storage was a problem for the Shanghai Community International Schools (SCIS), three college preparatory schools in Shanghai, China. By spring 2007, the schools' outdated, overburdened storage infrastructure had no space available for new data. Restoring lost or damaged files was difficult and time-consuming, with centralized data backup taking five or six hours and failing about half the time.

"Our old setup just wasn't working anymore," says Jerry Tang, systems supervisor at SCIS. "Our teachers and students always need to store things like video and audio files on the server, but the hard drive wasn't big enough. A lot of people were being disappointed." Meanwhile, he had to shuttle between the three campuses to back up data on a removable 300 GB USB hard drive, which introduced physical and security risks. Clearly, SCIS needed a more stable, scalable storage solution, at an affordable price, that would be easy to configure and ready to use before the 2007–2008 school year began in late August. The solution also needed to support a system-wide upgrade from the Microsoft® Windows® 2000 Server OS to the Microsoft Windows Server® 2003 OS.

DELL PROVIDES PLANNING AND INTEGRATION SUPPORT

In spring 2007, Tang began looking at network attached storage (NAS) solutions that could help ease management and meet his storage needs. He considered storage from both Adaptec and Dell, and soon rejected Adaptec Snap Server because it runs a version of the Linux® OS that he felt was too high maintenance compared with Windows.

The cost-effectiveness of the Dell hard drives was a key factor in his decision to choose Dell—Tang had projected data storage for SCIS growing from about

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> **"[Dell] had the comprehensive knowledge needed to answer all our questions. They understood our needs and came to us with a plan showing which product would work for which purpose."**
>
> —Jerry Tang
> Systems supervisor at Shanghai Community International Schools
> January 2008

600 GB in early 2007 to 1 TB by the end of the year, and ultimately even up to 24 TB. But what really drove his decision was the planning and integration support from Dell and Dell partner TSI. Tang comments that in his area, storage from Adaptec and other leading vendors was sold only through distributors, who generally were not experts on the products. The Dell pre-sales support team, in contrast, had worked with SCIS before and were knowledgeable about Dell products, including whether they would support his choice for backup and antivirus software. "[Dell] had the comprehensive knowledge needed to answer all our questions," Tang says. "They understood our needs and came to us with a plan showing which product would work for which purpose."

In June, Tang decided on a solution. For the primary SCIS data center, he chose a Dell PowerEdge 2900 as the e-mail server and a PowerEdge 4210 rack enclosure, which took up approximately 40 percent less space in the server room. The other two SCIS campuses would use twin NAS arrays comprising a Dell PowerVault NX1950 networked storage solution and a PowerVault MD3000 Internet SCSI (iSCSI) storage array. A PowerVault TL2000 tape library at each campus supports fast, easy-to-use automated data backup, while Dell OpenManage™ Server Administrator provides remote management and configuration and Dell Silver Enterprise Support helps troubleshoot hardware and software issues.

The products were shipped in early July and went live within two weeks. Installation and integration with the existing servers went smoothly, and Tang even had time to oversee the concurrent upgrade to Windows Server 2003.

DELL SOLUTION SIMPLIFIES MANAGEMENT AND BACKUPS

The new Dell solution has made the IT infrastructure at SCIS much simpler and easier to manage, Tang says. The Dell OpenManage software lets him remotely check work status, resource usage, and temperature levels for computers at each school. In addition to reducing his travel between campuses, Tang spends approximately 60 percent less time on storage administration, even though the storage space has doubled and the amount of data storage has increased by half.

In addition, the backup failure rate has dropped from almost 50 percent to about 1 percent. The automated features of the PowerVault TL2000 tape library and Symantec Backup Exec enable Tang to schedule full backups every two weeks and differential backups every workday, rather than whenever he could fit them in. In addition, the time required to restore an accidentally deleted or damaged file was reduced from several hours to 15–30 minutes—a metric put to the test when Tang had to perform three data restores in one day, including a principal's vital spreadsheet for scheduling classes for the coming year. "He was quite anxious. But I felt confident and relaxed about getting it back, because I knew we had a stable tape backup," Tang says.

DELL OFFERS SCALABLE, HIGH-PERFORMANCE STORAGE

Students and faculty at SCIS appreciate the new infrastructure. In the first month of the new school year, SCIS added another 100 GB of data to the 600 GB of data already stored. Teachers now have a central data store for an unlimited range of digital resources to plan and implement lessons because of the extra storage available with the PowerVault NX1950 and PowerVault MD3000 systems, Tang says. The storage platform also can be scaled out for years ahead, not just for terabytes of data but for future upgrades, networking, and clustering.

The value Dell provides to SCIS is not just higher transaction speeds, increased storage, and a reduced administrative burden, Tang says, but the simplicity of working with a single vendor and receiving trustworthy technical support. He expects the solution to pay for itself within six months. "Throughout Shanghai, the biggest city in China," Tang says, "I couldn't find another storage solution as comprehensive as Dell's."

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QUICK LINK

Dell PowerVault storage:
DELL.COM/PowerVault

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THE ART OF STORAGE

For online retailer MisterArt.com, the Dell™ PowerVault™ MD3000i Internet SCSI (iSCSI)–based storage array simplifies storage management and provides high performance in support of 80 percent annual business growth.

CHALLENGE

The MisterArt.com IT group needed to increase storage capacity to accommodate its 80 percent year-over-year business growth. The team wanted to simplify storage management with a reliable system that could deliver outstanding performance.

SOLUTION

After testing the performance of several storage systems, the MisterArt.com IT group selected a Dell PowerVault MD3000i Internet SCSI (iSCSI)–based storage array with a Dell PowerVault MD1000 disk expansion enclosure.

BENEFITS

- Dell PowerVault MD3000i nearly doubles performance compared with a competing system, with improved database response contributing to better system response, enhanced customer satisfaction, and increased employee productivity.
- High-availability configuration improves reliability, while standardized hardware design provides easy serviceability.
- Standard Ethernet connectivity and the intuitive Dell Modular Disk Storage Manager interface simplify storage administration.
- Modular hardware options ease future scalability.

Related Categories:
Case study, Dell PowerVault storage, Internet SCSI (iSCSI), MisterArt.com

Visit DELL.COM/PowerSolutions for the complete category index.

Established in 1996, MisterArt.com was among the first companies to sell arts and crafts supplies online. Today, the company maintains its competitive edge by offering more than 60,000 items to painters, illustrators, photographers, and hobbyists across the United States—and relies heavily on Dell technology to do so.

"IT is the engine that runs our business," says Marco Nicolayevsky, CTO at MisterArt.com. "We're an online company, so every customer interaction, every product purchase is handled by technology. We standardized on Dell PowerEdge servers and Dell storage solutions years ago because we needed reliable, high-performance systems that could deliver the best customer experience while also optimizing the productivity of our IT staff."

BUSINESS GROWTH DRIVES THE NEED FOR SCALABLE STORAGE

The company's reliance on IT means that its infrastructure must grow along with its business—and currently, the company is growing at a rate of 80 percent per year. "The company's phenomenal growth placed significant demands on our IT infrastructure and staff," says Nicolayevsky. "We needed to increase our storage capacity to make room for more product information and customer data. We needed to add storage that would accommodate our growth for the next 12 to 18 months."

Although the IT group was satisfied with their existing Dell/EMC CX300 Fibre Channel storage area networks (SANs), they wanted to investigate cost-effective alternatives for expanding them. The IT team knew reliability was essential, and the enhanced system would need to support a round-the-clock online business while simplifying administration and providing outstanding performance.

Internet SCSI (iSCSI) provided the solution. Because it uses standard Ethernet components, iSCSI storage can be much easier to manage and less expensive to implement than Fibre Channel systems. "The Dell/EMC SANs had the reliability we needed. In five years, we never had an unplanned outage," says Nicolayevsky. "Still, we realized that we could save significant costs on host bus adapters, switches, and drives by integrating an iSCSI system. If we could help our IT staff become more productive, they could spend more time on finding innovative ways to help improve our shopping site."

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After considering iSCSI systems from several vendors, the IT group tested the Dell PowerVault MD3000i iSCSI-based SAN array against a comparably priced system from another vendor. "We brought both systems into our lab, set up an identical environment, simulated typical workloads, and measured results. We recorded I/O operations per second, transactions per second, and megabytes per second," says Nicolayevsky. "The PowerVault MD3000i outperformed the competing system on all the metrics we tested. In one test, the Dell system delivered nearly two times the transactions per second of the other system."

"The PowerVault MD3000i outperformed the competing system on all the metrics we tested. In one test, the Dell system delivered nearly two times the transactions per second of the other system."

— Marco Nicolayevsky
CTO at MisterArt.com
December 2007

DELL MODULAR DISK STORAGE MANAGER SIMPLIFIES MANAGEMENT

The intuitive Dell Modular Disk Storage Manager interface was another key feature for the IT group. "When I was first introduced to the PowerVault MD3000i, the Dell account team set up a Web conference so that I could test-drive the interface," Nicolayevsky says. "Even before the Dell engineer began the demonstration, I was able to start using the system on my own."

The common components of the PowerVault MD3000i and Dell PowerEdge™ servers help make the PowerVault MD3000i easy to service. "The PowerVault MD3000i uses the same 15,000 rpm Serial Attached SCSI drives as the PowerEdge servers," says Nicolayevsky. "Using the same drives for servers and storage lowers the cost of carrying replacement parts so our business can stay up and running. Of course, if we need it, we can always use our Dell Gold Enterprise Support for fast assistance—there is just one number to call."

As a result of the performance and interface tests, the IT group selected the high-availability configuration of the PowerVault MD3000i combined with a PowerVault MD1000 disk expansion enclosure for a total of 9 TB of storage. The 30-drive configuration would provide both the capacity for growth and the performance necessary for running the company's applications, while the high-availability configuration helps ensure business continuity.

DELL POWERVAULT SUPPORTS PRODUCTIVITY AND BUSINESS AGILITY

Using the intuitive Dell administrative tool, the IT group installed the system rapidly. "We had a very short time to put the additional storage into production. Dell delivered the unit in less than one week—no question, the Dell sales team clearly understood our needs," says Nicolayevsky. "Once we had the system in the data center, setting it up was simple. . . . We were able to roll it into production in about 20 minutes."

The IT group received immediate positive feedback from employees about the performance of the new storage system. "We began to migrate some back-office applications from the Fibre Channel SAN to the PowerVault MD3000i without telling anyone. People actually asked me if I had upgraded a server because everything was faster," says Nicolayevsky. "That made me realize that the Dell SAN had a direct effect on worker productivity." He notes that the high level of performance should also help improve business agility, allowing MisterArt.com to quickly adjust prices in response to changing costs and providing an enhanced online shopping experience for companies.

As the MisterArt.com IT group looks ahead to further growth, they have a storage platform that can expand as the company grows. "With the Modular Disk Storage Manager, I can increase the size of volumes so I can provision more space to a server or a set of servers," says Nicolayevsky. "If we need more physical capacity, the modular design of the PowerVault MD3000i makes it simple to add another PowerVault MD1000 with 15 more drives. And if we need to move beyond the capacity of the PowerVault MD3000i . . . we can simply add another PowerVault MD3000i."

Although MisterArt.com was willing to pay a premium for reliability, performance, scalability, and simplified management, after looking at several SANs, the company found that the PowerVault MD3000i had all the features it needed at an attractive price. "For us," Nicolayevsky says, "the PowerVault MD3000i is an ideal storage foundation for an online business."

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Dell iSCSI storage solutions:
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HIGHER PERFORMANCE FOR LESS POWER

The efficient power usage and heat output of Dell™ PowerEdge™ Energy Smart 1950 servers helped Deutsche Rentenversicherung reduce energy bills and avoid a potentially costly upgrade to its existing infrastructure.

CHALLENGE

When Deutsche Rentenversicherung wanted to combine its IT systems from two locations into one data center, it recognized that the consolidation could stretch the limits of its infrastructure and increase heat output beyond the capacity of its existing air-conditioning system.

SOLUTION

Deploying Dell PowerEdge Energy Smart 1950 servers helped reduce power consumption and heat output, enabling the company to reduce day-to-day power costs and maintain its existing air-conditioning system.

BENEFITS

- Dell PowerEdge Energy Smart 1950 servers provide high energy efficiency in data centers requiring highly fail-safe, continuous operation.
- A combined reduction in power consumption and heat generation helps reduce energy utility bills and allow the organization to continue to use its existing air-conditioning system.

Related Categories:
Case study, Dell PowerEdge servers, Deutsche Rentenversicherung, green IT, power and cooling

Visit DELL.COM/PowerSolutions for the complete category index.

During a reorganization of German state pensions and annuity insurance in 2005, Deutsche Rentenversicherung, a provider of pensions and annuity insurance, combined its IT systems in Westphalia and Rheinland into one data center at Zentrales Rechenzentrum West (ZRWest). Steadily rising power consumption from the existing servers created higher energy costs for the organization, and the air-conditioning system at the ZRWest facility could not cope with the corresponding rise in heat output from the servers.

The consolidated data center is critical to the daily operations of Deutsche Rentenversicherung. ZRWest operates one mainframe, which administers the core business processes for the organization and manages, maintains, and calculates the contributions for 18 million insurance plans. Employees of the organization access the application through a graphical user interface set up in the Microsoft® Windows® OS, with future plans to run the interface through Java. A Citrix® terminal server environment provides desktop interfaces for 4,000 employees.

The server farm at the ZRWest data center includes approximately 100 systems—predominantly computers used as terminal servers, but also some application-specific servers. Deutsche Rentenversicherung has been using Dell PowerEdge servers for several years. "Dell servers have proved robust and reliable," says Achim Manz-Bothe, head of systems technology at ZRWest in Düsseldorf.

The existing PowerEdge systems perform well, even in an environment requiring virtually nonstop operation. "The systems are in continuous operation," says Manz-Bothe, "with the OS as well as applications running on the terminal servers themselves rather than in the storage area network, for instance. Despite the high level of usage, we have experienced hardly any failures so far."

DELL ENERGY SMART SERVERS HELP REDUCE ENERGY COSTS

The power requirements for the organization's servers and the corresponding heat output have been rising steadily. "The rising power consumption and heat output was reflected in our electricity bill," says Manz-Bothe. "We were also fast approaching our infrastructural limits. Sooner or later we would have

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required a completely new air-conditioning system and some major structural work to the premises."

To save this time and expense, the IT staff at Deutsche Rentenversicherung chose to deploy an enhanced, power-efficient generation of servers: the Dell PowerEdge Energy Smart 1950 series. In addition to current sociopolitical awareness of global warming and climate change issues, Deutsche Rentenversicherung also recognized the economic benefits of addressing power consumption and heat output from its servers.

Before making the investment decision, however, Manz-Bothe made some comparative model calculations, and the result came out clearly in favor of the PowerEdge Energy Smart 1950 servers. "The slightly higher purchase costs of the PowerEdge Energy Smart series are quickly balanced by the savings on power consumption," Manz-Bothe says. The PowerEdge Energy Smart 1950 servers have helped reverse the general trend toward ever-increasing power consumption for Deutsche Rentenversicherung, requiring just 50 percent of the power of the previous server models.[1]

> **"As the price per kilowatt rises, the PowerEdge Energy Smart servers are becoming increasingly cost-effective for us."**
>
> —Achim Manz-Bothe
> Head of systems technology at ZRWest
> January 2008

The increase in energy efficiency helped reduce the monthly electricity bill for the ZRWest data center by approximately €5,000, which helped shorten the organization's return on investment accordingly.[2] "As the price per kilowatt rises, the PowerEdge Energy Smart servers are becoming increasingly cost-effective for us," says Manz-Bothe.

DELL ENERGY SMART SERVERS HELP MINIMIZE HEAT OUTPUT

Because the Dell PowerEdge Energy Smart 1950 servers help reduce the amount of heat generated from running multiple servers in a single location, they helped Deutsche Rentenversicherung avoid the time and expense of remodeling work to replace the air-conditioning system at the data center. Not only did the PowerEdge Energy Smart 1950 servers help increase performance, but by not generating as much heat as the existing servers, the organization could continue using its existing air-conditioning system for the consolidated data center.[3] "Now all new servers we purchase are PowerEdge Energy Smart servers," says Manz-Bothe.

Even in the public administration sector, business processes today are typically highly dependent on IT. "Users are interested in performance and availability," says Manz-Bothe. "It is the job of the IT department to take into account other aspects too, such as power consumption." The IT staff at Deutsche Rentenversicherung opted for the Dell PowerEdge Energy Smart 1950 servers because they can provide outstanding performance while helping reduce power consumption and excess heat.

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Dell Energy Smart:
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[1,2,3] Customer experiences and individual results may vary.

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AUTOMOTIVE GIANT BOOSTS EFFICIENCY

The Dell™ Premier Pages service combined with VMware® virtualization on Dell PowerEdge™ servers enabled automotive supplier Magna International to take control of its IT procurement processes and streamline its server infrastructure—helping increase efficiency and reduce costs company-wide.

CHALLENGE

Magna International needed to streamline its procurement processes and consolidate its server infrastructure to help increase productivity, optimize business processes, and avoid wasted hardware resources and unnecessary energy consumption.

SOLUTION

Using the Dell Premier Pages service, the company built a customized Web portal with an efficient ordering system and deployed VMware ESX Server virtualization, helping reduce the number of active servers in its Frankfurt office from 70 to 3.

BENEFITS

- Procurement personnel can manage acquisitions better with improved order tracking.
- Personnel spend less time on lower-value tasks, installing new servers in 15 minutes.[1]
- End users gain a more robust network as virtualization supports business continuity.

Related Categories:

Case study, Magna International, virtualization, VMware

Visit DELL.COM/PowerSolutions for the complete category index.

Magna International, the third-largest automotive supplier in the world, manufactures and distributes automotive parts, systems, and complete modules to its customers around the world—including General Motors, Ford, and Chrysler. With its headquarters in Toronto, Canada, the company operates from 235 production centers and 62 engineering and research and development sites in 23 countries across five continents.

As part of its drive for greater operational efficiency, the company wanted to streamline IT procurement and consolidate its IT network. It had been operating on a decentralized system in which specific regions and local sites handled their own IT inventory and equipment requirements, without standardized management or control over IT procurement. It lacked a solid framework for efficient ordering as well as transparency in its IT inventory and orders. As a result, the company would regularly incur superfluous purchases, unnecessary costs, and operational delays from un-customized support—causing inventory problems, obstructing order consolidation, and disguising expenditures, costs, and budget standings.

In addition, the company was running too many servers, using the majority of its Intel® processor–based systems only for special applications that consumed 5–15 percent of the relevant processing power. The company housed its servers in four data centers—in Shanghai, Detroit, Toronto, and Frankfurt—and the waste of energy resulted in high electricity bills.

Magna International chose Dell to help resolve these key business challenges. Together, they implemented the Dell Premier Pages personalized online procurement service to standardize IT purchasing worldwide, and designed and installed a virtualization solution that reduced the server pool and simplified IT management.

DELL PREMIER PAGES OFFERS CONTROL OVER IT PROCUREMENT

Dell Premier Pages offers Magna International standardized management and control over its IT procurement. A customized Web portal provides access to products and solutions for the entire organization, and the predefined framework contract allows the company to set standards and limitations and gain insight into prices, equipment variants and configurations, service agreements, and software licenses. Kurt Siegl, director of IT and finance projects at Magna International, says,

[1] Customer experiences and individual results may vary.

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> **"Dell Premier Pages allows us to place our IT procurement under global control to optimum effect. It coordinates future plans, streamlines costs, and delivers a more efficient service to the business."**
>
> —Kurt Siegl
> Director of IT and finance products at Magna International
> January 2008

"Dell Premier Pages allows us to place our IT procurement under global control to optimum effect. It coordinates future plans, streamlines costs, and delivers a more efficient service to the business. Employees benefit from standardized network support, which is helping them increase productivity. Such transparency makes Dell Premier Pages an excellent tool for us."

Dell Premier Pages allows the IT departments at individual centers to attend to their own IT procurement and specific technology needs, but alleviates the need for long, drawn-out referrals to external IT providers. By using one IT provider, the company can easily collaborate on and monitor the parameters of its global budget and inventory agreements. Siegl says, "The local units know their own requirements better than anyone else. With Dell Premier Pages, the individual sites can order independently in accordance with their specific needs. At the same time, we can consolidate all orders, know where we stand within the global framework contract, and know how much we have ordered in total and under what terms." This approach gives each Magna International center the flexibility to operate as an independent unit while still remaining within the company's overall budget and inventory limits.

With Dell Premier Pages, employees and business decision makers at Magna International can achieve critical insight into business operations, costs, budgets, and inventory standings across the company—helping eliminate unnecessary overstock, allowing centers to consolidate their orders, and streamlining and standardizing the company's IT network. IT staff also have access to a quick reference point for manufacturer-specific regulations and technical specifications, allowing them to work more efficiently within the guidelines.

Dell and Magna International have collaborated successfully on a number of projects, which has further developed their relationship. In 2005, Magna International purchased 6,500 computer systems from Dell, and in 2006, this figure increased to 8,000.

VIRTUALIZATION PROVIDES A NEW LEVEL OF EFFICIENCY

Virtualization offered a way for Magna International to simplify its server infrastructure and consolidate its resources. The solution deployed by the company includes Dell PowerEdge 1850 and PowerEdge 6850 servers configured with up to four Intel processors running the VMware ESX Server 3 virtualization platform. This solution helped reduce the number of servers at the company's Frankfurt center from 70 to 3. In addition, Siegl notes, "Dell hardware and VMware software are available bundled, which eliminates time spent on configuration."

Reducing the number of physical servers has drastically reduced the amount of energy wasted on running and cooling its network, and simplified configuration and management. Siegl says, "The virtualized servers save us considerable costs in terms of power consumption and cooling states and, as a result, virtualized systems pay for themselves quickly." IT staff can install virtual machines remotely, and the process now takes just 15 minutes—a significant decrease from the previous process.[2] "Before, a member of our staff had to go out to the hosted computer centers to set up new servers in person," says Siegel. "With virtualization, setting up new systems takes a fraction of the time." In addition, the virtualized infrastructure has helped improve recovery times from network failures, because the virtual machines can easily take over functions from the other systems if a problem arises. This capability alleviates disruptions to the network, allowing staff to continue working even if network problems occur.

Dell provides Magna International with a single point of contact for its virtualization needs. This level of service includes Dell Platinum Enterprise Support—the most comprehensive Dell support package for critical server environments, which helps ensure that any outages are resolved rapidly with engineers on-site within four hours and provides a dedicated Dell technical account manager to help plan future IT developments. The service helps ensure Magna International gains the most from its virtualized environment, maximizing cost-effectiveness and employee productivity.

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By Clay P. Breshears

OpenMP and Intel® Threading Tools

How Parallelism Can Be Used Effectively in a Serial Application

Note: *This white paper examines the use of the Intel Threading Tools—Intel Thread Checker and Intel Thread Profiler—to analyze OpenMP pragmas. The complete text, which contains code analysis, can be downloaded in its entirety from http://www.devx.com/go-parallel/Article/32724*

OpenMP programs are threaded programs and can suffer from the same errors and performance problems as explicitly threaded applications. For the purposes of this white paper, we assume you are familiar with OpenMP and so we delve into the ways you can use the Intel Threading Tools—Intel Thread Checker and Intel Thread Profiler—to analyze OpenMP programs.

Explicit threading methods, such as Windows threads or POSIX threads, use library calls to create, manage and synchronize threads. Use of explicit threads requires an almost complete restructuring of affected code. On the other hand, OpenMP is a set of pragmas, API functions and environment variables that enable you to incorporate threads into your applications at a relatively high level. Pragmas are used to denote regions in the code that can be run concurrently. An OpenMP-compliant compiler transforms the code and inserts the proper function calls to execute these regions in parallel. In most cases, the serial logic of the original code can be preserved and recovered by ignoring the OpenMP pragmas at compilation time.

Intel Thread Checker as Programming Assistant

Intel Thread Checker can determine if a section of code is a candidate for parallelization. With long code sections or those that have a deep call stack, it is extremely tedious and time-consuming to determine what dependencies exist within potential parallel loops. Dependencies such as an induction variable (a variable that is incremented at each iteration of a loop) or recurrence relation (accessing information computed on a previous loop iteration) inhibit correct parallelization without some algorithmic modifications to eliminate the dependence. Intel Thread Checker points out storage conflicts and, with examination of the code, you can confirm that the use of the noted variable does constitute a loop dependence. More often than not, some threads will need private copies of certain variables in order to avoid data races. In other cases, the logic of the program will be better served if access to some of these variables is synchronized.

Performance Tuning With Intel Thread Profiler

After a correctly threaded code has been created with the help of Intel Thread Checker, the performance of that code should be gauged. The serial and threaded execution times can be compared easily. If the threaded time is half that of the serial time when run with two threads on a dual-core system, you have done a great job implementing parallelism. If the threaded execution time is closer to (or even greater than) the serial time, certain questions arise. Do large segments of code still execute in serial? Does the required synchronization adversely affect the execution performance? Is the amount of work per thread properly balanced?

Thread Profiler for OpenMP can be used to answer these questions and guide the programmer to points within the code that could be improved and lead to better parallel performance. Because of the structured nature of OpenMP, Thread Profiler is able to make assumptions about the execution model for the application and point out very specific performance problems.

Summary

The Intel Threading Tools are often touted as being able to find threading errors in code quickly and point out performance bottlenecks that may not be apparent. By using these tools earlier in the development cycle, you can automate some of the more tedious tasks required to find where parallelism can be implemented effectively within a serial application.

For more details and information on using the Intel Threading Tools, see "Getting Started with the Intel Thread Checker" and "Getting Started with the Intel Thread Profiler," which are included in the threading tools documentation.

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