Applications

"Unlimited"

Oracle – Siebel – PeopleSoft – JD Edwards

✓ Continued New Releases
✓ Customer Driven Product Roadmaps
✓ Dedicated Development Teams
✓ No Forced Migrations

Get better results with proven applications tailored for your industry, processes and geography.

oracle.com
or call 1.800.ORACLE.1

Game changers

How blade servers up the ante on data center efficiency

Dell blade customers exhibit cutting-edge agility
Smooth blade management using CMC 3.0
Cost-effective tiering for virtualized iSCSI SANs

Building the dynamic data center
Desktop power management via the Dell KACE appliance
Seamless Microsoft Exchange across data centers

Dell.com/powersolutions
OCEANS of data...

...demand a COMPREHENSIVE data platform.

Microsoft SQL Server 2008 R2

- Trusted, Scalable Platform
- IT & Developer Efficiency
- Managed Self-Service BI

EVALUATE MICROSOFT. SQL SERVER. 2008 R2 TODAY!
WWW.MICROSOFT.COM/SQLSERVER

Because it’s everybody’s business
Designed for unparalleled computing density, Dell™ blade servers boost flexibility and minimize costs with innovative power and cooling, intelligent network integration, seamless manageability, and exceptional reliability. How nimble is your IT?

By Robert Bradfield, Chris Christian, and Jeanne Feldkamp

Designed for unparalleled computing density, Dell™ blade servers boost flexibility and minimize costs with innovative power and cooling, intelligent network integration, seamless manageability, and exceptional reliability. How nimble is your IT?
features

Blade solutions for the Efficient Data Center

Cutting-edge agility

What do a wind farm developer, a clothing manufacturer, a maritime security and tracking services provider, and three institutions of higher learning have in common? They heightened IT efficiency, reliability, and performance using Dell blade servers.

Smooth operator

Built by implementing an innovative, user-driven development process, the Dell Chassis Management Controller (CMC) 3.0 embedded management tool enables administrators to simply and intuitively manage multiple blade servers from a single console.

Storage optimization

Taking an intelligent data management approach to archiving data

By Kay Benaroch and Joe Colucci

By employing a strong archiving strategy as the foundation for an intelligent data management program, enterprises can enhance efficiency for IT staff, meet compliance requirements, and streamline backup processes.

departments

Editor’s comments
6 @Socially speaking
By Tom Kolnowski

Storage optimization
24 Cost-effective tiering for virtualized iSCSI SANs
By Achmad Chadran and Keith Swindell

28 Streamlining enterprise database environments for business continuity
By Annette Cormier, Jason Kotsaftis, and Jeff Browning

36 Accelerate operations with next-generation storage efficiencies
By Annette Cormier, Eric Cannell, and Brad Bunce

40 Best practices for deploying iSCSI SANs in DSS database solutions
By Suresh Jasrasaria, Ananda Sankaran, and Chris Almond
As a key component of the Dell Efficient Data Center strategy, the Dell Virtual Integrated System architecture helps organizations move from a static to a dynamic data center and increase efficiency in the virtual era by effectively managing technology and the people and processes that manage the technology.
enabling application-level consistency and
in Oracle environments

By Annette Cormier and Jason Kotsaftis

In Oracle database environments, Dell/EMC storage technologies help simplify and enhance the time-consuming replication process while enabling application-level replication efficiency and recovery to previous points in time.

Dell Power Solutions Magazine and special edition articles are also available online at dell.com/powersolutions. Check the Dell Power Solutions Web site for early-release articles, how-to’s, case studies, best practices, and expert tips you won’t find anywhere else.

Power Solutions Digital Edition

Dell Power Solutions Digital Edition offers a comprehensive IT library at your fingertips—featuring powerful searches across archived issues and direct links to related resources. For instant accessibility, visit powersolutionsdigital.dell.com.

Efficient Enterprise framework

Take control of your data center with open, capable, and affordable solutions that help you focus on driving business innovation rather than just “keeping the lights on.” For the full story, visit dell.com/efficiency.

Index to featured Dell customers
Antioch Unified School District........91
Cornell University Center for Advanced Computing........17
National Center for Supercomputing Applications........82
Pacific Sunwear........................18
Pole Star Space Applications.........19
Renewable Energy Systems............17
Stony Brook University...............19
Thomas College........................18
Xtium..................................56

Index to advertisers
Advanced Micro Devices, Inc........C3
American Power Conversion Corporation........67
BMC Software, Inc....................23
Broadcom Corporation.................5
Extreme Networks, Inc.................15
F5 Networks, Inc.......................7
Intel Corporation.......................87
Microsoft Corporation................C2
Network Engines, Inc..................35
Oracle Corporation....................C4
SonicWALL, Inc.........................83

Join the Dell TechCenter community at delltechcenter.com to share your experiences, voice your concerns, and pick the brain of your favorite Dell expert—or be the expert by signing up for the Dell Masters program. And you won’t want to miss TechTuesday chats, community forums, discussion groups, blogs, white papers, video demos, and much more.
Broadcom®
iSCSI HBA
on Dell™ PowerEdge™ Servers
with VMware® vSphere™

Broadcom best-in-class 10 GbE and 1 GbE iSCSI HBA and boot solutions provided "inbox" in VMware vSphere 4.1 for Dell PowerEdge servers

Contact your Dell sales representative for more information
Blame it on the allure of social media chatter. TweetDeck, my favorite desktop application for monitoring Twitter, was dutifully displaying tweet after tweet originating from the eminently mobile attendees at the recent VMworld 2010 conference in San Francisco. But with our press deadline for this issue looming large, the editing process for pages in my workflow queue had unfortunately slowed to a crawl.

That was a small price to pay, given the fact I never had to leave the Dell offices in Austin to socially experience the flavor of VMworld, and the value provided by the real-time nature and richness of many tweets from the individuals I routinely follow on Twitter. Among the more memorable 140-character bursts were instant knowledge and links about the VMware® vCloud Director announcement from the keynote address, and a stream of information and photos around the Dell® Virtual Integrated System (VIS) architecture from the Dell Super Session.

Socially closer to home, the Dell Power Solutions editorial team is also on Twitter, where we are tweeting many new articles and exclusive online-only postings as soon as they emerge from our content factory, along with news items we feel may be of interest. You can follow us at twitter.com/powersolutions (@powersolutions). In addition, many of our contributing authors and colleagues, as well as Dell product and solution teams we interface with, are frequent participants on Twitter. Here is a starter list of individuals or teams you may want to consider following: Susan Beebe (@susanbeebe), Dell HPC team (@HPCatDell), Dell Inside IT blog (@DellInsideIT), Dell Storage team (@Dell_storage), Dell KACE team (@DellKACE), Franklin Flint (@franklinatDell), Andrew Gilman (@andrewgilman), Scott Hanson (@dellservergeek), Dylan Locsin (@DylanAtDell), Marc Malotke (@MarcDELL), Lionel Menchaca (@LionelatDell), Jeff Sullivan (@SANpenguin), Greg White (@gregorydwhite), and Kong Yang (@kongyang_dell).

Our primary focus at Dell Power Solutions Magazine, of course, continues to be the delivery of in-depth content designed to help you increase the efficiency of your IT environment. As we extend our medium beyond the customary print, digital, and Web editions, social media tools such as Twitter provide you with yet another choice on how to consume and participate in conversations around the content. We look forward to following you.

Tom Kolnowski
Editor-in-chief and publisher
tom_kolnowski@dell.com
dell.com/powersolutions
powersolutionsdigital@dell.com

Editorial staff
Editor-in-chief and publisher Tom Kolnowski
Managing editor Debra McDonald
Features editor Kathryn White
Associate managing editor Jim Duncan
Senior editors Dawn Davidson, James Hurd, and Terence O’Donnell
Editorial assistant Amy J. Parker
Art director and cover designer David Chan
Designer and Illustrator Cynthia Webb
Business development manager Casey Walker

Staff writers Romy Bauer, Jeanne Feldkamp, Julie Jervis, Greg Thomas, and Chris Young
Contributing photographers Tony Bolding, Bryan Kurz, Adrian Malte, Joey Pera, and Bryce Vickmark

Advertising sales
Sales director Kyle Walkenhurst (323-340-8505)
National sales manager Shaun Metz (949-923-1660)
Western U.S. and South/Central America sales Melony Galley (949-481-1125)
Eastern U.S. sales Steve Branda (201-485-787)
Canada, EMEA, and APJ sales Mark Makinseyy (805-709-6745)
Advertising assistant Scott Hallquist (323-254-0950)

About Dell
Dell Inc., headquartered in Round Rock, Texas, near Austin, listens to its customers and delivers innovative technology and services they trust and value. Exclusively enabled by its direct business model, Dell is a leading global systems and services company and No. 34 on the Fortune 500 list. For more information, visit our Web site at dell.com.

Dell cannot be responsible for errors in typography or photography. Dell, the Dell logo, Dell KACE, Dell OpenManage, Dell Precision, EqualLogic, PowerConnect, PowerEdge, and PowerVault are trademarks of Dell Inc. Other trademarks and trade names may be used in this publication to refer to either the entities claiming the marks and names or their products. Dell disclaims any proprietary interest in the marks and names of others.

Dell Power Solutions is published quarterly by Dell Inc., 1 Dell Way, Round Rock, TX 78682, U.S.A. No part of this publication may be reprinted or otherwise reproduced without permission from the editor-in-chief. Dell does not provide any warranty as to the accuracy of any information provided through Dell Power Solutions. Opinions expressed in this magazine may not be those of Dell. The information in this publication is subject to change without notice. Any reliance by the end user on the information contained herein is at the end user’s risk. Dell will not be liable for information in any way, including but not limited to its accuracy or completeness. Dell does not accept responsibility for the advertising content of the magazine or for any claims, actions, or losses arising therefrom. Goods, services, and/or advertisements within this publication other than those of Dell are not endorsed or in any way connected with Dell Inc.

Copyright © 2010 Dell Inc. All rights reserved. Printed on the USA Printed on recycled paper containing 10 percent post-consumer waste. Please recycle this magazine.

2010 Issue 3
Get real about virtualization.

Virtualizing is a great way to cut costs and improve efficiency. But you can’t just deploy the technology and call it good. Is your infrastructure ready for the realities of virtualization?
Game changers
Economic uncertainty, workforce transformation, and shape-shifting technology advances have changed the rules of play for IT decision makers, and data centers are feeling the pressure from all sides. Demand for computing power will only continue to grow, but a lack of physical space can limit expansion, and construction of new facilities is costly. Many organizations find themselves spending more on power and cooling than they’d budgeted for infrastructure refreshes. Meanwhile, proliferation of disparate platforms, vendor-specific tools, and complex licensing agreements can result in tremendous operational complexity and administrative burden.

Building on the core tenets of standardization, simplification, and automation, Dell PowerEdge™ M-Series blade servers and enclosures offer a flexible platform for managing physical, virtual, and logical infrastructures. As a result, blade server environments help eliminate resource silos and optimize data center operations—enabling administrators to allocate resources dynamically and accelerate delivery of strategic IT services. For these reasons and more, blade servers play a pivotal role in fulfilling Dell’s vision for the Efficient Data Center (see Figure 1).
High-powered computing keeps its cool
IT departments must take a new tack to meet intensifying demands for computing power while increasing reliability and response to variable workload requirements—often within the confines of tight power and space quotas. Blade servers help organizations address these challenges in several important ways (see the “Is your data center a candidate for blade servers?” sidebar in this article).

Efficient design
Because of their design, blade servers simply require less physical space in the data center than traditional tower or rack-optimized form factors: as many as 16 half-height or 8 full-height blade servers can fit into a 10U Dell PowerEdge M1000e modular blade enclosure. This efficient, high-density design can provide multiple advantages:

• Up to 60 percent more two-socket density compared with 1U two-socket servers
• Up to 220 percent more four-socket density compared with 4U four-socket servers

• Up to 256 cores per enclosure (4 sockets with 8 cores per socket and 8 blades per enclosure with the PowerEdge M910)
• Up to 4 TB of memory per enclosure (32 dual in-line memory modules [DIMMs] at 16 GB per DIMM with 8 blades per enclosure)
• No extra rack space required for KVM (keyboard, video, mouse) and network switches or additional management infrastructure

To achieve this degree of computing density, Dell blade servers place a premium on efficient processor performance. Low-voltage Intel® Xeon® processors provide an excellent combination of high performance and low processor power levels, making them well suited for use in high-density blade configurations running exceptionally demanding workloads. The Intel Xeon processor 5600 series is designed to automatically regulate power consumption and adjust server performance to match application requirements. Intel Intelligent Power Technology dynamically scales power consumption, making power available for critical workloads and

Automated management of data through predictable, scalable, and open data storage:
• Minimize storage costs through storage virtualization, efficient object storage, automated data tiering, and deduplication
• Leverage on-demand capacity scaling and cloud disaster recovery

Rapid delivery of strategic IT services with groundbreaking capabilities:
• Automate day-to-day tasks, from workload deployment to image creation
• Use best-of-breed technologies as they develop, without vendor lock-in

Tools for managing and deploying physical, virtual, and logical infrastructure:
• Optimize the management of both physical and virtual servers
• Take an incremental, open approach to help protect IT investments

Smart, virtualization-ready infrastructure for rapid deployment and optimized operations:
• Dynamically manage servers, networks, storage, and workloads
• Radically reduce the number of devices to manage, power, and cool—and the tools required to do so

Figure 1. Building blocks for the Efficient Data Center
conserving power when demand subsides. In addition, Intel Xeon processor models that support Intel Turbo Boost Technology provide higher-speed execution on demand by using available power to run at a higher frequency.

Overall design efficiency contributes to lower operating costs and requires fewer cooling resources than other blade servers. For example, in a Dell competitive power study, 16 Dell PowerEdge M610 blade servers inside a Dell PowerEdge M1000e modular blade enclosure used up to 24.1 percent less overall power while idle than 16 HP ProLiant BL460c G6 servers inside an HP BladeSystem c7000 enclosure. In the same study, 16 Dell PowerEdge M610 blade servers used up to 63.6 percent less overall power while idle than 14 IBM® BladeCenter® HS22 servers inside an IBM BladeCenter H-Series enclosure.1

Innovative power and cooling
The blade server form factor is designed to optimize thermal and electrical efficiency. A power and cooling infrastructure shared among all blades in the enclosure allows resources to be diverted to the servers that need them at any given moment.

For example, suppose two blades in the same enclosure are handling different workloads. One server is running at 90 percent capacity, and its fans are working at full speed and struggling to keep the server cool. The second server is running at only 10 percent capacity and does not need the full cooling capability of its fans.

In a traditional configuration, the underutilized server would have no way to lend its power and cooling abilities to the server working at 90 percent capacity. In a modular configuration, power and cooling is shared—so those cooling resources can be directed to the blade that needs them.

Dell’s innovative fan technologies help to optimize system temperatures and significantly reduce power draw from the cooling infrastructure. The Dell blade enclosure utilizes three separate and distinct low-impedance airflow pathways to help ensure ambient air reaches components without being preheated. Power supplies for Dell blade servers are 80 PLUS platinum certified (over 94 percent efficient), the highest rating available. Management features such as Dynamic Power Supply Engagement further help to optimize both performance and efficiency based on configurable settings.

Intelligent tools work with existing IT infrastructure
Dell blade servers are designed to pair powerful computing capabilities with optimized connectivity based on open standards (see the ‘Dell blade servers up the ante on data center efficiency’ sidebar in this article). These flexible designs work with existing data center infrastructures and enable rapid deployment of advanced technologies. Intelligent architecture and streamlined systems management capabilities help simplify and automate IT tasks, while energy-efficient infrastructure optimizes operations to help reduce total cost of ownership.

Integrated networking fabric
Dell modular blade enclosures integrate edge networking for reduced bandwidth and distinct low-impedance airflow pathways to help ensure ambient air reaches components without being preheated. Power supplies for Dell blade servers are 80 PLUS platinum certified (over 94 percent efficient), the highest rating available. Management features such as Dynamic Power Supply Engagement further help to optimize both performance and efficiency based on configurable settings.

Intelligent tools work with existing IT infrastructure
Dell blade servers are designed to pair powerful computing capabilities with optimized connectivity based on open standards (see the ‘Dell blade servers up the ante on data center efficiency’ sidebar in this article). These flexible designs work with existing data center infrastructures and enable rapid deployment of advanced technologies. Intelligent architecture and streamlined systems management capabilities help simplify and automate IT tasks, while energy-efficient infrastructure optimizes operations to help reduce total cost of ownership.

Integrated networking fabric
Dell modular blade enclosures integrate edge networking for reduced bandwidth and distinct low-impedance airflow pathways to help ensure ambient air reaches components without being preheated. Power supplies for Dell blade servers are 80 PLUS platinum certified (over 94 percent efficient), the highest rating available. Management features such as Dynamic Power Supply Engagement further help to optimize both performance and efficiency based on configurable settings.

1 Based on SPECpower_ssj2008 benchmark tests performed by the Dell Server Performance Analysis team in June 2010. Each blade server was configured with two six-core Intel Xeon X5670 processors at 2.93 GHz, 24 GB of Double Data Rate 3 (DDR3) RAM, and two 73 GB, 15,000 rpm Serial Attached SCSI (SAS) hard drives. For complete details, visit spec.org.
Dell blade servers up the ante on data center efficiency

Dell’s latest virtualization-ready blade servers and enclosures feature intelligent power distribution for outstanding performance per watt, balanced system architecture for efficient memory performance, innovative power and cooling, integrated networking fabric, and simplified systems management.

Dell PowerEdge M610x blade server

This two-socket blade server based on the Intel Xeon processor 5600 series leverages the performance and capabilities of the PowerEdge M610 blade server in a rack-dense, full-height form factor. Coupled with PCI Express (PCIe) expansion capabilities, it supports an exceptional range of connectivity options.

Designed for enterprises that need the flexibility and efficiency of blade server technology, but with I/O needs beyond those supported in custom I/O mezzanine cards, PowerEdge M610x blade servers help enterprises run business applications efficiently and cost-effectively to heighten productivity and innovation. They help reduce the data center footprint through consolidation with high-performance virtual machines and expansion-card-based platforms. The result: enterprises can spend additional time on creating business value and reduce time spent on planning, deploying, and maintaining IT.

Dell PowerEdge M710HD blade server

This virtualization-optimized blade server offers outstanding I/O throughput, maximum memory density with 18 dual in-line memory modules (DIMMs), and robust Intel Xeon processor 5600 series compute power with 12 total cores—all in a half-height form factor with hot-swappable Serial Attached SCSI (SAS) drives or solid-state drives (SSDs).

Designed for enterprises that require a highly dense two-socket form factor with the ability to maximize total RAM, PowerEdge M710HD blade servers are well suited for medium and large general-purpose, mission-critical, and memory-intensive applications and databases. They may also be a good match for IT departments looking for a highly reliable and redundant half-height configuration that provides both density and I/O flexibility.

The PowerEdge M710HD blade server falls between the PowerEdge M710 and PowerEdge M610 blade servers in the portfolio because it is designed to offer more memory and more I/O throughput than the PowerEdge M610 server and greater density (half height) than the PowerEdge M710 server. The PowerEdge M710HD blade server additionally offers a network daughtercard, which is a flexible version of a conventional LAN on Motherboard (LOM) that allows choices for integrated connectivity. This modular daughtercard design enables the integrated network ports to be changed or upgraded as bandwidth requirements evolve over time. The PowerEdge M710HD initially includes a quad-port embedded Gigabit Ethernet network interface card (NIC), with two additional network daughtercard options expected to be available soon. These networking options as well as the expansion options offered by the existing I/O mezzanine cards provide a wide range of approaches for bandwidth delivery maximization and customization. Dual embedded hypervisors and hot-swappable, fault-tolerant hard drives also provide enterprise-class redundancy for mission-critical applications.

cabling to help simplify deployment and service as well as reduce consumption of expensive core switch ports. Dell modular blade switches—including the 48-port Dell PowerConnect™ M6348 blade switch—also help simplify the process of upgrading and adding bandwidth. Dell offers these advanced, fully featured integrated switches as well as a series of port aggregator devices known as the SimpleConnect series. For those administrators who do not need or desire in-depth management and configuration options for integrated networking, Dell’s SimpleConnect port aggregators provide the flexibility to scale their throughput as needed while helping reduce cabling. SimpleConnect features help IT staff avoid complex, time-consuming switch configuration and management tasks. And because the SimpleConnect series of networking devices does not require personnel with specialized skill sets, it also helps to reduce deployment time, training requirements, and operating expenses.

Dell FlexAddress Plus features can also streamline networking management by...
Exceptional connectivity
Development manager Richard Waldorf highlights the PCIe expansion design and other key capabilities of the PowerEdge M610x blade server.
youtube.com/watch?v=f6iH9LUssaw

Maximum memory and high reliability
Chris Christian outlines the advantages of the PowerEdge M710HD blade server, including the large memory capacity, hot-swappable drives, and hardware RAID.
youtube.com/watch?v=9vH8BYnz_8M

Dell PowerEdge M910 blade server
Delivering heavy-hitting performance and advanced reliability in a full-height, four-socket blade, PowerEdge M910 servers provide an outstanding platform for deploying large, enterprise-class applications. These Intel Xeon processor 7500 series–based blade servers feature extensive I/O scalability, pushing the limits of performance with intelligent, expandable processing power that is designed to automatically adapt to diverse, mission-critical workloads. Dell also offers FlexMem Bridge, an innovative, patent-pending technology that enables this leading-edge platform to seamlessly scale memory from 4 GB to 512 GB in either two-socket or four-socket configurations—helping meet changing organizational needs without the need to rip and replace.

PowerEdge M910 blade servers are well suited for data-demanding applications, private cloud deployments, and heavy virtualization environments supporting data center consolidation or robust data recovery plans.

Dell PowerEdge M1000e modular blade enclosure
By providing enhanced usability and manageability in a space-efficient form factor, PowerEdge M1000e enclosures are designed for exceptional power efficiency and rapid, straightforward deployment. Efficiency features include active, dynamic “zoned” cooling, breakthrough fan technologies, ultra-efficient power supplies with dynamic control and power monitoring, and regulators and board design optimized for power and cooling efficiency. An LCD panel, wizard-based setup, and centralized configuration through a chassis manager help to streamline deployment. Integrated ship options further help to minimize waste and speed installation.

Maximum memory and high reliability
Chris Christian outlines the advantages of the PowerEdge M710HD blade server, including the large memory capacity, hot-swappable drives, and hardware RAID.
youtube.com/watch?v=9vH8BYnz_8M

Streamlined management
Dell blade servers are designed with consolidated management capabilities embedded within the hardware, avoiding the need for management software to aid in deployment and troubleshooting. Through a single easy-to-use console, Dell Chassis Management Controller (CMC) 3.0 helps speed management tasks supporting Media Access Control (MAC) or World Wide Name (WWN) address virtualization without costly proprietary hardware requirements. Because it does not require separate management tools or proprietary infrastructure, FlexAddress can be extremely cost-effective compared with switch-based alternatives.

For example, in a typical blade server setup, a MAC or WWN address is coded to the physical blade server; if the blade is replaced, an IT administrator must reestablish the relationship between the server and its dedicated disk on the Internet SCSI (iSCSI) or Fibre Channel SAN. Dell FlexAddress Plus masks the physical MAC and WWN addresses coded to the hardware so that blade servers can be replaced without breaking the relationship with the SAN. This approach enables administrators to re-task or replace blade server hardware quickly and easily, without having to carry out the time-consuming processes involved in changing LAN or SAN access requirements or rezing switches.
"Dell blade servers are designed to provide a flexible infrastructure that accelerates delivery of strategic IT services."

and issue resolution by providing immediate access to system status and alerts. The CMC supports automated discovery and rapid server deployment to help minimize administrative overhead. By automating and simplifying hardware configuration and updates for BIOS, firmware, and drivers in a one-to-many manner, CMC 3.0 enables administrators to configure multiple blade servers at once.²

Virtual File Share features also allow updates and images to be hosted on network storage and made available simultaneously to multiple blades. MAC and WWN addresses can be displayed before blade installation, enabling IT staff to pre-provision LAN and SAN resources for rapid deployment.

Reliability

Reliability is central to all Dell PowerEdge server designs, and the M-Series is no exception. The PowerEdge M1000e chassis infrastructure is designed to be 100 percent passive. For example, none of the plugs on the midplane use male connectors, thereby avoiding the possibility of bent pins that could necessitate a chassis overhaul and result in significant downtime. All Dell blade fabrics are designed to be fully redundant—so if a switch or port experiences mechanical failure, the blade itself does not lose connectivity. Major subsystem components are also redundant and hot pluggable. This redundancy and commitment to removing and reducing potential single points of failure extends to the blade servers as well: all Dell blade servers offer hot-swappable hard drives and hardware RAID. The PowerEdge M710HD and PowerEdge M910 blade servers even feature an embedded, dual-media, fail-safe hypervisor to help protect against downtime in virtualized environments.

Winning efficiency accelerates delivery of strategic IT services

Data centers are grappling with increased cost and management complexity to maintain existing infrastructure in the face of increasing performance demands, physical space limitations, and maxed-out power and cooling capacity. Blade servers address these challenges in a cost-effective, energy-efficient form factor that enables organizations to shift the balance of IT spending from fixed maintenance to strategic investments that fuel innovation.

Dell blade servers are designed to provide a flexible infrastructure that accelerates delivery of strategic IT services by combining high density with innovative power and cooling, exceptional manageability, and integrated connectivity for virtually any network, storage, or management environment. Dell PowerEdge M610x, PowerEdge M710HD, and PowerEdge M910 blade servers together with the PowerEdge M1000e modular blade enclosure offer a game-changing array of features and capabilities designed to optimize data center efficiency—and outplay the competition.²

Learn more

Dell PowerEdge blade servers:
dell.com/blades

The Efficient Enterprise:
dell.com/efficiency

When you migrate your Data Center, make sure to go in the right direction.

The data center is quickly evolving from physical resources to highly virtualized environments and on to cloud computing.

The transformation is not a one-size-fits-all proposition. Extreme Networks Four Pillar strategy for moving from physical to highly virtualized and on to the cloud enables enterprises and hosting providers of any scale to migrate their networks at their own pace.

Let Extreme Networks® show you how the data center network is evolving to meet the challenges of next-generation virtualization and cloud environments. Be ready when you’re asked to move your data center from physical to virtual and on to the cloud.

For information on how to migrate your data center go to extremenetworks.com/solutions/datacenter.aspx

© 2010 Extreme Networks, Inc. All rights reserved. Extreme Networks and the Extreme Networks logo are either registered trademarks or trademarks of Extreme Networks, Inc. or its subsidiaries in the United States and other countries.
What do a wind farm developer, a clothing manufacturer, a maritime security and tracking services provider, and three institutions of higher learning have in common? They heightened IT efficiency, reliability, and performance using Dell™ blade servers.

Efficiency has become the watchword across virtually every line of business. The good news is that technology advances in today’s blade server infrastructures make it a snap to optimize data center efficiency and manageability—enabling organizations around the world to invest newfound IT cost savings in initiatives that inspire innovation and accelerate growth.

The success stories highlighted here represent a small but diverse sample of how organizations are putting Dell PowerEdge™ blade servers to work in ways that help maximize IT efficiency and flexibility, whether to consolidate data center resources, boost savings on power and cooling, virtualize servers for rapid deployment, or process data-intensive applications on a high-performance computing (HPC) platform. Their results may surprise you.
**RES: Running like the wind on Dell blade servers**

For rapidly growing wind farm developer Renewable Energy Systems (RES), a power-efficient HPC platform is mission critical. Having built more than 80 wind farms around the globe, RES continues to expand into new regions, including Turkey and South Africa, and had to upgrade its existing Dell HPC solution to quickly and accurately assess these complex emerging markets.

Minimizing its carbon footprint and saving space were key requirements, particularly because an RES sister company was hosting the system until a new data center could be built. Because IT resources were scarce, simplified systems management was also essential.

The Dell Global Infrastructure Consulting Services team worked closely with RES to understand its needs, and recommended an energy-efficient HPC cluster built on 16 Dell PowerEdge M610 blade servers with Intel® Xeon® X5550 processors running Platform Cluster Manager – Dell Edition software. Mounted in a PowerEdge M1000e modular blade enclosure and connected with Dell PowerConnect™ M6220 switches, the cluster easily fits in the space available, and includes a Dell PowerVault™ MD1000 direct attach array for high-volume storage.

“Now we can complete the job in two to three weeks—approximately 20 times faster—which means we can get wind farms in place quicker,” says Peter Stuart, technical manager at RES. In addition, the company has reduced power consumption by approximately 75 percent and freed up valuable IT staff time.

**Cornell University: Simplifying HPC solutions on the TeraGrid**

HPC is the backbone of the work performed by the Cornell University Center for Advanced Computing (CAC), which supports Cornell researchers and students from scientific disciplines across the United States. The center recently received a National Science Foundation grant to deploy the MATLAB numerical computing environment to a cluster called “MATLAB on the TeraGrid.” The goal was to demonstrate a working model for high-performance utility computing with MATLAB, and to encourage other software vendors to develop similar capabilities.

The cluster uses Dell PowerEdge M600 blade servers with Intel Xeon 5420 processors running the Microsoft® Windows® HPC Server 2008 platform and DataDirect Networks storage. Force10 Networks switches were sourced through Dell. This HPC cluster allows a wide range of scientific researchers and students to use MATLAB to help reduce the time to solution in a seamless experience, without having to tackle the complexity and intricacies of parallel computing. For example, external researchers were able to remotely access all 512 cores of the MATLAB cluster to model a hepatitis C virus, a major cause of liver disease worldwide.

“We’re confident that scientific users and engineers from across the nation will benefit from the reliability and performance of the Dell blade solution.”

—David Lifka
Director at Cornell CAC
April 2010
Blade solutions for the Efficient Data Center

Pacific Sunwear: Taking a shine to huge time savings
Performance and reliability are essential for clothing chain Pacific Sunwear (PacSun) of California. This top teen fashion retailer relies on its high-speed reporting system to collect data from stores daily, spot trends, and coordinate deliveries with its distribution center in Kansas. This system helps ensure that the latest products reach stores in time to meet demand. If an IT system goes down, it can affect the entire sales chain and result in missed opportunities.

When PacSun needed to refresh its infrastructure to increase availability, reduce costs, simplify management, and enhance business agility, it created a virtualized data center with VMware® vSphere™ virtualization software running on Dell PowerEdge M610 blade servers with Intel Xeon 5500 series processors and a Dell EqualLogic™ PS Series iSCSI (Internet SCSI) storage area network (SAN).

“From a three-year ROI standpoint, we could easily double our return with a virtualized environment versus just replacing old servers with new physical machines,” says Ira Ham, director of network and information security at PacSun. “Virtualization could also help us deploy new applications faster and open up space in the data center for growth.”

PacSun has also dramatically decreased its operating expenses by eliminating more than 100 servers through virtualization, while simplified storage management has resulted in a 20 percent reduction in administrative time.

Thomas College: Making the grade in server reduction
Server consolidation through virtualization is important to private liberal arts school Thomas College in Maine, which serves more than 1,100 students with a cutting-edge IT infrastructure designed to offer the latest Microsoft communication and collaboration tools. The college’s IT department needed a simplified system that would allow it to provide high-performance laptops, desktops, and portable computers while increasing management efficiency in the data center. The college became an early adopter of Microsoft Windows 7 on Dell OptiPlex™ desktops and Dell Latitude™ laptops, enabling IT staff to image computers more quickly than in previous OS versions.

In the data center, Thomas is consolidating on virtualized Dell PowerEdge M600 and PowerEdge M610 blade servers with Intel Xeon processors running the Microsoft Hyper-V™ platform—a move that has helped the college consolidate its footprint by 50 percent and reduce heat generation by more than 30 percent, thereby saving on power and cooling costs. Microsoft System Center Virtual Machine Manager enables IT staff to repair and upgrade physical hosts without interrupting users simply by moving the virtual machine images to a different blade server, eliminating half of the planned downtime. And IT staff can also set up a virtual machine in half an hour, making it easy to accommodate evolving needs of the Thomas faculty.

RES
75%
An energy-efficient cluster of Dell blade servers helped RES reduce power consumption by roughly 75 percent while minimizing the server footprint.

Cornell University
512 cores
Cornell CAC demonstrated a utility that helped simplify a complex scientific solution involving access to all 512 cores of a Dell blade server cluster.

Pacific Sunwear
100 servers
Virtualization on Dell blade servers helped Pacific Sunwear eliminate more than 100 physical servers and reduce administrative time by 20 percent.

Thomas College
50%
Consolidation on Dell blade servers enabled Thomas College to reduce its server footprint by 50 percent and lower heat generation by 30 percent.
Pole Star: Navigating maritime security requirements

When the International Maritime Organization issued a regulation stating that every ship at sea must report its position four times a day, Pole Star Space Applications Ltd., a UK-based provider of maritime security and satellite-enabled tracking technology, anticipated a massive increase in sales volume. With the new law pending, Pole Star had less than 12 months to prepare its infrastructure for the rise in demand.

The organization was running Dell servers in hot standby clusters for high availability, but this approach was relatively expensive and required new hardware every three years. The company needed a powerful environment that could scale quickly with minimum expense, and recognized virtualization as a flexible and easy-to-deploy solution. Working with Dell, Pole Star IT staff designed and deployed VMware vSphere virtualization on Dell PowerEdge M600 blade servers with Intel Xeon E5410 processors and Dell EqualLogic storage, protected by Dell ProSupport for IT.

The move to Dell blade servers cut the physical server footprint by 83 percent, and Pole Star estimates that the current virtualized environment will serve business needs for the next five years even with an anticipated 50 percent growth in business volume within the next three years. “We’re expanding rapidly, and having the technology to support that process is incredibly important,” says James Bayley, consultant head of IT for Pole Star. “The Dell solution has delivered on the promise of business agility.”

Stony Brook University: Leading the pack with Dell PowerEdge servers

Dell performance, reliability, and speed were all put to the test—literally—when the Stony Brook University team at the Supercomputing Conference (SC) Student Cluster Competition needed the components of an HPC cluster to beat competing universities in processing large data sets and compute-intensive scientific applications.

In the spirit of preparing students and attracting interest in HPC, SC sponsors an annual competition in which students compete on the basis of benchmarking and scientific problem solving. A quick response from Dell enabled the Stony Brook University team to build an HPC cluster of five PowerEdge M905 blade servers with 20 six-core AMD Opteron™ 2435 processors and a 40 Gbps InfiniBand interconnect provided by Mellanox Technologies.

As a result of Dell’s rapid response and the system’s ease of deployment and simplified configuration, cluster setup was quick, and the students had the time they needed to prepare for the event. The Stony Brook team came away with the honors, and Dell performance was critical to success: “The amount of memory we had on the Dell machines allowed us to run much larger data sets than the other teams, which was definitely a factor in our winning,” says Aaron Pellman-Isaacs, senior biology major and team leader.

Dell PowerEdge blade servers: Standardized platforms for flexible growth

As IT decision makers run a gauntlet of financial and organizational challenges, Dell PowerEdge blade servers ease the way with a compact form factor designed to increase operational efficiency, reliability, and manageability while saving big on power and cooling expense. PowerEdge blade servers also provide diverse IT environments with the computational density and intelligent fabric integration needed to optimize availability and performance for a world of applications. The six success stories featured here demonstrate that big results can indeed come in a very small package.

Stony Brook University finished first at the SC Student Cluster Competition thanks to Dell blade server performance.

83%

Virtualization on Dell blade servers cut Pole Star’s physical server footprint by 83 percent while supporting an anticipated 50 percent growth.
Smooth operator

By Roger Foreman

Built by implementing an innovative, user-driven development process, the Dell™ Chassis Management Controller (CMC) 3.0 embedded management tool enables administrators to simply and intuitively manage multiple blade servers from a single console.

The Dell Chassis Management Controller (CMC) is a management tool embedded in Dell PowerEdge™ M1000e modular blade enclosures that provides powerful functionality to help administrators simply and easily manage blade servers and blade server enclosures. Functionality available in the CMC includes dynamic power management, blade server component monitoring, and real-time reporting of power consumption, temperature, and other indices of blade server and chassis health.

To help make chassis management even easier and more intuitive than using traditional management tools, Dell substantially redesigned the CMC interface for version 3.0. In particular, the development team wanted to dramatically enhance the simplicity and usability of the management tool—with the goal of enabling busy system administrators to spend as little time as possible managing servers, leaving them with additional time for other, increasingly complex tasks.

The development team utilized an innovative, iterative, user-driven design process to help streamline the management tools for administrators of PowerEdge blade servers and modular blade enclosures. The team collaborated with the Dell Experience Design Group to begin designing an interface that would be robust yet intuitive and easy to use, and then built and tested the software using the Agile programming methodology, an iterative
development method that incorporates user feedback continuously throughout the development process.

The result: CMC 3.0 offers a rich set of features and a graphical user interface (GUI) that incorporates the Dell Clarity E style, an approach that provides dynamic, self-refreshing pages; an updated color scheme; and an intuitive home page that allows administrators to perform most monitoring and management functions from a single screen, and with significantly fewer mouse clicks than in previous CMC versions.

**Collaborative design**

A key goal for the CMC 3.0 development team was to design a tool that provides robust functionality but is also intuitive. To help achieve that goal, the team enlisted the help of the Dell Experience Design Group, a cross-functional team of design experts at Dell that comprises UI designers, usability engineers, and Ph.D.-level cognitive scientists and psychologists.

In collaboration with this group, the CMC 3.0 development team first used extensive input from target users to identify and carefully catalog typical chassis management tasks that administrators perform. Identified tasks included managing power usage, monitoring blade server components, and quickly consulting indices of server health such as temperature and power consumption; additional tasks included adding users, configuring servers, and diagnosing and resolving errors.

The team then used this feedback to design a UI prototype based on the Dell Clarity E style, which is now the standard for Dell OpenManage™ systems management tools. The style employs a wide range of dynamic, self-refreshing screens, colors, and features, and offers a consistent look and feel across systems management tools in the Dell OpenManage suite.

Using the Agile programming methodology, a Dell team of more than 20 programmers developed incremental features during
“The heart of CMC 3.0 is its intuitive home page, which enables administrators to use a single Web-style page to perform most monitoring and management tasks.”

every three-week sprint. Sprints concluded with a live demonstration to solicit feedback and final approval that each feature met the need to optimize simplicity, functionality, and ease of use.

Intuitive management
CMC 3.0 offers a redundant monitoring and management tool that is embedded in Dell PowerEdge M1000e modular blade enclosures. The CMC 3.0 user interface, accessible through standard Web browsers, is automatically included with the hardware and does not require special installation.

The heart of CMC 3.0 is its intuitive home page, which enables administrators to use a single Web-style page to perform most monitoring and management tasks (see Figure 1). Using the home page, administrators can see the status of chassis components at a glance and perform key functions such as power cycling, power management across blades, and error diagnosis. The home page is also dynamically updated, enabling administrators to access up-to-date status and error information without having to manually refresh the screen.

CMC 3.0 is also scalable: administrators can see and monitor up to 16 blades on a single screen, and can easily drill down into individual components to view detailed information. For example, an administrator can click a power supply to quickly see its properties, its status, and links to other actions or detailed information. Similarly, clicking an individual blade server brings up key status indicators such as health, power consumption, and temperature, and also provides server properties and links to other actions (see Figure 2).

Other features of CMC 3.0 include automatically populating the slot name that appears in the browser title or tab with the host name as defined by the OS running on the blade, as well as system-wide temperature monitoring, which enables administrators to monitor not only chassis ambient temperature, but also individual blade temperatures (see Figure 3). CMC 3.0 also expands Lightweight Directory Access Protocol (LDAP) functionality to include support for a range of LDAP services such as Microsoft® Active Directory® directory services, Novell® eDirectory™ directory services, and open source directory services such as OpenDS and OpenLDAP.

User-driven expansion
By combining enhanced graphics and usability features with extensive user feedback, the user-driven design of CMC 3.0 helps deliver robust, streamlined functionality through an intuitive, easy-to-use interface. Building on the design process of CMC 3.0, Dell plans to incorporate the same look and feel and design methodology across the Dell OpenManage systems management suite to help simplify management, streamline operations, and enhance administrator productivity.

Roger Foreman is a senior product manager on the Dell OpenManage Marketing team with responsibilities for CMC firmware and management of blade servers. Previously, he led the team that created deltechcenter.com.
No matter which approach you choose,
use BMC Software to take full control
of your IT operations from a single,
unified platform.

Learn more at www.bmc.com/controlthecloud
Cost-effective tiering for virtualized iSCSI SANs

By Achmad Chadran and Keith Swindell

Tiering in a Dell™ EqualLogic™ PS Series SAN helps organizations boost resource utilization and enhance service levels by deploying storage on the most cost-effective tiers based on performance, accessibility, and criticality requirements.

Rampant data growth and stringent data retention policies are placing huge demands on enterprise storage resources. Several factors have contributed to this explosion of data, including increasing application diversity and specialization, the proliferation of automated data collection tools for advanced decision support and other processes, and regulatory standards for data retention.

To manage this increase in demand, many organizations have consolidated data on storage area networks (SANs) to help dramatically simplify storage management and increase utilization. When using SANs as part of a virtualization strategy to consolidate resources, balancing performance and cost-efficiency can be challenging, because simple SAN consolidations limit the flexibility to optimize storage for multiple applications.

A typical SAN, for example, might utilize 10,000 rpm Serial Attached SCSI (SAS) drives throughout the deployment as a simple approach to data consolidation. Different applications within that deployment, however, may have very different performance requirements: some applications may produce data with a heavy I/Os per second (IOPS) load, which cannot be met easily using 10,000 rpm media, while other data—such as backups, archives, and file data such as documents and media—may be rarely accessed. As a result, when using a single-tier SAN, some applications may be performance-constrained while others use storage that is much more costly than they require. IT organizations can manage these challenges by classifying data based on specific criteria and then assigning it to an appropriate storage tier, helping increase resource utilization, enhance service levels, and reduce costs.

Deploying data on storage tiers

Storage tiering has emerged as a strategy for balancing performance and cost-efficiency. In a tiered storage deployment, data can be moved to different storage media based on specific requirements. Application data with extremely high performance requirements or high access rates, for example, may be deployed on high-performance storage, while data with low performance requirements or access rates may be deployed on lower-cost storage. In addition to enhancing cost-efficiency, storage tiering also helps ensure that performance-optimized arrays are available to meet service-level agreements (SLAs) and other criteria.

Implementing a storage tiering strategy can be labor intensive, however. It requires administrators to predict which storage workloads will be associated with which applications, define tiering requirements based on application mix, commit arrays at each tier to accommodate current requirements plus growth, and continuously monitor workloads to validate the tiering architecture and adjust as necessary.
To help organizations take advantage of the performance and cost-efficiency benefits of tiering, Dell EqualLogic PS Series Internet SCSI (iSCSI) SAN arrays provide a rich set of tools to tier data based on multiple criteria. In particular, the EqualLogic solution offers three different techniques for storage tiering: automatic performance load balancing within an EqualLogic storage pool, RAID preference configuration tiering within an EqualLogic storage pool, and pool-based tiering using multiple storage pools within an EqualLogic group. EqualLogic PS6000XVS and EqualLogic PS6010XVS arrays can extend the value of tiering by enabling tiers within each volume (see the "Sub-volume storage tiering in Dell EqualLogic arrays" sidebar in this article). Automated storage tiering on EqualLogic SANs helps reduce costs, enhance efficiency, and boost the performance of storage infrastructures.

**Tiering storage on Dell EqualLogic PS Series arrays**

EqualLogic PS Series iSCSI SANs provide a scalable, high-performance, easy-to-manage platform with which organizations can simply and cost-effectively consolidate enterprise storage. The arrays offer tremendous capacity and utilize a virtualized storage architecture that enables storage to be scaled rapidly and efficiently without reducing performance or disrupting availability. EqualLogic SANs incorporate a range of features designed to support rapid installation, streamlined management, and efficient data protection and recovery.

With virtualized storage as a central design tenet, each EqualLogic SAN comprises one or more EqualLogic arrays (members) connected to an IP network and managed as a single system. Individual arrays are grouped into one or more virtualized storage pools—essentially, a partitioned "SAN within a SAN"—which may be homogeneous, with members utilizing the same type of storage media and RAID level, or heterogeneous, with members utilizing different storage media and/or RAID levels. A volume, or a logical unit (LUN), is assigned to a storage pool (see Figure 1); data on that volume is striped across all the disks in that pool that contain part of the volume, per the RAID policy.

EqualLogic SANs support automated storage tiering and can be monitored through EqualLogic SAN HeadQuarters (SAN HQ), a Microsoft® Windows® OS–based application with an easy-to-use interface that offers visibility into storage IOPS and utilization at the volume, pool, member, and group levels. Organizations can deploy the combination of automatic performance load balancing, RAID preference configuration tiering, and pool-based tiering techniques that best suits their needs, and can easily modify the storage tiering strategy as needed. When using EqualLogic firmware version 5.0, SAN HQ is also able to provide information about the amount of data that is in one of three I/O categories—high, medium, or low—to further assist the administrator in...

---

**Why tier storage?**

Although SAN-based storage consolidation can help manage spiraling enterprise data, application diversity can pose challenges for maintaining both performance and efficiency. This video makes the case for SAN tiering and offers a peek at the advanced tiering capabilities offered on EqualLogic PS Series SANs.

equallogic.com/whytier
Storage optimization

understanding the overall needs of the organization’s data and usage patterns.

Automatic performance load balancing

Automatic performance load balancing is the default storage tiering policy on EqualLogic SANs. When using automatic performance load balancing, the arrays automatically tier data within a pool based on random IOPS for a volume, with no administrator intervention required.

This policy utilizes algorithms built into the EqualLogic firmware to monitor IOPS at the volume level. When appropriate, the firmware can move a volume to arrays within the pool that are configured for RAID-10, which is suitable for high levels of random IOPS.

Automatic performance load balancing is designed to be an excellent all-purpose tiering mechanism, and is especially well suited for larger enterprises that may not have had the opportunity to analyze application storage workloads and that have four or more arrays in a single pool. Because this policy evaluates usage patterns and moves data very gradually, it is well suited for organizations with large amounts of data or data that does not need to be rapidly migrated from one tier to another.

RAID preference configuration tiering

Another storage tiering technique available with EqualLogic SANs is RAID preference configuration tiering, which allows a storage volume to be associated with a RAID preference. This option overrides the automatic performance load balancing. A volume expected to have a very high IOPS requirement might be associated with a high-performance RAID policy such as RAID-10, while a volume expected to have a low IOPS requirement might be associated with a low-performance RAID policy such as RAID-50.

The EqualLogic firmware stores volume data on an array or set of arrays that matches the preferred RAID policy level for that volume if it is available within the pool—that is, a volume with a RAID-10 preference is stored on a RAID-10 array, if available. If an array using the preferred RAID policy is not available, an alternative array or set of arrays would be used. Although storage tiering based on RAID policy preference is automatic, it is not guaranteed: the firmware attempts to satisfy the preference, but if a RAID level is over-allocated, some volumes will be moved to other RAID levels to maintain appropriate free space. Additionally, the pool must have arrays of different RAID types for this tiering technique to be effective.

RAID preference configuration tiering is well suited for organizations that need to control disk resources, maintain good performance for tier 1 applications, and support application-by-application SLAs.

Pool-based tiering

EqualLogic SANs also offer pool-based tiering, which is designed to deliver maximum control over storage tiering. In an environment using this technique, each storage pool is a tier, and volumes are assigned to individual pools. For example, an organization might choose to deploy two storage pools, or two tiers—one for mission-critical data and one for bulk storage data that is not accessed as heavily (see Figure 2). The storage pool for the mission-critical application data can contain high-performance arrays and use a RAID level consistent with the read/write patterns associated with the applications accessing that pool. The storage pool for the bulk data can contain high-capacity arrays configured to maximize storage capacity and minimize cost for long-term storage.

When adding arrays to the SAN, administrators can deploy them in the appropriate pool, and they can configure the pools—and volumes assigned to them—based on a wide range of criteria, including application performance requirements, geographic location, business units, budgetary considerations, and more. One example strategy would be to divide storage into the following four tiers:

- **Tier 0**: Utilizes SSDs for applications that have a high number of random reads

![Figure 2. Separate Dell EqualLogic storage pools configured for specific data requirements](image)
Sub-volume storage tiering in Dell EqualLogic arrays

Storage tiering—matching storage media to specific organization requirements—has emerged as a way to help optimize storage performance while minimizing costs. Most storage tiering occurs at the volume level; that is, a volume is assigned a storage tier based on criteria defined by the application, such as performance, capacity, and availability. This approach treats all data on that volume as equivalent, when in fact some of the data may be very active, while the majority of the volume may be relatively inactive.

EqualLogic PS6000XVS and EqualLogic PS6010XVS arrays from Dell, however, offer storage tiering at the sub-volume level, enabling discrete workloads to be isolated and tiered separately within a volume. Each array incorporates both solid-state and spinning media and includes EqualLogic firmware version 5.0, which extends existing auto-tiering algorithms to enable tiering within volumes on these models.

Sub-volume storage tiering can be especially useful for volumes associated with virtual desktop infrastructure deployments. Each virtual desktop instance is typically deployed with two parts: a high-read-intensity “hot” master image, and a less-heavily accessed “warm” desktop that stores data unique to that virtual machine. With sub-volume tiering, organizations can leverage extremely high-performance solid-state drives (SSDs) to service the hot master images, and use 15,000 rpm Serial Attached SCSI (SAS) drives for “warm” data for each virtual machine. This type of tiering enables organizations to leverage the tremendous performance advantages of SSD-based storage without having to provision the entire volume with SSDs.

Many other possibilities exist with pool-based storage tiering, and the appropriate combination of disk types and RAID types chosen will depend on the needs of the organization. Pool-based storage tiering can be well suited for organizations with easily defined storage requirements and a need for maximum control over data placement.

Enhancing efficiency with flexible, cost-effective storage tiering

Organizations can select an appropriate storage tiering strategy by considering criteria that are the most relevant to their needs; these criteria can include metrics such as access frequency, performance, mission criticality, and data protection, or can be based on data type. Analyzing current and past storage usage also helps organizations identify an appropriate storage tiering strategy. Administrators can use the EqualLogic SAN HQ monitoring tool to observe storage usage patterns through an easy-to-use console that provides not only visibility into storage IOPS and utilization, but also a range of near-real-time and trend data statistics for monitoring tiering schemes. Dell Services also provides a broad range of storage optimization services that can include tiering planning, implementation, and management.

By enabling organizations to cost-effectively tier storage based on specific requirements, with both administrator-defined and automatic storage tiering, an EqualLogic PS Series iSCSI SAN from Dell helps enhance both efficiency and service levels. And by enabling storage tiering at the sub-volume level, EqualLogic PS6000XVS and EqualLogic PS6010XVS arrays enable organizations to deploy next-generation automatic storage tiering technology to help maximize flexibility and minimize administration.

Achmad Chadran is a storage solution marketing manager in the Dell Large Enterprise Business Unit.

Keith Swindell is a product manager on the EqualLogic Engineering team at Dell with over 20 years’ experience in designing and implementing effective IT solutions to solve complex business problems.

Learn more

Dell EqualLogic PS Series:
dell.com/pseries
dell.com/equallogic

Dell EqualLogic storage tiering:
equallogic.com/tiering
Managing a database environment presents common challenges across midsize and large organizations, including controlling costs, optimizing resource utilization, scaling the environment effectively, and isolating resources to help ensure maximum availability and performance. Many organizations are also looking to reduce power, cooling, and space requirements in the data center. At the same time, organizations may lack sufficient IT resources to deploy, manage, and maintain complex or customized environments.

Combining Oracle Database 11g and multi-protocol Dell/EMC unified storage, along with Oracle Direct Network File System (DNFS) included in Oracle Database 11g, helps organizations efficiently address these challenges. Oracle DNFS offers a highly tuned protocol that helps Dell/EMC unified storage deliver high performance, low server processor overhead, and simplified administration. Together with virtualization, the Dell/EMC unified storage platform enables organizations running Oracle database software to maximize performance and scalability based on workload requirements while helping simplify backup operations, accelerate deployments with cloning, and increase the performance of disaster recovery operations.

Capitalizing on the advantages of NAS and SAN protocols

Organizations deploying Dell/EMC unified storage can migrate Oracle databases between network attached storage (NAS) protocols and storage area network (SAN) protocols without downtime, enabling administrators to match database operations to the appropriate protocol and infrastructure. For example, database replications used in testing and development as well as backup and recovery processes can be seamlessly migrated to economical, high-availability Network File System (NFS)–mounted storage. NFS is a broadly adopted and cost-efficient protocol, and does not require specialized training to use. Simultaneously, production databases requiring maximum availability and low latency can be maintained on high-performance Fibre Channel Protocol (FCP) storage. Enterprise flash drives (also known as solid-state drives) can also enhance performance in many database use cases.

Streamlining enterprise database environments for business continuity

By Annette Cormier, Jason Kotsaftis, and Jeff Browning

The combination of Oracle® Database 11g, Oracle Direct Network File System, and multi-protocol Dell/EMC unified storage offers a single platform to help unlock the power of virtualization and optimize database performance.
Dell/EMC unified storage enables this combined storage model by consolidating NAS and SAN functionality and performance into a single shared storage system that supports both NFS and Fibre Channel. Organizations deploying Oracle Database software can choose either standard kernel NFS (KNFS) or Oracle DNFS with Dell/EMC unified storage. DNFS provides additional benefits and enhancements beyond what KNFS offers.

Overcoming NFS I/O performance variability

Oracle DNFS embeds the NFS client directly into the Oracle Database 11g database application kernel. Bypassing the OS for concurrent I/O helps reduce memory and processor utilization, thereby enhancing performance. DNFS is optimized for database workloads and supports asynchronous I/O, which can make this protocol preferable to KNFS in some organizations; DNFS can also load balance more efficiently than OS-based KNFS clients that are not optimized.

In validation testing of Oracle DNFS using a decision support system (DSS) workload, DNFS showed significantly increased maximum throughput compared with KNFS (see Figure 1). This increased performance benefits administrators and users of highly demanding business intelligence and DSS applications, helping to maintain high levels of responsiveness for these mission-critical capabilities.

A key performance challenge in database environments is that IP storage offloads the file and volume management operations to the storage array, but works with the host OS in caching I/O read/write operations to the database. In non-database environments, the use of the OS to mediate cache and control the I/O for the NFS protocol is standard. In database environments, however, the read/write and asynchronous nature of database I/O is typically not managed well by OS client kernels, resulting in I/O performance variability. Oracle DNFS is designed to overcome this variability in multiple ways:

- **OS independence**: Hosting the NFS client directly in the database kernel instead of in the OS kernel helps ensure consistent performance across operating systems.
- **Asynchronous direct I/O**: The DNFS kernel enables asynchronous direct I/O, a highly efficient approach that allows database I/O to continue while other requests are submitted and processed. DNFS also uses database caching with asynchronous direct I/O to help ensure almost immediate data writes, which helps reduce integrity risks.
- **Efficient setup**: The DNFS client manages load balancing and high availability to help simplify network setup, which helps reduce dependence on network administrators and avoids the need to set up network subnets and bond ports such as Link Aggregation Control Protocol (LACP) bonding.
- **OS write locking**: DNFS overcomes OS write locking, which can be inadequate in some operating systems and cause I/O performance bottlenecks in others. DNFS also helps reduce database server processor and memory usage by avoiding the overhead of copying data between the OS memory cache and the database System Global Area (SGA) cache.

Figure 1. Comparing data throughput for standard KNFS and Oracle DNFS using a DSS workload

Innovative storage efficiencies

This series of on-demand Webcasts offers best practices for tiered storage deployments in Oracle environments, performance benchmarks with enterprise flash drives for ultra-high performance, and using advanced features of Oracle Database 11g.

dellenterprise.com/goto/emcoracle

---

1 Based on EMC testing performed in October and November 2008 using an Oracle Real Application Clusters (RAC) architecture consisting of four Dell™ PowerEdge™ 2950 server nodes configured with dual-core processors at 3 GHz, 16 GB of RAM, and the 64-bit Microsoft® Windows Server® 2003 OS, connected to an EMC Celerra® NS-40 storage array.
Migrating a virtualized database from a SAN to NAS

By consolidating SAN and NAS functionality while supporting both Fibre Channel and NFS, Dell/EMC unified storage helps simplify database migration. The Dell/EMC NS-480 array, for example, enables organizations to efficiently move a virtualized Oracle database from a SAN to NAS-mounted storage and across protocols (see Figure 2).

Using this capability, organizations can easily support testing, backup, and recovery on NFS storage and production on Fibre Channel storage from within a single storage system. Administrators can also deploy storage replication and continuous data protection on the same system using a different FlexAddress I/O port than the one used by the production database.2

Migrating an online Oracle database from a SAN to NAS starts with performing a consistent backup using capabilities provided by the Dell/EMC NS-480 array. Administrators can perform the backup using the following steps:

1. Use EMC® Replication Manager software to automate application-consistent snapshots.
2. Use EMC SnapView™ software to create a snapshot of the database.
3. Mount this backup and the NFS target array on the migration server, which may be either a VMware® virtual machine or a physically booted server.
4. Create an Oracle Recovery Manager (RMAN) backup of this database as a database image so that the data files are written directly to the target NFS mount.
5. Switch the migration database to the copy on the NFS target.

As an alternative to mounting the RMAN image backup directly, administrators can optionally use Oracle Data Guard to place the target database into continuous recovery mode. Log ship and log apply processes then catch up the target to the production version, and Data Guard failover can be used to retarget the NFS database. With either method, the result is that a production Fibre Channel–mounted database can be migrated to NFS with little performance impact and no downtime.

Administrators can migrate an online Oracle database from NAS to a SAN with the same sequence, but using EMC SnapSure™ software instead of SnapView and using Fibre Channel as the target instead of NFS. This nondisruptive migration can be extremely beneficial when a successful business grows and needs to scale its IT infrastructure from NAS to a

---

SAN. This may be the case when a database workload grows enough that it requires the low-latency performance and scalability that a Fibre Channel SAN provides, such as a highly transactional online transaction processing (OLTP) infrastructure. The ability to nondisruptively migrate between NAS and a SAN is one primary reason that an organization might choose a multi-protocol storage system.

**Performing high-speed backups and database cloning**

Dell/EMC unified storage also enables high-speed, nondisruptive array-based snapshots, which can be used for either quick data restoration or as the basis for full database backups. EMC SnapSure snapshots can be checked into the Oracle RMAN repository, and are integrated with RMAN for restoration and recovery operations.

Using SnapSure checkpoints, EMC Replication Manager enables quick replication and seeding of production environments without reducing database server performance, helping to reduce per-processor licensing costs. Array-based synchronization of production environments helps avoid the database log shipping overhead on the server processor. This array-based synchronization also helps protect the database from a variety of additional logical storage errors, and production environments can quickly be restored to a specific point in time.

 Organizations can use SnapSure writable checkpoints to replicate one or many copies of the production database. Changes can be rolled back into the production database if necessary. These replicas are well suited for use in quality assurance, testing, and multiple reporting environments, and for applying patches. SnapSure creates a logical point-in-time image of a production file system (PFS) that reflects the state of the file system at the time when the checkpoint was created. SnapSure can maintain up to 96 PFS checkpoints.

The basic principle of the SnapSure process is copy on first write. When a block is modified, a copy containing the block’s original content is saved to a separate volume. Subsequent changes made to the same block are not copied, so only space for the modified data is required. SnapSure reads the original blocks and the unchanged blocks remaining in the PFS according to a bitmap and blockmap data-tracking structure. These blocks combine to provide a complete point-in-time file system image. The snapshot reads blocks A and B from the source logical unit (LUN) and block C from the reserved LUN.

**Supporting a highly efficient architecture**

Server processor capacity is one of the most precious resources in enterprise IT environments, particularly in database architectures. Oracle Database 11g and Oracle DNFS support highly tuned NFS systems that Dell/EMC unified storage platforms can use to provide tangible benefits—helping free the server processor, memory, and I/O channels from utility operations such as backup and recovery, disaster recovery staging, testing and development, and cloning.

Using Oracle DNFS with Dell/EMC platforms can be an important step in developing an efficient architecture. DNFS is designed to simplify network setup and management by minimizing the need for administrative tasks such as configuring network subnets, performing LACP bonding, and tuning NFS parameters in Linux® operating systems. Load balancing and high availability are managed internally within the DNFS client, an approach that can offer measurable performance gains.

The use of a multi-protocol storage system, like Dell/EMC unified storage, offers flexible and scalable single-system configurations of mixed protocols and drives, including NFS, Common Internet File System (CIFS), Fibre Channel, Internet SCSI (iSCSI), and Multi-Path File System (MPFS) protocols along with enterprise flash drives, Fibre Channel drives, and low-power Serial ATA (SATA) drives. It enables an increasingly resilient and cost-effective architecture for nondisruptive migrations from a SAN to NAS to support either cost-effective test and development or mission-critical database operations in growing organizations.
Taking an intelligent data management approach to archiving data

By Kay Benaroch and Joe Colucci

By employing a strong archiving strategy as the foundation for an intelligent data management program, enterprises can enhance efficiency for IT staff, meet compliance requirements, and streamline backup processes.

Growing data volumes are making data management increasingly costly and labor intensive for IT departments. One primary culprit is e-mail. As employees become increasingly mobile and e-mail becomes the preferred method of enterprise communication, e-mail volume is expanding exponentially. And organizations are keeping their e-mails around for a long time. According to the Forrester Q1 2010 Global Message Archiving Online Survey, for example, 57 percent of survey respondents with currently deployed message archiving solutions retained e-mail for an average period of 5–10 years.1

Collaborative work styles are also contributing to rapid data growth. As the volume of unstructured content (such as e-mail, rich media objects, Microsoft® Office PowerPoint® presentation files, and Web content) grows, and the popularity of platforms such as Microsoft Office SharePoint® Server collaboration and document management software increases, it can be difficult to determine the value of each piece of stored information—so enterprises often simply default to saving everything.

However, for many organizations, only a small portion of the data on primary storage is active at any given time. A lack of uniformity in applying existing data management policies can further compound the data growth problem. The result: all too often, a company’s primary storage is overflowing with aged, duplicate, or nearly worthless data.

At the same time, retention and deletion requirements for compliance are becoming increasingly complex. The retention period for a specific file type depends on a combination of governmental, industry, application, and business unit requirements. Organizations can face stiff penalties if they do not retain the proper information for the required period, and they can also face liability if they retain certain data past its expiration date or are unable to find critical files or e-mail correspondence during litigation.

Archiving—moving valuable data from high-cost transactional storage media to lower-cost, fixed, or read-only storage—helps enterprises address these challenges. However, confusion about the differences between archiving and backup processes can also create inefficiencies and unnecessarily increase costs. Archiving moves aging or infrequently accessed data off of primary storage media to less-expensive storage media, thereby removing it from the backup stream; backup simply creates a copy of the data on the secondary storage, without moving the original information. As a key part of a comprehensive intelligent data management (IDM) strategy, effective archiving can help organizations increase efficiency for IT staff while cost-effectively meeting compliance requirements and streamlining backup processes.

Archiving as a foundation of intelligent data management

To address the challenges created by data growth, enterprises must take a comprehensive approach to IDM that spans the entire information life cycle, from creation and distribution through use, maintenance, and disposal. Key technologies for IDM include the following:

- **Object storage**: Objects are files or file collections that are enhanced by metadata that includes an object ID. Enterprises can leverage this standard to store, access, and distribute digital content by creating efficiencies, ease of access, and simplified management throughout the life cycle of unstructured data (see the “Dell DX Object Storage Platform” sidebar in this article).
- **Deduplication**: Deduplication technology plays a key role in data optimization by helping eliminate multiple copies of data at file, block, or sub-block levels to reduce the total capacity required to store and protect data.
- **Unified storage**: Unified storage includes data tiering and optimization in a single array that provides an integrated platform designed to simplify data management, and offers integrated tiering and array-based deduplication across multiple types of data.
Dell DX Object Storage Platform

The Dell™ DX Object Storage Platform supports archiving with policy-based management capabilities, including automated, object-level retention and deletion based on metadata—helping avoid the human error, access, and preservation problems that can increase risk and drive up costs.

The platform is designed to intelligently access, store, protect, and distribute fixed digital content. Automated management, Serial ATA (SATA)-based storage, and a modular scaling approach offer low total cost of ownership. Self-healing functionality continuously self-manages the integrity of stored objects to detect and repair errors, and automatically reconfigures and regenerates objects without the need for IT intervention.

The DX Object Storage Platform enables enterprises to keep more data online and accessible than traditional storage platforms allow, because it doesn’t need the conventional file hierarchies associated with traditional storage area networks and network attached storage. An extremely large number of available addresses means that a common pool of storage can support literally billions of objects. It provides continuous migration and investment protection with nondisruptive security and capacity upgrades as well as node replacement and retirement. It also supports selectable data immutability for compliance needs.

A large and ever-growing number of independent software vendors support the DX Object Storage Platform. This support helps maximize an enterprise’s investment by utilizing a common object-storage pool for multiple applications such as file, e-mail, and medical record archiving software.

Data archiving is a key pillar of IDM. By relocating little-used data from primary storage to a long-term data repository on a separate physical tier of storage media, archiving helps free up the space on high-performance disks for transactional data. Archiving falls into two distinct categories (see Figure 1):

- **Data archiving for space reclamation:** This category requires policies and software to mark files for movement from high-cost primary storage to lower-cost (and lower-performance) storage media while still retaining access to help meet enterprise requirements. Space reclamation includes archiving of data such as files, e-mail, or Microsoft SharePoint data stores that contribute to the rapid growth of primary storage.

- **Data archiving for legal retention and regulatory compliance:** This category requires legally approved policies that direct data movement from primary storage to a specified storage device for long-term managed retention. This task can be handled with content archiving or object-based storage and automated policies. High-performance disk storage is not required, because data recall only occurs in response to planned events or legal e-discovery, which allows for retrieval from offline media that does not need to be executed as rapidly. The storage device must be read-only and must have the capability of enforcing retention limits for files. It must be able to recognize, based on policy, when a file is no longer required to be held, and then delete or destroy the file.

**Distinguishing archiving and backup processes**

In many organizations, backup and archiving processes are discussed interchangeably. However, backups cannot act as archives, or vice versa. Understanding the differences between these two processes is critical to optimizing efficiency and reducing costs associated with IDM. During a backup, the primary copy of the data remains in its original location after it has been copied; each time a backup is performed, a new copy of the data is produced and stored.

Archiving, in contrast, involves moving the primary copy of the data off the primary storage media to a more cost-effective storage platform. Deduplication technologies can complement both backup and archiving processes by helping eliminate multiple redundant copies of data. The archive process can help alleviate backup issues by reducing the volume of data that must be backed up regularly.

Reducing the amount of primary storage being backed up helps ensure that backups are completed within the available window. The differences between archiving and backup become extremely important when an organization must perform e-discovery in response to litigation. If the organization is asked to produce data that IT leaders thought they had archived, and it turns out they had actually backed up the data to tape, IT personnel must begin going back through their tapes to find the required information—a process that may take months. Inefficient manual e-discovery processes can, in turn, contribute to increased labor and litigation costs.

**Expanding data management strategies**

Dell can help enterprises expand their existing data management strategies and strengthen their archiving practices by applying automated policies to help...
determine the relative value (relevance) of their data. Object-based storage platforms used with applications from independent software vendor partners can help to identify and tag data objects by scanning metadata during the process of creating data archives. This approach helps IT departments avoid archiving unnecessary data, simplifies data-store searches, and allows information to be retrieved, stored, and managed based on its attributes—that is, on the information contained in metadata associated with the stored objects.

Dell also helps organizations reduce complexity through policy-based automation that moves data into archive repositories designed to reduce primary storage data stores. Dell unified storage solutions can support enhanced enterprise efficiency, while Dell’s incorporation of data deduplication technologies with software and hardware helps to reduce the backup storage footprint, power costs, and wide area network replication bandwidth requirements.

Dell Data Management Consulting Services provide analysis to help determine when to implement archiving and other IDM technologies; Dell consulting experts can also help design and implement archiving solutions. Data Management Assessment Services help organizations define their challenges and requirements through a workshop designed to highlight data management issues that could be compounding the challenges. A Dell team performs an assessment to capture the current state and requirements, then designs an archiving services catalog to guide the solution configuration and implement Dell best practices for archiving.

**Taking a broad approach to intelligent data management**

Although many organizations consider archiving and backup processes to be interchangeable, they are not. Both are key cornerstones of an IDM strategy. Through a variety of key services, Dell can help enterprises expand their data management strategies and strengthen archiving practices to create an effective, efficient IDM approach to data management.

**Comprehensive archiving for Microsoft Exchange**

As this solution brief shows, the combination of the Dell DX Object Storage Platform and NearPoint software from Iron Mountain can provide an efficient and effective way to store, manage, and protect user-generated, unstructured Microsoft Exchange e-mail content.


Kay Benaroch is a senior marketing consultant at Dell focused on data protection, deduplication, and object-oriented storage, and has more than 30 years of experience in marketing technology products.

Joe Colucci is a global solution architect on the Dell Global Infrastructure Consulting Services Data Management team. He has 15 years of IT experience, including 10 years in storage consulting.
Accelerate operations with next-generation storage efficiencies

By Annette Cormier, Eric Cannell, and Brad Bunce

Dell/EMC NS unified storage offers tight integration with VMware® vSphere™ performance, utilization, and recoverability features designed to increase quality of service and efficiency within virtualized environments.

Virtual machine (VM) sprawl can lead to resource contention, duplicate data, inefficient utilization of processor cycles, and inconsistent data protection. And because storage and virtualized environments are typically managed separately through independent tools and consoles, it can be difficult for IT organizations to efficiently provision and configure resources, troubleshoot performance bottlenecks, and perform capacity planning and trend analysis.

To help address these challenges within VMware virtual environments, Dell/EMC NS unified storage offers tight integration with VMware vCenter™ software with key features—including the EMC® Unified Plug-in for VMware; EMC Unisphere™ storage management software; optimization capabilities such as EMC Fully Automated Storage Tiering (FAST), FAST cache, and data deduplication and compression; and data protection with the EMC Celerra SnapSure™ and EMC Celerra Replicator™ applications. Through these and other key technologies, Dell/EMC NS unified storage can help simplify management, enhance efficiency and performance, streamline data protection and recovery, and accelerate VM deployments and backups.

Flexible storage management
Because virtual infrastructures are dynamic, storage requirements for VMware virtualization vary across deployments, and can rapidly change as new VMs are spawned and as virtualization deployments move from test and development to mission-critical operations. As a result, organizations often need to support multiple file- and block-level storage protocols. Internet SCSI (iSCSI) may be desirable for leveraging staff with existing IP skill sets, while network attached storage (NAS)—using Network File System (NFS) and Common Internet File System (CIFS) protocols—can be effective for organizations deploying virtual desktop infrastructure environments. Mission-critical operations, such as the online transaction processing used in trading and e-commerce, may have low-latency quality-of-service requirements that would be best suited to the Fibre Channel protocol.

The support for both file- and block-level protocols in Dell/EMC NS storage enables...
organizations to support a wide range of virtualization use cases within a single storage infrastructure (see Figure 1). Organizations can use the protocols that they have experience with or those that are most appropriate for their application needs, and can easily add or modify storage based on usage and growth.

The EMC Unified Plug-in for VMware—available at no additional cost for Dell/EMC NS unified storage and Dell/EMC CX4 Series storage—enables VMware administrators to provision storage from the VMware vCenter console (see Figure 2). This plug-in provides end-to-end mapping of VMs to the physical storage resources that support them, enabling both storage and VMware administrators to view and manage the virtualized infrastructure through a single console. It also enables administrators to authenticate and connect to all Dell/EMC NS unified storage in the environment regardless of protocol; shows the correlation between logical units (LUNs), data stores, hosts, targets, and virtual storage; and provides advanced details on how storage is being utilized within the environment.

The plug-in also offers end-to-end mapping and visualization of VMs and the storage resources that support them, and supports both block and file storage provisioning through NFS, CIFS, iSCSI, and Fibre Channel protocols. VMware administrators can view and self-service provision the storage infrastructure from the vCenter console, including creating and deleting block-level Virtual Machine File System (VMFS) data stores and file-level NFS data stores. New data stores are automatically created and added to the VMware vSphere platform cluster. Administrators can easily assign allocations at the cluster, ESX host, VM, or even VMware Distributed Resource Scheduler (DRS) resource pool level, and can identify the connection between data stores, LUNs, targets, VMs, and storage.

Other key features include the following:

- **Compression:** Dell/EMC NS unified storage helps reduce storage sprawl by offering both file- and block-level data compression. Compression can be activated within the VMware vCenter console, enabling...
Storage optimization

administrators to compress and uncompress VMs in an NFS file store. Network-efficient backup and recovery is achieved with the combination of compression and deduplication, which helps considerably reduce the amount of data transferred over the network.

- **Deduplication:** Duplicate files (or redundant data) and infrequently used files can consume extra capacity and network bandwidth, both during storage operations and during backup and recovery operations over a wide area network (WAN) or local area network (LAN). Dell/EMC NS unified storage offers file-level deduplication, which, when combined with compression, can help reduce file data capacity requirements by up to 50 percent.

- **Automated volume management:** The EMC Unified Plug-in for VMware helps automate the process of creating NFS data stores by enabling administrators to easily provision a file system, optimized by workload, in just a few simple steps.

To offer storage administrators comprehensive visibility into virtual infrastructures, the EMC Unisphere storage management tool is tightly integrated with VMware platforms. Storage administrators can use it to see the end-to-end mapping of VMs to storage resources as well as additional information such as disk consumption and capacity utilization for individual VMs.

**Targeted performance optimization**

VMware virtual environments often have a range of storage performance requirements within a single infrastructure. Dell/EMC NS unified storage offers several performance optimization features that enable VMware environments to cost-effectively and automatically meet varied performance requirements.

EMC Unisphere extends integration with VMware environments through VMware vStorage APIs for Array Integration (VAAI), in which storage-related functions are offloaded from the VMware server to block-based Dell/EMC storage, including Dell/EMC NS unified storage with the Fibre Channel option and Dell/EMC CX4 Series storage. This approach enables increasingly efficient use of server resources to enhance performance and consolidation, hardware-accelerated copy operations, and bandwidth and processor utilization.

Dell/EMC NS unified storage supports a wide range of drive types to facilitate targeted, cost-effective performance, including enterprise flash drives (EFDs), also known as solid-state drives; Serial ATA (SATA) drives; and Fibre Channel drives. EFDs are designed to offer extremely high-performance and low-latency storage that is well suited to the most performance-sensitive applications. High-capacity SATA II drives offer cost-effective, high-capacity storage for applications such as archiving software that are not as performance intensive as applications that require high I/O workloads. Fibre Channel drives can offer reliable, high-performance storage for applications that require extremely fast response times.

To help optimize performance in dynamic VMware environments, some Dell/EMC storage arrays also offer EMC FAST technology. FAST can automate data movement across drive types within an array based on preset policies and I/O usage patterns. Heavily accessed data or data with very high performance requirements can be moved to high-performance storage, such as EFDs, while infrequently accessed data can be moved to more cost-effective storage, such as SATA drives.

FAST supports automated movement of data at the sub-LUN level as well. This optimization feature is especially beneficial in VMware environments.
environments, because many VMs and data stores may reside on a single LUN but have very different performance needs. Using this feature can help organizations meet high performance requirements cost-effectively and efficiently.

VMware environments are also prone to unexpected spikes in application workloads that can overwhelm cache capacities. To help maintain performance and ensure that response times and service-level agreements are maintained during these spikes, Dell/EMC NS unified storage includes FAST cache as a flash-based extended cache. FAST cache allows flash drives to be used as an extension of the system cache, and is fully read/write capable. This automatic absorption of excess workload helps to minimize performance degradation because of unexpected spikes in workload, while helping avoid the need to expand expensive memory cache.

Streamlined data protection and recovery

Enterprise VMware virtualization deployments generally have rigorous data protection and recoverability requirements. To help ensure data protection and recoverability, Dell/EMC NS unified storage provides robust, built-in data protection features including automated snapshot, replication, and recovery capabilities.

EMC Celerra SnapSure software, included with Dell/EMC NS unified storage, can create application-consistent point-in-time snapshots, including writable snapshots for test and development. SnapSure supports built-in automated recovery. Administrators can create up to 96 read-only file system copies, which are immediately available to end users and applications; administrators can also have 16 copies available for read/write. End users can access the copies to perform self-service file-level recovery through copy-and-paste operations. The copies are also available to IT staff to perform complete file system recoveries. Because the copies store only changed data, they are generally much smaller than the production file systems, only current data is kept in the production file system.

SnapSure also provides fast VM cloning functionality, which enables administrators to create pointer-based clones that are the size of unique data only. This pointer-based copy technology helps minimize disk space and enhance performance. Full cloning enables the creation of a full copy of the VM in the same data store or in an alternate data store. Rapid cloning of VMs is important for simplifying virtual desktop deployments and when scaling virtualized infrastructures from test and development to mission-critical virtualization operations.

EMC Celerra Replicator software supports automated, asynchronous, multisite replication. Celerra Replicator creates point-in-time, read-only, and read/write copies of production file systems or LUNs on local or remote storage systems. It supports up to 1,024 replication sessions, sending only changed blocks over the network, and does not affect VMware virtualization performance. A recovery point objective is set for each file system to be replicated. Celerra Replicator then manages the transmission of changed data to the target file system. Celerra Replicator is designed for ease of use, scalability, and flexibility to help meet the most demanding disaster recovery infrastructure requirements.

Automated disaster recovery is also supported through the EMC VMware vCenter Site Recovery Manager (SRM) Failback plug-in, which leverages Celerra Replicator to enable end-to-end disaster recovery of VMware infrastructures from the VMware vCenter SRM application. It also provides data replication of all or part of the virtualized infrastructure, supports both Dell/EMC NS and Dell/EMC CX4 storage systems, enables automation of the recovery process, and supports disaster recovery simulation and testing.

Efficient unified storage for virtualized infrastructures

The ability to support self-service storage management and provisioning—and maintain data protection and recoverability in enterprise-level virtualized environments—is available now. Through tight integration with the VMware vSphere platform, Dell/EMC NS unified storage helps dramatically streamline storage management and data protection within VMware infrastructures while enhancing quality of service for mission-critical operations.
Best practices for deploying iSCSI SANs in DSS database solutions

By Suresh Jasrasaria, Ananda Sankaran, and Chris Almond

Following key best practices can help organizations create scalable, high-performance decision support systems or data warehousing solutions based on the Microsoft® SQL Server® 2008 database platform and Dell™ EqualLogic™ PS Series storage arrays.

Effective decision support systems (DSSs) or data warehousing (DW) database solutions require scalable storage platforms that offer high levels of performance and capacity. DSS applications are typically designed to support long-running, complex analytical query activities using very large data sets. The data I/O pattern from storage to server is predominantly sequential and usually consists of large blocks—typically 512 KB or 1 MB in size. When designing such a system, IT administrators must consider the availability, scalability, and performance of each component layer within the solution stack, as well as how these characteristics affect the overall solution.

This article describes best practices for deploying DSS or DW solutions based on Microsoft SQL Server 2008 using Dell EqualLogic PS Series Internet SCSI (iSCSI) storage area network (SAN) arrays. To demonstrate these practices, in January 2010 Dell engineers deployed and tested two DSS configurations with the following design goals:

- Test a heavy DSS workload with high I/O requirements against Dell EqualLogic PS Series 10 Gigabit Ethernet (10GbE) arrays, Dell PowerEdge™ servers, and Dell PowerConnect™ 10GbE switches
- Maximize end-to-end solution performance to confirm best practices for system configuration in each component layer

As the results demonstrate, following best practices and taking advantage of flexible EqualLogic storage can help organizations design and deploy scalable, high-performance DSS or DW solutions in their own environments.1

DSS test environment

The test environment included two configurations, both based on Dell EqualLogic PS6010XV arrays, each of which had sixteen 450 GB, 15,000 rpm Serial Attached SCSI (SAS) drives in a RAID-50 configuration. The first configuration used a single EqualLogic PS6010XV array for SQL Server data and another array for SQL Server transaction logs; the second configuration used three arrays for SQL Server data and one array for SQL Server transaction logs (see Figure 1).

The arrays were connected to a Dell PowerEdge M710 blade server with two quad-core Intel® Xeon® X5570 processors at 2.93 GHz; 32 GB of RAM; two 73 GB, 15,000 rpm SAS drives; the Microsoft Windows Server® 2008 Enterprise OS; and the 64-bit version of Microsoft SQL Server 2008 Enterprise with Service Pack 1. The test team had selected the PowerEdge M710.

as the database server in order to take advantage of its expanded I/O capability.

To create the 10GbE iSCSI storage network, the test team installed two Broadcom NetXtreme II 57710 10GbE mezzanine network interface cards (NICs) on the server in fabric B, and connected these NICs to external PowerConnect 8024F switches through the pass-through modules installed on the PowerEdge M1000e modular blade enclosure. (A Dell PowerConnect M8024 switch can also be used as an alternative to the pass-through modules.) A PowerEdge M610 blade server ran the DSS query simulation tool (Quest Benchmark Factory) and hosted the EqualLogic SAN HeadQuarters (SAN HQ) monitoring application. A modified benchmark similar to TPC-H was used to model the DSS workload.

### Figure 1: Second configuration used in the DSS test environment

![Diagram showing network configuration](image)

---

**Best practices for DSS component configuration**

The test environment was designed to follow best practices when configuring the components of the DSS solution stack. This section outlines some of the key recommendations that IT administrators can take into account when designing a scalable solution in their own environments.

**Dell EqualLogic storage array configuration**

The following are recommended best practices for EqualLogic storage array configuration as part of a DSS solution.

- **Select an appropriate disk drive type and size.** The test environment used EqualLogic PS6010XV storage arrays configured with sixteen 450 GB, 15,000 rpm SAS drives, because 15,000 rpm SAS drives offer the highest level of disk I/O throughput among the supported hard disk drive types. In environments requiring lower levels of I/O throughput, administrators could consider using 10,000 rpm SAS drives in an EqualLogic PS6010X array or Serial ATA (SATA) drives in an EqualLogic PS6010E array. The appropriate drive size depends on the capacity requirements of the database.

- **Select an appropriate RAID policy.**

  The test environment used RAID-50 on each array across 14 disk drives, with the remaining 2 disk drives set as hot spares. It is a best practice to use RAID-50 because DSS environments are highly read intensive and require large storage capacities. RAID-10 is also recommended for environments that include a mix of both read and write operations.

- **Select an appropriate storage pool configuration.** The test team created...
two storage pools in each test configuration: one pool hosted the SQL Server data volumes, including the tempdb volumes, and the other hosted the SQL Server transaction logs. The transaction logs were physically separated from the DSS database disk drives to provide high levels of data protection and recoverability.

DSS workloads are primarily read intensive and typically generate minimal transaction log activity. Thus, in smaller DSS database environments, the database and transaction log volumes can be typically hosted on the same pool without sacrificing performance. SQL Server mirroring or replication solutions can also be considered for additional recoverability in such scenarios.

**SAN configuration**

The following are recommended best practices for SAN configuration as part of a DSS solution.

**Use redundant switch paths between servers and storage arrays.** The test configurations used redundant switch paths in the SAN to help ensure uninterrupted access to storage controllers in the event of a switch or interconnect cable failure or scheduled switch downtime for maintenance. The following best practices are recommended when designing an iSCSI SAN for a DSS solution:

- Equally distribute the NIC ports installed on the server for iSCSI SAN connectivity across the redundant switches or fabric.
- Equally distribute the Ethernet ports from each controller of the storage array across the redundant switches or fabric.
- Interconnect the two switches with a sufficient number of inter-switch links to support the workload.

It is also a best practice to always isolate the SAN so that the iSCSI switching infrastructure is dedicated to storage traffic.

**Use flow control and jumbo frames.** Flow control increases the ability of the SAN to regulate packet flow between nodes (servers, switches, and storage) during conditions of high I/O traffic. Jumbo frames are Ethernet frames that have a maximum transmission unit larger than 1,518 bytes. Jumbo frames can help increase SAN throughput by allowing additional data to be transferred in each Ethernet frame.

The jumbo frame size on the switch ports must match or exceed the settings at the end-device ports (the server and storage NICs). Generally, end devices conform to a jumbo frame setting of at least 9,000 bytes and switches of up to 9,216 bytes. It is a best practice to enable flow control (both TX and RX) and jumbo frames on all switch ports, including virtual port channels created for link aggregation groups.

**Pay attention to Spanning Tree Protocol (STP).** The test team disabled STP on all switch ports connecting to end devices (the server and storage controller NICs), and enabled the PortFast setting on those switch ports. Because NIC and storage controller ports are endpoints, they cannot create loops. Enabling the PortFast setting avoids the STP forwarding-state delay time that occurs when a port becomes active, which helps accelerate initialization of new iSCSI sessions when ports on an existing iSCSI connection path change status.

**Select appropriate physical interconnects.** PowerConnect 8024F switches support small form-factor pluggable + (SFP+) ports for 10GbE connectivity. Support for 10GBase SFP+ is typically provided with 10GbE switches. Either SFP+ transceivers with optical cables or SFP+ copper cables can be used for interconnecting switches and for connecting end devices to the switches. Connection distance and cost determine the appropriate type of physical connection.

**Dell PowerEdge server configuration**

The following are recommended best practices for PowerEdge server configuration as part of a DSS solution.

**Configure server hardware to meet performance and capacity requirements.** In the test environment, the PowerEdge M710 database server was configured with two quad-core Intel Xeon X5570 processors and 32 GB of RAM to meet the needs of the workload under test. The Dell SQL Server Advisor tool (available at dell.com/sql) can provide a starting point for sizing server configurations to support SQL Server DSS workloads.
Think beyond processor and memory.
In the test environment, each NIC was connected to the two blade sockets internally through an x8 PCI Express (PCIe) interface. This eight-lane interconnect path can provide up to 16 Gbps of PCIe 1.1–compliant bandwidth per mezzanine NIC. (The PowerEdge R710 supports PCIe 2.0; using PCIe 2.0–compliant NICs would increase this bandwidth further.) It is a best practice to choose servers with appropriate PCIe technology, a sufficient number of PCIe slots, and a sufficient number of PCIe lanes to provide the data transfer bandwidth required by the DSS workload.

Properly size the SAN connection paths. It is a best practice to provision the quantity (at least two for redundancy) and connection speed of the SAN NIC ports on the server based on workload throughput requirements, and to provision separate NICs for the server LAN connections.

OS configuration
The following are recommended best practices for OS configuration as part of a DSS solution.

Align disk partitions with storage stripe boundaries. If disk partitions do not align with external storage RAID striping scheme (that is, the block size), then the system generates more I/O operations than in an optimal configuration. By default, Windows Server 2008 aligns partitions with an offset of 1,024 KB, and thus can accommodate all RAID stripe sizes up to 1,024 KB. For previous-generation operating systems, the best practice is to manually align the data partitions with an offset suitable to the RAID stripe size using a utility such as DiskPart.

Use flow control and jumbo frames. As with the SAN configuration, it is a best practice to enable flow control (TX and RX) and jumbo frames on the server NIC ports connecting to the SAN, and to match these settings with the switch and array controller port settings.

Utilize NIC offload capabilities. The test team used Broadcom NetXtreme II 57710 NICs in TCP/IP Offload Engine (TOE) mode. Enabling this mode on the NICs to work in conjunction with the Microsoft iSCSI Software Initiator, Microsoft Multipath I/O (MPIO), and the EqualLogic MPIO Device Specific Module (DSM) helps provide optimal performance for SQL Server DSS workloads. As an alternative to TOE, the network card can also be set up in the iSCSI Offload Engine (iSOE) mode. Performance of offload engine modes from different NIC vendors may vary.

Disable NIC teaming and unused NICs. It is a best practice to disable NIC teaming on all ports used for iSCSI connections when MPIO is enabled. Disabling unused NIC ports can help simplify systems management and reduce configuration errors.

Use the EqualLogic MPIO DSM to optimize the MPIO configuration. The EqualLogic MPIO DSM is provided in the EqualLogic Host Integration Tool Kit for Microsoft Windows® operating systems, and can provide enhanced performance for bandwidth-intensive applications such as SQL Server DSS workloads. The test environment used the default values for the number of connections per member (two) and the total number of connections per volume (six).

Microsoft SQL Server 2008 configuration
The following are recommended best practices for SQL Server 2008 configuration as part of a DSS solution.

Properly size the storage volumes for each database I/O component. SQL Server data layout on the storage volumes is an important factor for optimal operation.
Storage optimization

Storage volumes must be appropriately sized for capacity and performance to host the database data, transaction logs, and tempdb databases, respectively. Because DSS workloads often create large temporary data objects during query processing, it is critical to size the tempdb appropriately.

**Match RAID levels to DSS I/O components.**

Different database types can generate different I/O patterns in a DSS environment. The recommended RAID levels for each volume type are as follows:

- **Database volumes:** RAID-50 is recommended to optimize for both capacity and performance.
- **Tempdb volumes:** If write activity is low, RAID-50 is recommended to optimize for both capacity and performance. If write activity is high, RAID-10 is recommended.
- **Log volumes:** In most cases, RAID-50 is recommended to optimize for both capacity and performance. If the DSS database refreshes include very large bulk updates, however, then RAID-10 is recommended.

Use SQL Server table partitioning to help increase query processing performance. Table partitioning is a recommended best practice to enhance query processing, particularly when implemented on frequently accessed large tables and when based on the most commonly queried table field. In the test environment, the largest table was partitioned into four subsets, each residing on its own file group and volume; this partitioning scheme was based on a particular table column that contained the most common field in the user queries.

**DSS test results**

Figure 2 shows the relative instantaneous peak throughput at the server NICs (receive) in each configuration, as measured using the Microsoft Windows Performance Monitor tool while the DSS queries were executing. The maximum throughput observed at the server NICs scaled almost linearly from the single-array configuration to the three-array configuration. This scalability was due to the increased storage bandwidth available (three times the number of storage array 10GbE controller ports) and the increase in available storage resources (three times the number of storage controllers and disk drives).

Figure 3 shows the average processor utilization on the database server during each test; Figure 4 shows the query response times measured at the test client for completion of all DSS query streams. These results illustrate that as more I/O bandwidth is available (because of the increased storage resources), the database server was able to reduce query response times. More processor cycles were utilized to process the data arriving at a higher rate with three arrays.

**Scalable, available, high-performance design**

Scalability and availability are key factors of an effective DSS or DW solution. Adhering to the best practices outlined in this article for integrating Dell EqualLogic PS Series iSCSI SAN arrays into the design can help IT administrators create a scalable high-performance infrastructure that can grow as the needs of the organization change.

---

Suresh Jasrasaria is a product marketing senior consultant in the Dell Enterprise Storage Product Group, and has worked in the data storage industry for more than 20 years.

Ananda Sankaran is a senior development engineer on the Dell Storage Infrastructure and Solutions team, and has more than 9 years of experience in software engineering, systems engineering, and solutions architecture.

Chris Almond is a senior consultant responsible for development of publications produced by the Dell Storage Infrastructure and Solutions team.

---

Learn more

- **Dell and Microsoft SQL Server:**
  dell.com/sql

- **Dell EqualLogic PS Series:**
  dell.com/pseries
dell.com/equallogic
Virtualization is growing rapidly in small and midsize organizations. Dell™ PowerVault™ MD32x0 SAS and PowerVault MD32x0i iSCSI arrays are designed to meet these organizations’ performance, capacity, flexibility, and ease-of-use requirements.

Exceptional performance

The Dell PowerVault MD32x0 series and PowerVault MD32x0i series incorporate a range of features to help meet the needs of small and midsize organizations.

- **Scalability** to grow as capacity needs increase
- **Flexible deployment options** to fit in with existing platforms
- **Integrated functionality** including data recovery and protection

Virtualization is a widely adopted strategy for solving many of the challenges IT organizations currently face, such as simplifying infrastructure, optimizing data management, and using resources efficiently. Organizations are deploying virtualization across server and storage platforms to help reduce capital and operational costs while increasing IT productivity.

Research supports the increasing momentum of virtualization adoption: according to Gartner, “only 16 percent of workloads are running in virtual machines today, but Gartner predicts that this will rise to around 50 percent of x86 architecture server workloads by the end of 2012, representing approximately 58 million deployed machines.” Tom Bittman, vice president and distinguished analyst at Gartner, says, “While large enterprises were quick to leverage virtual machines to reduce server sprawl and power costs, as well as conserve data center space, small business started late on virtualization. However, by year-end 2010, enterprises with 100–999 employees will have a higher penetration of virtual machines deployed than the Global 500. For years the entry point was simply too high for small enterprises, but increased competition by server vendors has enabled smaller firms to embrace virtualization.”

The data storage needs of small and midsize organizations are growing, and virtualization is helping to improve the cost-efficiency of storage systems that address these needs. Storage virtualization is increasingly deployed as a key component in server virtualization projects, helping consolidate storage resources and reduce infrastructure investment and operating costs.

As small and midsize organizations increasingly deploy virtualization, the demands placed on their storage systems that support the virtualized workloads also continue to increase. These organizations must support the growing deployment of virtual machines using fewer resources than large enterprises. Strategies often include streamlining administration to offset limited IT staffing, and looking for ways to obtain additional leverage from virtualization technology investments.

---

With data volumes continuing to expand rapidly, finding smaller-scale but powerful storage arrays to support virtualization becomes increasingly important. Several considerations and trade-offs are involved in deploying storage systems for virtualization projects.

Defining the requirements of virtualized storage

The storage systems needed to support growth in small and midsize organizations are different from large enterprise systems. In addition to right-sized capacity and performance, small and midsize organizations require storage that is cost-effective and based on open standards so that it can be deployed without costly changes to existing environments. Systems should also be highly flexible, supporting a variety of virtualization technologies, RAID levels, and drive types so that each organization can meet its specific requirements and fully utilize existing infrastructure.

Systems that offer a choice of Serial Attached SCSI (SAS) or Internet SCSI (iSCSI) host interface connectivity support multiple deployment options and provide the flexibility that small and midsize organizations need (see Figure 1). SAS connectivity is well suited for deployments in which bandwidth and price/performance are key considerations, and when the organization is directly connecting storage to multiple servers. Arrays based on iSCSI technology, on the other hand, are an excellent choice when an organization is centralizing storage for multiple servers on one Ethernet storage area network (SAN). Because iSCSI-based arrays work with cost-effective, well-understood Ethernet technology, they can help reduce costs for additional training as well as for hardware such as switches and other infrastructure components.

Other core storage requirements for small and midsize organizations include the following:

- **Performance:** Organizations need scalable application performance within budget. Performance should be sufficient to meet the demands of the large database applications used by many midsize organizations. The ongoing proliferation of data types—including media such as audio, video, and high-resolution images—further increases need for processing performance.

- **Capacity:** Small and midsize organizations often require enough capacity to store an estimated range of 100–200 TB of data. Of course, the amount of data a fast-growing organization stores today could be a fraction of what it will need to store a year from now. A modular architecture enables the organization to scale efficiently and add capacity in cost-effective increments.

- **Ease of use:** Streamlined administration is essential for organizations that lack large IT staffs. Storage arrays must be easy to deploy and manage, and provide built-in intelligence to help avoid costly staff expansion or outside consultants. Integration with leading hypervisors is also required to help reduce manual setup and make the most of the virtualization investment.

Assessing Dell PowerVault arrays

Dell PowerVault MD32x0 series SAS-based arrays and PowerVault MD32x0i series iSCSI-based arrays are specifically designed to provide storage virtualization for small and midsize organizations (see the “Small environments, big demands” sidebar in this article). These arrays support storage virtualization deployments with integrated functionality.
such as data recovery, online data migration, application awareness, data protection, and failover.

For example, these arrays can take point-in-time snapshots of data for backup and make full copies of virtual disks for decision support or software development testing. Data from key applications can be restored back to a specified point in time in the event of a failure. Additionally, self-encrypting drives (SEDs) are designed to automatically make data unreadable by unauthorized persons if a drive is removed from the array.

The arrays are designed to provide the performance and scalable capacity that small and midsize organizations require. The PowerVault MD32x0 series provides up to twice the performance of previous-generation PowerVault storage arrays, and even greater improvement can be achieved with solid-state drives and the optional High-Performance Tier firmware upgrade. Administrators can easily add capacity as needs grow by adding hot-pluggable PowerVault MD1200 and PowerVault MD1220 expansion enclosures, with each enclosure holding up to 12 or 24 hard drives, respectively, to support a maximum of 96 drives. PowerVault MD32x0 and PowerVault MD32x0i arrays support multiple virtualization technologies, including VMware® ESX and VMware vCenter®, Microsoft® Hyper-V®, and Citrix® XenServer™ software, enabling organizations to continue using existing platforms.

Virtualization and consolidation help simplify storage management, and the PowerVault MD32x0 series and PowerVault MD32x0i series arrays can make management even simpler with PowerVault Modular Disk Storage Manager, a built-in application designed for easy interaction with the system regardless of the user’s level of familiarity with storage infrastructure. The software features an enterprise window that monitors multiple systems through a single interface as well as wizard-based array management to help streamline configuration. It can also detect problems and launch an automatic Recovery Guru to help troubleshoot and resolve the problems using a built-in knowledge base.

Starting small with a scalable foundation
Virtualization is a valuable IT strategy, and storage is an important part of that strategy for small and midsize organizations. Dell PowerVault MD32x0 series SAS arrays and PowerVault MD32x0i series iSCSI arrays are designed for these environments—providing a rightsized, automated platform that allows organizations to start small, minimize risks, and establish a solid foundation on which to grow.

Figure 1. Example Dell PowerVault MD3200i iSCSI array configuration in a virtualized environment

Using Modular Disk Storage Manager
PowerVault Modular Disk Storage Manager features system status monitoring for multiple arrays, an image view of the system that provides status information for key components, and quick and intuitive steps for creating a new virtual disk and mapping it to a host. For more information, including a video demonstration, visit the “learn more” links below.

John Mannix is a marketing manager on the Dell Storage team and was previously with Gemalto, Hyperformix, and Cirrus Logic.

Kyle Walczak is a product marketing manager at Dell and has been in the storage industry for 13 years.

Learn more
Dell PowerVault MD32x0 series: dell.com/md3200
Dell PowerVault MD32x0i series: dell.com/md3200i
Robust data protection in a virtual world

By Ed Casmer

Working with traditional backup tools in virtualized environments can be time-consuming and difficult. Symantec™ data protection software was designed with virtualization in mind—providing intelligent backups, granular file recovery, and more.

Virtualization can bring numerous benefits to the data center, including server consolidation as well as enhanced utilization, availability, and disaster recovery. Consolidation alone can provide substantial cost savings, yet consolidating many virtual machines (VMs) onto one physical system increases not only utilization, but also risk: a single physical hardware failure can bring down multiple VMs. And the greater the density, the greater the risk—a lost host server could inhibit productivity for multiple departments for as long as it takes to recover the virtual environment and the individual VMs.

Because of these considerations, organizations today are looking for efficient backup and recovery software that can provide productivity benefits and cost savings on par with those provided by server virtualization. Symantec data protection software such as the Backup Exec™ 2010 and Veritas™ NetBackup™ 7 applications can help meet these needs, providing administrators with powerful, flexible tools for backing up and recovering critical VMs and core enterprise applications.

Designing for virtualization

When virtualization was introduced to the data center, data protection was about protecting the VMs. First-generation backup applications were not tuned for virtualization; they simply expected an agent to be included in each VM. Even today, backup tools not specifically designed for virtualization can have multiple limitations when used in virtualized environments—requiring administrators to take VMs offline during backup; restore entire VMs simply to recover a single file; perform lengthy, separate backup processes when running software such as the Microsoft® Exchange, SQL Server®, and Active Directory® platforms inside VMs; and more.

In some scenarios, such a model can still make sense. But as hypervisors have evolved, virtualized environments have become scalable, high-performance platforms that support an increasing number of powerful applications. Practices once frowned upon—such as running Exchange, SQL Server, and Active Directory in a VM—are now generally accepted. Add to this the growing density needs of data centers around the world, and the need for finely tuned, virtualization-aware backup software becomes clear. Backup administrators and IT professionals don’t want to protect the physical and virtual aspects of environments at the price of vendor or product sprawl, nor do they want to protect VMs running core business applications differently than they do VMs running Web servers, print servers, and similar basic services.

Symantec data protection software is designed to meet both the virtual and physical needs of the entire enterprise in a single package by leveraging Symantec’s innovative Granular Recovery Technology (GRT). GRT helps to save time and...
reduce costs by allowing administrators to restore individual files and folders within a VM from a single-pass image backup of the entire VM (see Figure 1). The VM need not be taken offline, nor is a separate file-by-file backup on the VM needed to restore an entire VM or individual files from within a virtual disk (.vmdk or .vhd). Additionally, Symantec software enables granular recovery from an original image-based backup of a VM running software such as Exchange, SQL Server, or Active Directory, without requiring separate databases or application-agent-specific backups.

Symantec data protection software also offers several other key benefits:

- Backups for Microsoft Hyper-V™ and VMware® virtualized servers and physical systems are provided in a single package.
- Block-level as well as native file-level incremental and differential backups can help reduce backup time while also providing flexible backup policies.
- Support for source and target deduplication can dramatically reduce the amount of backup data and help greatly increase storage density.
- Single-pass backup provides both full and object-level restore, allowing Exchange, SQL Server, and Active Directory software running inside a VM to be protected while online and running. Administrators can recover individual objects such as Exchange e-mails and mailboxes, SQL Server databases, and Active Directory user accounts without requiring an application-agent-specific backup.
- Newly added or created VMs can be automatically included in backups.

Deploying comprehensive data protection
As virtualization technologies have matured in scope from test and development applications to include today’s complex production environments, Symantec data protection software has remained at the forefront of the virtualization adoption curve. By deploying tools such as Backup Exec 2010 and Veritas NetBackup 7 in virtualized environments, IT administrators can create a versatile, high-performance approach to protecting VMs and core applications as part of a comprehensive enterprise backup and recovery strategy.

Ed Casmer is a technical strategist in the Partner Alliance Group at Symantec dedicated to the Dell Alliance.

Learn more

- Symantec Backup Exec: backupexec.com
- Veritas NetBackup: symantec.com/netbackup
- Dell and Symantec: dell.com/symantec symantec.com/dell
Building the dynamic data center

By M. Consuelo Ortiz

As a key component of the Dell Efficient Data Center strategy, the Dell™ Virtual Integrated System architecture helps organizations move from a static to a dynamic data center and increase efficiency in the virtual era by effectively managing technology and the people and processes that manage the technology.

In the new virtual era, organizations need to get a lot more for a lot less. Technologies such as virtualization have provided some improvements but have also added to the complexity of the environment. Increasingly, organizations must manage two infrastructures—physical and virtual—and have created ‘virtual machine sprawl.’ In effect, one type of management complexity has been substituted for another.

The Dell Virtual Integrated System (VIS) helps meet these challenges. VIS addresses IT efficiency in the virtual era by effectively managing technology as well as the people and processes that manage the technology. Efficiency is no longer confined to just hardware, and moving beyond hardware efficiencies is what defines the virtual era.

VIS is designed to facilitate the data center transformation from statically to dynamically managed, and to address the operational challenges created by this transformation. It streamlines key activities in the data center using an open architecture that seamlessly integrates into the existing environment. It extends the benefits of virtualization while increasing infrastructure efficiency by helping reduce the time wasted on repetitive tasks. These advantages translate into rapid, cost-effective resource provisioning and workload deployment, as well as increased efficiencies in IT processes, cycle times, and service levels—without compromising choice or simplicity.

Dell VIS architecture

Data centers are heterogeneous, typically populated by a variety of server models, network switches, and storage systems from a range of vendors. The adoption of server virtualization has added another heterogeneous component to the mix: hypervisors. These infrastructure components come with their own management tools, but the tools are typically not well integrated—which can lead to organizational silos and a plethora of management systems that data center managers must learn and support. This lack of integration can also result in diminished efficiency and increased response times.

The open Dell VIS architecture helps address these problems by providing integration, automation, and predictability. It helps streamline capacity planning, cost allocation, performance monitoring,
and automated workload deployment. It also provides a self-service portal, dynamic provisioning, and resource tiering and pooling. Dell’s open architecture provides choice in what technologies organizations select today and in the future. It’s about the ability to connect and integrate multi-vendor server, storage, and networking into a single pool; the ability to migrate from multi-vendor hypervisors with a simple reboot, and the ability to seamlessly incorporate current processes and custom applications.

The Dell VIS architecture consists of three main elements: VIS Infrastructure, VIS Delivery Center, and the Integration Suite (see Figure 1). This design brings together software, hardware, and services to enhance efficiency and enable rapid IT response to business requests. The Integration Suite can incorporate existing Dell management tools into the Microsoft® System Center Virtual Machine Manager, VMware® vCenter™ Server, or Citrix® XenCenter™ management consoles, enabling administrators to efficiently manage large environments with a minimal number of tools—again, leveraging the investments already made in the infrastructure.

Dell VIS Infrastructure
As a key part of VIS Infrastructure, Dell Advanced Infrastructure Manager (AIM) software provides a single management point for physical and virtual resources that helps accelerate heterogeneous hardware provisioning while providing a highly dynamic and flexible environment. AIM supports a variety of infrastructure elements regardless of make, model, form factor, or access protocol. Administrators can build a dashboard that provides a holistic view of the data center, and can invoke many AIM functions directly from common systems management tools like VMware vCenter Server and Dell Management Console powered by Altiris™ from Symantec™.

AIM advantages include enhanced quality, performance, scalability, and system availability and uptime. It helps increase server utilization and enhances the ability to perform routine maintenance on both physical and virtual systems—all while helping to reduce costs and minimize operational interruption. It also helps provide

"In my opinion, the Dell VIS architecture is key to the future of the data center. Moving toward flexible and dynamic data centers is the biggest challenge the IT industry has through the next couple of years, and I believe Dell’s strategy is right on target.”

—Gustavo Viceconti CEO of NeuralSoft July 2010

Extending the value of virtual infrastructures
Static IT environments can lead to major inefficiencies. In this Webinar, learn how Dell AIM enhances and extends virtualization technologies to deliver a truly dynamic data center.
eseminarslive.com/c/a/Virtualization/Dell091610
the fundamental business continuity and high-availability requirements that facilitate cloud or grid computing.

Achieving high levels of agility, efficiency, and flexibility requires the deployment of purpose-built servers, storage, networking, and fabrics that help reduce acquisition and operating costs. Dell offers a range of infrastructure products to support the Dell VIS architecture and help meet these needs, including 11th-generation Dell PowerEdge™ servers, Dell EqualLogic™ PS Series storage arrays, Dell/EMC CX4 Series storage arrays, Dell/EMC AX4-5 Series storage arrays, and Dell PowerConnect™ switches. IT staffs need to rack and cable only once, and retain the flexibility of a multi-vendor approach.

The use of infrastructure management tools helps increase data center efficiency by integrating IT operations with broad organizational objectives and needs. Dell VIS Infrastructure integrates and automates common tasks and workflows, helping free up resources while enabling dynamic responses to changing levels of demand for services.

**Dell VIS Delivery Center**

IT administrators need high levels of visibility, automation, and customization to help them increase productivity, optimize performance and resource utilization, and increase quality of service while still controlling costs. An understanding of the relationships and dependencies between infrastructure components is critical to identifying and then remediating performance and capacity problems. This intelligence, along with “what-if” scenarios and utilization-based analysis, can help CIOs and IT architects to accurately plan for growth and efficiently utilize resources.

Dell VIS Delivery Center is designed to increase the speed and agility of the data center by delivering enhanced levels of visibility and control over the IT infrastructure. It provides performance monitoring, capacity planning, service management, and automation to help organizations mitigate the impact of resource sharing, and also provides a venue to model cost recovery, depreciation, and other financials for IT infrastructure investments.

VIS Delivery Center also compresses the time it takes to deploy applications by standardizing and automating the way administrators deploy application workloads. With it, the IT team can create a self-service portal for application workloads that provides templates and monitoring tools, so that the organization can quickly and easily get the most out of its infrastructure investment.

VIS Delivery Center includes two components: VIS Self-Service Creator and VIS Director. The VIS Self-Service Creator component is an automated
catalog-based service delivery and management platform that provides IT users with the power to deploy and manage their resources while enabling IT staff to respond rapidly to business requests and improve control over IT workloads and costs.

VIS Director is the command center for the next-generation data center, providing an intuitive, end-to-end view of the data center that logically links physical and virtual resources. VIS Director gives organizations high levels of visibility and reporting, performance and capacity management, and automated remediation.

Dell services
Organizations face multiple challenges on the path to a more dynamic cost- and resource-efficient data center. To help them deal with these challenges, Dell offers a broad, customizable range of services designed to simplify the assessment, design, implementation, management, maintenance, and support of IT environments. Dell works with each organization to understand the current IT environment and its specific challenges. Then Dell maps out goals and provides practical, action-oriented recommendations for reducing, removing, or isolating unnecessary complexity.

In delivering a VIS solution, Dell can provide workshops on areas of interest, such as efficient architectures, cloud computing, and virtualization, followed by readiness assessments and technology introductions, or proofs of concept. This leads into dynamic data center design and implementation, followed by management, maintenance, and/or support services. The preliminary phases include establishing a baseline of projected costs before IT decision making, and prioritizing initiatives so that they can be implemented on schedule and within budget. Most important, Dell VIS services are open, capable, and affordable—meaning that organizations can incorporate into their plans as much or as little as they need.

Dynamic data center management
To align with organizational needs and provide the agility needed in today’s fast-paced environment, the data center must be cost-effective, nimble, and flexible. CIOs, IT architects, and administrators must increase levels of standardization and automation and develop consistent policies across the organization.

Dell VIS provides a path for the static-to-dynamic data center transformation—without sacrificing existing technology choices. Dell’s open architecture helps ensure that organizations retain flexibility and choice while gaining tangible benefits at each step. By helping simplify data center management and enhancing visibility and reporting, VIS enables organizations to maintain cost-effective infrastructures while meeting dynamic business demands.

“Life cycle management of virtual workloads is one of the most important elements of evolving and optimizing our private clouds. VIS Self-Service Creator gives us on-demand, self-service workload provisioning along with scalable orchestration to contain sprawl and rightsize capacity with workload leasing and reclamation.”

—Matt Brooks
Senior enterprise architect for Dell IT
August 2010

M. Consuelo Ortiz is a product marketing strategist for Dell.

Learn more
Dell VIS:
dell.com/vis
dell.com/efficiency

Life cycle management of virtual workloads is one of the most important elements of evolving and optimizing our private clouds. VIS Self-Service Creator gives us on-demand, self-service workload provisioning along with scalable orchestration to contain sprawl and rightsize capacity with workload leasing and reclamation.”

—Matt Brooks
Senior enterprise architect for Dell IT
August 2010

M. Consuelo Ortiz is a product marketing strategist for Dell.
Using multitiered arrays to optimize application performance

By Andrew Gilman and Suresh Jasrasaria

IT organizations have long been challenged to make sure "hot" data is served to applications quickly and cost-effectively. Now, they can meet both these challenges with Dell™ EqualLogic™ hybrid storage arrays that use multiple tiers in a single enclosure.

Organizations have always had "hot" information that is accessed more frequently than other data. Ensuring fast access for this high-demand information has traditionally required inefficient processes such as making multiple physical copies to allow several people to view the data at the same time. Today, with large numbers of concurrent users accessing high-demand data electronically, ensuring that this data is quickly and easily available to applications and users is an even greater priority.

Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS Internet SCSI (iSCSI) storage area networks (SAN) arrays offer an efficient way to meet this need. Incorporating both solid-state drives (SSDs) and Serial Attached SCSI (SAS) drives in a single array, these systems can help organizations create a highly responsive yet cost-effective platform for a range of multitiered workloads, including virtual desktop infrastructure (VDI) with VMware View as well as business-critical database applications.

Addressing the high-demand data challenge

Rapid access to high-demand data is essential to the performance of mission-critical databases and key business applications when deployed in a physical or virtual environment. If an application is unable to retrieve high-demand data from storage quickly enough, the user experience for these applications can suffer.

This problem can be especially acute for applications that serve multiple users. Activities such as month-end database processing can exacerbate the problem by greatly multiplying simultaneous demand for key data. Adding to the problem is the pace at which data is growing, increasing the pressure on storage system performance.

Networked storage and extensive use of SSDs help deliver fast access to data and increased application performance—but these technologies can be complex, as well as cost prohibitive for all but the largest of organizations. As data centers become increasingly consolidated, providing application performance on demand while keeping costs low has challenged even the most sophisticated IT organizations.

Data on demand

Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS arrays include SSD and SAS drives in a single enclosure and provide a cost-effective, highly efficient approach to ensuring fast access to high-demand data.

- Multiple storage tiers with SSDs and SAS drives in a single enclosure
- Automated load balancing for an appropriate balance of performance and cost
- Integration with the VMware® vSphere™ 4.1 hypervisor to increase responsiveness in virtualized environments
Overcoming limitations of traditional multitiered load balancing

When using traditional load balancing across multiple arrays, administrators must be cautious about migrating data to a lower tier of storage. For example, the latency involved in moving a data volume to a lower-tier array can reduce application performance. When high and low data access frequency coexist on the same volume or file, it is often difficult to manually separate frequently accessed data from infrequently accessed data. Moreover, when storage systems perform volume- or file-based auto-tiering based on actual access frequency, volumes or files may need to move frequently between tiers of storage, causing thrashing.

A cost-effective approach to reducing access time for frequently used data is to enable content-based auto-tiering between high-performance SSDs and less-costly SAS drives within the same array. Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS iSCSI SAN arrays follow this strategy, providing an efficient way to implement multitiered load balancing.

Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS array capabilities

The high-performance Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS arrays are designed to support fast access to high-demand data in a multitiered volume. Each array includes eight low-latency SSDs and eight cost-efficient 15,000 rpm SAS drives for multiple tiers of storage within a single array.

On-board intelligence provides automatic load balancing across these drives, helping deliver the appropriate balance of responsiveness and cost for tiered workloads. EqualLogic firmware enables efficient load balancing between the SSD and SAS tiers. Intelligent data tiering and automated management are built into both arrays, along with snapshots and replication for data protection and disaster recovery capabilities, requiring no additional licensing costs.1 The EqualLogic PS6010XVS array also offers simplified cabling and exceptional sequential performance by using 10 Gigabit Ethernet (10GbE) interfaces.

Integration with VMware virtualization

Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS arrays are designed to boost data efficiency for tiered workloads by automatically migrating data to the appropriate drives and by leveraging tight integration with VMware virtualization technologies, including VMware vStorage application programming interfaces (APIs).

EqualLogic firmware version 5.0, included with all EqualLogic arrays, is closely integrated with VMware vStorage APIs. The firmware allows VMware vSphere virtualization software running on servers with the VMware ESX 4.1 hypervisor to offload storage-related functions from the hypervisor layer to the EqualLogic firmware. This offload capability helps increase the responsiveness of VMware virtual infrastructures running on EqualLogic arrays, and enables intelligent data tiering for multitiered workloads.

Virtualization

Accelerating cloud services

When SAP asked infrastructure-as-a-service (IaaS) provider Xtium to deliver “test drive” environments for prospective customers, the company quickly took advantage of EqualLogic firmware version 5.0. The thin clone technology and tight VMware integration have provided Xtium with a robust, scalable, easy-to-manage platform that enables quick, cost-effective provisioning while supporting aggressive service-level agreements. The results have been dramatic:

- 30 times faster provisioning of clones for test drive environments (from one hour to two minutes)
- 5 times faster copies using Xcopy for single instances of test drives and virtual desktops
- 90 percent savings on disk space using thin clones
- 70 percent more hosted virtual machines on fewer physical resources with atomic locking
- 50 percent fewer volumes to manage

The firmware upgrade came at no additional cost to Xtium, and the combination of technologies like thin provisioning and thin clones is allowing the company to deliver new and enhanced services going forward. “Customers are enjoying services that are making them more efficient and providing new revenue,” says Xtium CTO Tim Vogel. “And the new EqualLogic firmware enables us to grow dynamically, so it’s a win-win.” *


Responding intelligently to data requirements

The ability of the Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS arrays to sense and intelligently respond to data requirements is applicable to multiple use cases, including VMware View–based VDI and business-critical applications such as Oracle® databases and SAP® implementations. In each of these use cases, EqualLogic PS6000XVS and EqualLogic PS6010XVS iSCSI SAN arrays help organizations increase the efficiency of data processing operations.

VDI offers one example. With potentially hundreds or thousands of desktop users booting from the same file, a VDI implementation presents significant challenges for serving hot data. For example, an organization might have a thousand call-center workers all coming to work at the same time each morning; when using virtual desktops, these employees would all turn on their clients, access the same file, and boot up the same gold master image at the same time.

This scenario could easily lead to a daily “boot storm,” resulting in resource contention, delayed booting, and sluggish performance that can substantially reduce user productivity. EqualLogic PS6000XVS and EqualLogic PS6010XVS arrays use the linked-clone capability in VMware View Manager with View Composer to allow multiple desktop images to work from the same gold template image, reducing the need for spinning up new whole desktops and avoiding this situation.

Understanding how Dell EqualLogic arrays enable efficient cloning

Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS iSCSI SAN arrays use a combination of intelligent data placement and SSD acceleration to automatically deliver performance where and when it is needed. To use the VDI boot-up example, the data optimization process includes storing the gold master image on the top-tier SSDs, providing low-latency data access and accelerating the cloning of the image as it is booted up using the linked-clone capability in VMware View Composer.

The gold master image can be cloned rapidly to start virtual desktops while minimizing the use of disk space. When users are ready to shut the desktops down, each user’s data changes can be saved and all of the clones deleted, so that the organization is still only storing one gold master copy at the end of the day. Infrequently accessed user and application data can be moved to the SAS portion of the array for cost-effective data storage.

The linked-clone capability in VMware View Manager with View Composer enables virtual desktop administrators to clone and deploy multiple desktops from a single centralized VM called a master VM (see Figure 1). The clones do not...
have any link to the master VM, which can even be deleted without affecting the clones. The first time a desktop clone is created, a uniquely identified copy of the master VM—called a replica—is also created. Desktop clones are anchored directly to the replica, and changes to the master VM do not affect the anchored clones. Because the clones in this environment are connected to a common source, View Composer enables the centralized management of desktops while maintaining a seamless user experience.

**Creating an end-to-end virtual desktop platform**

Together, Dell and VMware offer an end-to-end virtual desktop platform using Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS iSCSI SAN arrays, Dell PowerEdge™ servers, and Dell PowerConnect™ switches along with VMware View and vSphere—an approach that enables organizations to standardize on a common platform and a tested, scalable architecture. The Dell Virtual Remote Desktop (VRD) architecture is designed to provide a cost-effective, automated solution for managing client platforms. Using Dell VRD, organizations can take advantage of existing investments in VMware virtualization and extend powerful cloud delivery features to the desktop infrastructure.²

**Increasing the efficiency of data processing operations**

By helping increase the efficiency of data processing operations, including application access to high-demand data, Dell EqualLogic PS6000XVS and EqualLogic PS6010XVS iSCSI SAN arrays can support growing data requirements without a corresponding increase in cost and complexity. And by incorporating intelligent data tiering, automated management, and other features, these arrays provide a high-performance, cost-effective way to meet the needs of today’s critical multitiered workloads.

---

² For more information on the Dell VRD solution, visit dell.com/vrs.
How desktop virtualization enhances end-user productivity

By Todd Mitchell and Doug Coombs

By emphasizing customized, secure workspaces for end users, Symantec™ Endpoint Virtualization Suite helps to maximize productivity while simplifying management and security for IT administrators.

As traditional lines between virtualization, management, and security continue to blur, desktop virtualization is emerging as a compelling option for many organizations. Interestingly, leaders in this field commonly discuss management and security benefits more than they do the underlying abstraction technologies they implement. Therefore, when evaluating desktop virtualization options, it’s a best practice to keep in mind that vendors take vastly different architectural approaches to solving similar problems. Architectural differences emphasize value at different points in the overall solution stack, and can dramatically limit the degree to which those management and security benefits are realized in the real world.

Because end users are key to creating business value, Symantec approaches the virtual desktop with an exclusive focus on end-user productivity. By focusing on the workspace rather than on the hypervisor, and providing each user with a secure shell customized to meet individual needs, Symantec Endpoint Virtualization Suite (SEV) helps to maximize end-user productivity while offering IT administrators simplified, flexible control over the environment.

Delivering robust workspaces to end users

Rather than delivering a hypervisor or an OS, SEV layers together a dynamic user interface based on combinations of local, streamed, and virtualized applications on top of the organization’s existing OS distribution method—regardless of the underlying compute environment, connectivity, and location. The result offers consistently available, highly productive workspaces across a wide variety of infrastructures, including VMware® and Citrix® platforms as well as traditional thick clients (see Figure 1). Furthermore, SEV uses a single management framework to both deliver dynamic desktops and enable proactive license compliance.

Symantec’s heterogeneous cross-platform, cross-model approach extends the many benefits of desktop virtualization across as much of the environment as possible, and turns the challenge of proprietary system lock-in into an opportunity for optimization and standardization. This approach offers simplified, centralized management as well as the freedom to move users across a variety of compute models, hypervisors, and vendors as needs and budgets evolve.

In addition to this hypervisor-agnostic approach for simplified management across both virtual and thick clients, SEV offers many additional advantages:

• Integrated, real-time license management: SEV is designed to provision applications to users or devices in real time. Because software is not moved to the system before it is used, a license is provisioned only after the software is actually launched, helping prevent the
purchase of unneeded software. For applications that allow license reclamation, SEV enables administrators to set rules for harvesting unused licenses and assigning them to other users. Simply using this single feature across a few high-priced applications can provide a compelling return on investment.

- **Fast, heterogeneous application packaging:** Symantec application packages are portable between 32-bit Microsoft® Windows® XP, 32- and 64-bit Windows Vista®, and 32- and 64-bit Windows 7 environments—enabling administrators to truly “package once, run anywhere” in both client- and server-based computing environments.

- **Enterprise cloud ready:** Symantec’s lightweight architecture helps increase performance for applications that require streaming across low-bandwidth lines.

- **Application visibility:** The highly proprietary nature of some application virtualization platforms means that those platforms are unlikely to be supported by existing management and security tools—often requiring the purchase of replacement tools from the desktop virtualization vendor. Symantec virtualization technologies are designed not to abstract applications from the OS so much that they become lost to management and security tools. The added application visibility provided by SEV benefits users as well, by allowing virtualized applications to continue behaving as expected: functions such as copy and paste and file associations remain in place without additional up-front packaging work.

- **Optional secure shell:** Symantec dynamic workspaces can present either the entire Windows shell or a locked-down, customized shell showing only specific interface elements or applications.

- **Follow-me printing:** As users move between systems, they can automatically print to a local printer.

- **Fast login times:** Symantec software can help dramatically increase user productivity in challenging multiuser environments such as hospitals.

- **Remote application reset without reinstallation:** Some products require that broken applications be uninstalled and reinstalled, sometimes forcing an IT engineer to visit the endpoint. SEV can quickly, easily, and remotely reset applications to a known good state.

- **Mix-and-match installation:** Unlike some solutions, SEV does not require installing all features and components at once—IT administrators can implement only the parts they need. Administrators can choose to stream applications, virtualize applications, or both.

### Maximizing productivity while simplifying management

Desktop virtualization promises numerous benefits, but can also add complexity. SEV allows IT administrators to provide end users with optimized performance while simplifying management and security functions. Whether by enhancing end-user productivity through increased mobility, supporting system security through compatibility with existing applications, or avoiding unnecessary costs through automation, SEV can help both end users and IT administrators make efficient use of available computing resources, enhancing productivity in both spheres.

Todd Mitchell is a technical director in the Global Strategic Alliances organization at Symantec.

Doug Coombs is senior director of product management for endpoint virtualization at Symantec.

### Learn more

- **Symantec Endpoint Virtualization Suite:** symantec.com/business/endpoint-virtualization-suite

- **Dell and Symantec:** dell.com/symantec

symantec.com/dell
Much has been said about the role of cloud computing in the future of IT. Public, private, hybrid, and community clouds merge together into a utopian future of seamless, unending capacity and unparalleled customer service. Although such a goal helps focus activity, IT leaders today recognize that this end is easier described than built. Still, in the short term, there are real and tangible cost and flexibility benefits that can be reached with cloud computing.

Defining the cloud
A brief definition helps frame the challenge: a cloud is a pool of resources from which users can request a service to be automatically and rapidly provisioned for their needs. The abstraction layer of cloud management obscures the location, hardware, and sometimes even size of that resource from end users, providing the service without the burden of managing systems. Meanwhile, on the back end, a cloud should be intelligent enough to optimize the use of the underlying hardware for cost savings, flexible enough to reallocate resources to meet service-level agreements, and (in some cases) elastic enough to seek resources from third-party clouds when needed.

That’s a lot to ask from an IT environment that, until very recently, sat in one spot and ran a single OS and workload day in and day out. Of course, there are a whole range of IT components that come into play with cloud computing.

Dell offers different solutions that facilitate the data center transformation and help IT organizations build optimized data centers and cloud computing environments. For mainstream customers, Dell offers the Virtual Integrated System, an architecture that enables rapid resource deployment and on-demand delivery and management of services. And for large enterprise customers with more demanding IT challenges, Dell has partnered with BMC to provide dynamic cloud management solutions using BMC Cloud Lifecycle Management deployed on Dell PowerEdge servers, Dell EqualLogic storage, and Dell PowerConnect switches.

A discussion of the cloud necessarily begins with the servers: without scalable processing power, there is no cloud. Dell PowerEdge servers provide a scalable, manageable, and flexible foundation to the cloud architecture.

Successful liftoff: Achieving cloud computing in the enterprise

By Lilac Schoenbeck

Deploying BMC® Cloud Lifecycle Management on a foundation of Dell™ servers, storage, and switches can help organizations create dynamic cloud computing environments designed for flexible, on-demand service provisioning and simplified management.
The servers must in turn be augmented by storage, because the data and virtual machines in the cloud must be stored somewhere. Storage is often an afterthought of the cloud architecture, which can be dangerous given that the portability of the workload is often strongly tied to the portability of the data. Provisioning a cloud service requires provisioning storage alongside it, and ensuring that this storage is as well managed as the services it supports. The simplified storage management and seamless expansion features of Dell EqualLogic PS Series Internet SCSI (iSCSI) storage area network (SAN) arrays enable scalable performance and reliability as the cloud grows.

Networks are the connective tissue of a cloud. Often a bottleneck, bandwidth to the cloud and between elements in the cloud must be allocated and prioritized so that it doesn’t become a constraint on the flexibility and elasticity of the environment. Allocated network resources are often also the location of security measures, so the proper translation of isolation requirements into the cloud architecture is critical to helping ensure that security is maintained or enhanced as workloads move to the cloud. Dell PowerConnect managed switches provide a high-performance and secure foundation for networking the components in the cloud infrastructure. On top of that foundation, BMC BladeLogic® Network Automation enables dynamic configuration change to meet the changing needs of the cloud.

Once the physical components have come together, additional components layer on top: hypervisors, operating systems for each cloud service, and the stack of middleware and applications that comprise the service most tangible to the customer or internal group. For users of the service, the cloud need only display the highest layers of the stack. For IT departments, however, the full complement of pieces must come together to deliver the value of cloud efficiently and economically.

### Controlling the cloud life cycle

Cited for its business service management leadership,1 BMC Software provides a comprehensive and unified platform designed to simultaneously optimize IT costs, demonstrate transparency, increase business value, control risk, and ensure quality of service. BMC brings together the benefits of traditional IT management—including operational excellence, automation, and service delivery models—and merges them with the dynamic potential of cloud architectures.

BMC Cloud Lifecycle Management knits together the various cloud component resources and provides the foundation for a strong, flexible, and valuable cloud infrastructure that supports IT operations and delivers exceptional service quality (see Figure 1). It provides an operational model for the life cycle of private cloud resources and the utilization of public clouds in a hybrid model. Each resource in the environment goes through a life cycle that, when defined and appropriately automated, provides a seamless and predictable model for both IT departments and the organization as a whole.

---

Virtualization

The platform comprises six key functions: a self-service portal, a service catalog, flexible provisioning, closed-loop compliance, decommissioning, and hybrid cloud operations.

Self-service portal
The most visible user-facing part of the cloud computing environment is the self-service portal (see Figure 2). Through the intuitive Web browser–based interface of BMC Cloud Lifecycle Management, end users can manage the services they have requested from the cloud, including turning them on or off and requesting additional time or resources. Built on the BMC Remedy® Action Request System™ platform, the self-service portal is designed to be inherently multi-tenant, scalable, and secure.

From this portal, users can also request new services through a simple wizard that exposes specific options that are available to that user based on his or her role in the organization. Options range from different resource sizes, service tiers, and operating systems through application stacks and higher-level services, such as compliance and monitoring.

The portal provides an approachable front end to the cloud environment, customized for both the functionality and the appearance of the organization—helping dramatically simplify the end user’s interaction with the cloud. As users become increasingly sophisticated (and service offerings become more complex), the self-service portal can continue to address the needs of research and development, software development, application deployment, and even internal business customers.

Service catalog
Behind the self-service portal lies a service catalog, which acts as a listing of the services and options available to users of the cloud. Ranging from resource profiles to operating systems to full listings of available applications, this catalog controls what appears to each user in the self-service portal. Behind the scenes, the service catalog also captures the intelligence and processes to be followed to implement the operating systems and applications in an automated fashion.

The service catalog is a major source of flexibility and control in the cloud environment. The many combinations available from the service catalog represent a diverse and vast set of configurations to help meet a user’s specific needs. But the constraints, role-based access, and policies reflected in the catalog enable the cloud administrators to maintain tight control over the cloud environment and the services deployed.

Based on the BMC Atrium® configuration management database (CMDB), the service catalog not only offers new service instances that users can select from the portal; it also represents the authoritative record of the functional components that make up that service, from servers and storage to OS and application binaries and licenses to the IT resources needed to maintain the service in production. For example, as IT staff install new servers and storage and publish those resources to the catalog, they are automatically factored into the model of capabilities that may be made available to users.

Flexible provisioning
To help maximize the flexibility of the service stacks for users, BMC Cloud Lifecycle Management supports a versatile underlying provisioning capability. Traditional virtualization provisioning is image based, requiring IT staff to either restrictively standardize on a very small set of images or, alternatively, manage a library of hundreds of unique images. The BMC Cloud Lifecycle Management approach is one of controlled customization, delivering...
flexibility for end users within the constraints designed by IT departments.

Beginning with the physical resources and the OS and climbing up the stack through middleware and applications, the provisioning capability can even layer compliance rules and monitoring tools into each service delivered. The physical foundations—Dell PowerEdge servers—can be provisioned rapidly and securely using BMC BladeLogic Server Automation integration with the Dell Lifecycle Controller. In cloud environments, this integration enables the newly provisioned servers to be inventoried and accounted for in the service catalog before the server is even powered up. Upcoming integration with Dell Advanced Infrastructure Manager (AIM) is expected to provide a unified, logical abstraction of the disparate components in the cloud infrastructure, so they can be organized into flexible resource pools to be dynamically allocated, and re-allocated, to meet the desired availability and capacity metrics of the services offered by the cloud. These resource pools represent the core building blocks of the cloud.

BMC BladeLogic Server Automation manages change in the cloud. As new capacity is requested, BMC BladeLogic Server Automation works with Dell AIM to draw from the resource pools and to instantiate virtual machines, provision applications, and help ensure that the appropriate security, compliance, and governance constraints are enforced on an ongoing basis within these virtual machines. Backed by the robust service catalog, automation capability, and role-based access controls, this provisioning approach helps give users precisely the stack they require while maintaining the tight controls necessary to manage a complex IT environment.

Closed-loop compliance
Clouds are not islands in the data center. Rather, a cloud should be a component of a broad array of infrastructure, from the physical to the virtual and even to the public cloud. It stands to reason, then, that clouds should be managed through the same rigorous approaches that have grown from years of investment and experience in IT management. The CMDB should track cloud services just as it tracks other items. And perhaps most important, change management and compliance should be applied just as thoroughly in the cloud as on other systems.

As dynamic as the cloud environment is, change management can be challenging for IT administrators. Inventories and lists are difficult to maintain in a world of shifting workloads and newly provisioned services. Closed-loop compliance—for both configuration and regulatory reasons—helps ensure that a change is identified, a remediation is enacted, and the result is confirmed. This automation is accomplished through BMC BladeLogic Server Automation Suite, which integrates with the Dell Lifecycle Controller in PowerEdge servers.

Decommissioning
Cloud services are designed to be transient. Easy to request and provision, they can be instantiated for hours or days and then retired, freeing the resources for the next user. The retirement of resources is a critical part of that cycle.

BMC Cloud Lifecycle Management automates this step on a calendar and helps ensure that cloud services aren’t simply neglected in the environment, taking up costly resources and delivering no value. Instead, on a schedule, cloud users are prompted to decommission or extend their services, helping ensure that the life cycle continues seamlessly.

Hybrid cloud operations
One of the primary values of the cloud architecture is its elasticity and scalability, even beyond the organization’s data center. Public cloud service providers are proliferating, offering an array of options for enterprises looking to extend the scale of their IT operations—whether temporarily or permanently—with external resources. Critical to using those resources, however, is a management model that can integrate the services seamlessly into the organization’s environment.

BMC Cloud Lifecycle Management enables IT departments to take advantage of public cloud resources, like those of Amazon’s Elastic Compute Cloud (EC2) service, from within the same self-service portal as the private cloud resources. Regardless of whether the ultimate destination of their cloud service is made clear to end users, or whether provisioning decisions are automated on the back end, this capability enables great flexibility for enterprises seeking to efficiently meet demand.

Building robust, flexible environments
With comprehensive life cycle automation and customizable components, BMC Cloud Lifecycle Management enables IT organizations to build cloud environments that are robust and flexible. Leveraging underlying resources from Dell PowerEdge servers, Dell EqualLogic iSCSI SAN arrays, and Dell PowerConnect switches, an enterprise cloud can help to significantly lower administrative burdens, reduce costs, and ultimately deliver the greatest value to the business: excellent customer satisfaction.

Lilac Schoenbeck is senior manager of product marketing for cloud computing at BMC Software.

Learn more
Dell cloud computing: dell.com/cloud
BMC cloud computing: bmc.com/cloud
How end-to-end services can transform Oracle environments

By Tim Daigle and Thomas Kopec

The Dell Services Oracle Practice provides end-to-end services to organizations running Oracle® software—including applications, middleware, and database platforms—to help drive cost and complexity out of the IT infrastructure.

Dell’s acquisition of Perot Systems in 2009 significantly expanded the Dell Services portfolio. Perot Systems was a pioneer in the field and a world-class provider of applications, technology, infrastructure, and consulting services—and the addition of its capabilities has enabled Dell Services to expand and enhance the services it can provide for businesses and other organizations.

A key component of this broadened approach is Oracle-related services. Perot Systems had a consulting practice focusing on Oracle applications in place since 1995, while Dell has built up a range of services based on running Oracle middleware and database software on Dell™ servers and storage. Bringing these capabilities together, Dell has created the Dell Services Oracle Practice to provide end-to-end services for a comprehensive range of Oracle technologies.

The Dell Services Oracle Practice is charged with supporting and extending the ongoing efforts of both Dell and Oracle to take cost and complexity out of the IT infrastructure. Many companies spend a majority of their IT budgets simply on maintaining the status quo—just keeping the lights on, from an IT perspective. Dell’s goal is to help organizations drive that number down to under 50 percent, so that they can instead focus on new and strategic initiatives. Spanning strategy, design, implementation, maintenance, and outsourcing, the Dell Services Oracle Practice opens up a wide range of options to help organizations meet these goals—enabling them to simplify their operations, reduce costs, and get the most out of their Oracle platforms and applications.
Providing comprehensive services

The Dell Services Oracle Practice includes some 1,100 professionals and a network of Oracle-specific centers in Brazil, China, India, Mexico, and the United States. Dell is a Specialized Oracle Platinum Partner, the highest level in Oracle’s partner programs. And Dell Services brings extensive expertise in Oracle applications, middleware, and databases, supported by a cost-effective global delivery model.

The Dell Services Oracle Practice works with a wide range of Oracle technologies. It offers services focusing on applications, including Oracle E-Business Suite, PeopleSoft®, JD Edwards®, Hyperion, Oracle Business Intelligence Enterprise Edition, Oracle Communications Billing and Revenue Management, and Siebel software. The practice also works with Oracle Fusion middleware and service-oriented architecture software, as well as Oracle’s industry-specific solutions for manufacturing, travel and transportation, consumer packaged goods, life science and pharmaceuticals, education, health care, and government.

To help organizations get the most out of these technologies, the Dell Services Oracle Practice provides consulting that focuses on identifying opportunities for transformation or improvement through customization, modernization, and maintenance. And to help take them advantage of those opportunities, the practice provides development, customization, implementation, integration, testing, and maintenance services.

Meanwhile, Dell Services also helps organizations simplify data center operations with assessment, design, and implementation services that focus on Oracle Database, including Real Application Clusters, in a standards-based x86 environment. These services—designed to enhance data availability while lowering total cost of ownership—are based on best practices developed through rigorous joint engineering between Dell and Oracle. Organizations can also offload database administration and get customized support through Dell Services. (For additional examples, see the “Accelerating return on investment” sidebar in this article.)

Addressing key challenges

In addition to broad Oracle-specific capabilities, the Dell Services Oracle Practice can help organizations meet a range of specific challenges:

- **Business transformation**: Competition in today’s global economy can be brutal. Dell Services uses best practices and organizational change management in conjunction with Oracle enterprise resource planning (ERP) and supply chain management (SCM) software to help transform businesses as they expand into new markets and products.

- **Application management**: Using a service-level agreement (SLA)–based delivery model, Dell Services focuses on delivering both cost-effective, reliable service and ongoing quality and productivity enhancements. Delivery is based on IT infrastructure reducing IT complexity can pay off in increased productivity and lowered costs. The expanded Dell Services portfolio includes a variety of targeted services designed to standardize, simplify, and automate ongoing operations.

| Platform migration: Dell Services can help organizations assess and carry out migrations from proprietary systems to Linux® OS–based Oracle and Dell platforms, including moving applications and database systems to the new platforms and implementing Oracle Real Application Clusters—enabling organizations to take advantage of cost-effective, standards-based infrastructures. |
| Preconfigured software: Options include preconfigured analytics for the health care, manufacturing, consumer, and packaged goods industries, as well as supply chain and human resources applications. Preconfigured industry solutions are also available for milled products, education, and state and local government. |
| Accelerators: Dell Services can help speed Oracle E-Business Suite implementations with a methodology that uses Oracle Business Accelerators to quickly provide scalable, industry-specific functionality. These accelerators are available in prepackaged, fixed-price, and fixed-scope application bundles. |
| Cloud services: Services can include cloud assessments, on-demand Oracle cloud development environments for upgrades and add-ons, and a JumpStart Cloud service that enables accelerated enterprise resource planning (ERP) implementations. |

Accelerating return on investment

Reducing IT complexity can pay off in increased productivity and lowered costs. The expanded Dell Services portfolio includes a variety of targeted services designed to standardize, simplify, and automate ongoing operations.
Library (ITIL), Capability Maturity Model Integration (CMMI), and Application Implementation Methodology (AIM) techniques along with a mix of onshore, nearshore, and offshore resources customized to help meet each organization’s specific needs. Dell application management services include functional and technical support, support for ancillary systems, core database administration services, infrastructure hosting, network services, and help-desk support.

- **Business intelligence:** Dell helps organizations draw on information from multiple sources to provide management with comprehensive reporting on business performance, along with deep-dive analytics and dashboards to enhance decision making. Services include the Dell Services Optimized Business Intelligence program, an approach that integrates key financial and operational analytics throughout the organization with a focus on using best practices to standardize processes and drive profitability. Dell also provides data models for key industries, and an optimization program designed to jump-start business intelligence deployments. As a starting point, a complimentary Discovery Session involves key stakeholders and Dell professionals to help identify the potential value of a given business intelligence initiative.

- **ERP evaluation and enhancement:** Many factors can affect an enterprise system’s ability to meet the needs of the organization: applications may have been implemented incorrectly, there may have been inadequate attention paid to change management and training during implementation, certain features and functions may be underutilized, and requirements and the organization itself can change over time. The ERP Health Check service gauges how effectively an organization is using its current Oracle applications, and then helps it realize the full value of those applications. The service addresses problems by evaluating the existing deployment, mapping requirements to the application configuration, identifying performance gaps, and providing a road map for filling those gaps.

- **ERP upgrades:** The ERP Upgrade service leverages Dell’s Oracle applications knowledge, its cost-effective tools, templates, and methodologies; and its onshore and offshore resources to help deliver predictable benefits and return-on-investment metrics in ERP upgrade efforts. This service helps organizations simplify current software approaches; reduce or eliminate customization; streamline corporate portal services such as financial, payroll, human resources, and customer relationship applications; and set the stage for significant operational savings.

- **Governance, risk, and compliance (GRC):** Organizations must manage growing amounts of data for financial reporting, data security, records retention, risk reporting, and more. The Dell Services Oracle Practice helps identify and involve key leaders and stakeholders throughout the organization, and brings them together to develop an understanding of what is needed to build a case, ascertain return on investment, and develop a GRC program plan based on Oracle solutions.

**Reducing IT cost and complexity**

The creation of the Dell Services Oracle Practice builds on the long and successful relationship between Dell and Oracle—a collaboration that can offer significant benefits to organizations running Oracle software on Dell hardware. Ranging from high-end strategy work and global systems design to implementations and upgrades, multiyear support, and application outsourcing, the services offered by this practice can help organizations gain the knowledge and tools to help simplify the data center, increase productivity, and keep IT aligned with strategic goals. 

*Tim Daigle* is the global Oracle Practice leader at Dell.

*Thomas Kopec* is a senior technical account manager with Oracle.

**Learn more**

[Dell Services: dell.com/services](dell.com/services)

[Dell and Oracle: dell.com/oracle oracledell.com/dell](dell.com/oracle oracledell.com/dell)
Announcing APC’s new, interactive energy-saving Smart-UPS.

Intuitive alphanumeric display:
Get detailed UPS and power quality information at a glance – including status, about, and diagnostic log menus in your choice of up to five languages.

Energy savings:
A patent-pending “green” mode achieves online efficiencies approaching 99 percent, reducing heat loss and utility costs.

Configurable interface:
Set up and control key UPS parameters and functions using the intuitive navigation keys. On rack/tower convertible models, the display rotates 90 degrees for easy viewing.

If you want Legendary Reliability inside, it had better say APC outside.
What do you get when you combine 25 years of Legendary Reliability with the latest in UPS technology? Introducing the new APC Smart-UPS range of interactive, intuitive, and energy-saving UPSs, designed to protect critical server and network equipment from power threats and downtime.

Thanks to millions of dollars in research, APC can proudly claim that only the new Smart-UPS features the unique battery life expectancy predictor, telling you the exact month and year for battery replacement. Precision temperature-compensated charging extends battery life; unique power meter function monitors energy usage; and a patent-pending “green” mode boosts online efficiencies up to 99 percent, saving on utility costs. Plus, the interactive LCD provides detailed status, configuration, and diagnostic information previously available only via software.

When dollars count and performance is critical, insist on the more intelligent, more intuitive APC Smart-UPS. Now more than ever, the name on the outside guarantees reliability on the inside: APC Smart-UPS.

APC Legendary Reliability
Only APC offers the most technologically advanced, user-friendly features, and the guaranteed reliability you need to protect your critical data and equipment. Look for APC on the outside to ensure Legendary Reliability on the inside.

Contact your Dell Representative today and ask for APC Smart-UPS

Visit www.apc.com/promo Key Code t441w
Call 888-289-APCC x0000 • Fax 401-788-2797

©2010 Schneider Electric Industries SAS, All Rights Reserved. Schneider Electric, APC, Smart-UPS, and Legendary Reliability are owned by Schneider Electric, or its affiliated companies in the United States and other countries. e-mail: esupport@apc.com • 132 Fairgrounds Road, West Kingston, RI 02892 USA • 998-2158
Networking

Enhancing Ethernet network controllers for server virtualization

By Dhiraj Sehgal, Abhijit Aswath, and Srinivas Thodati

Broadcom and Dell are working with a range of virtualization providers to enhance Broadcom® network controllers in Dell™ PowerEdge™ servers to help reduce the bottlenecks and overhead that can impair performance in virtualized environments.

In enterprise IT environments, virtualization offers numerous advantages—enabling organizations to consolidate and share computing resources, increase control and efficiency, and operate their data centers cost-effectively. Getting the most out of a virtualized environment, however, requires more than simply deploying virtual machines (VMs). An effective networking infrastructure is essential.

Like other hardware resources in Dell systems, Broadcom network adapters are virtualized to the VM. Virtualization platforms use a hypervisor-based architecture—also known as a VM monitor (VMM) architecture—that hides the physical characteristics of the computing platform and allows unmodified VMs to run concurrently on host platforms.

This design means that virtualization comes at the cost of reduced performance. Today’s virtualization architectures include VMs with device drivers, I/O stack, and applications running on top of a virtualization layer that includes device emulation, I/O stacks, and physical device drivers that manage the Ethernet network controllers. This virtualization layer adds overhead and degrades system performance, driving up processor utilization and reducing available bandwidth.

Broadcom, a networking leader in Gigabit Ethernet (GbE) and 10 Gigabit Ethernet (10GbE) network controllers, has been working closely with a variety of virtualization vendors—including VMware, Microsoft, Citrix, and Dell—to address these problems. Broadcom controllers are included across a range of Dell PowerEdge servers as LAN on Motherboards (LOMs), mezzanine cards, and standard network interface cards (NICs), and are used as part of Dell’s overall virtualization solutions.

Broadcom is currently working in a two-phase effort to enhance its controllers for use in virtualized environments, helping organizations using Dell systems to maximize the benefits of their virtualization initiatives.

**Phase 1: Removing bottlenecks and increasing performance**

In the first phase of enhancements, Broadcom worked to remove virtualization bottlenecks and increase system performance by providing a number of additional features. For example, Broadcom Ethernet network controllers now support stateless offloads such as TCP checksum offload, which enables network adapters to compute TCP checksums on transmit and receive, and TCP large send offload, which allows the TCP layer to build a TCP message up to 64 KB long and send it in one call down the stack through IP and the Ethernet device driver, saving the host processor from having to compute the checksum in a virtualized environment.

In addition, Broadcom’s jumbo frame support in virtualized environments is designed to save processor utilization by reducing interruptions, and to increase throughput by allowing the system to concentrate on the data in the frames instead of the frames around the data. However, because of the
The single-threaded nature of the hypervisor in processing I/O and the duplicate I/O copies in the virtualization layer, performance is still limited with this approach. Broadcom also supports the VMware® NetQueue and Microsoft® Hyper-V™ VM queue (VMQ) features, helping remove such single-queue bottlenecks and avoiding the need for stateful offloads such as TCP offload. And the Internet SCSI (iSCSI) host bus adapter (HBA) mode in Broadcom controllers, supported as part of Dell virtualization solutions, can provide excellent performance in virtualized environments.

**Use of multiple queues**

The trend toward increased processor core density is leading to the use of an increased number of VMs, which requires additional processor cycles to route packets to the VMs. Using hardware queues provided by the network controller, virtualization vendors have avoided the single-thread limitation of a traditional OS and optimized the hypervisor for multiple hardware threads.

In both the VMware and Microsoft Hyper-V platforms, packets must traverse the hypervisor or parent partition because a direct path is not available between the controller and the VMs. On egress, packets are first copied from the originating VM for processing in the virtual switch. The destination Media Access Control (MAC) address and virtual LAN (VLAN) ID are looked up to determine the route, and the packet is then copied to the receive queue of the other VMs and/or submitted to the network driver for transmission. On ingress, packets are indicated to the switch, which uses the destination MAC address and VLAN ID to determine which VM or group of VMs the packets can be copied to.

Route lookup, data copy, and filtering tasks represent additional processor load and latency absent in the non-virtualized environment. The associated overhead can significantly affect networking performance, especially at 10 Gbps; this problem is addressed by offloading these tasks into a network adapter, where the transport queue manager can transmit packets from multiple queues and steer the receive packets into multiple queues. The VMware NetQueue and Microsoft Hyper-V VMQ features enable Broadcom controllers to take on these tasks, thereby helping meet the demands of bandwidth-intensive applications that require high levels of performance and networking throughput in virtualized environments.

**Storage offload**

Networked storage is crucial in virtualized environments, enabling the smooth migration and failover of a VM from one physical server to another. iSCSI has emerged as a high-performance, accessible networked storage technology popular in many virtualization deployments. Broadcom NetXtreme II® iSCSI HBA functionality, with support for VMware, Microsoft Hyper-V, and Citrix® Xen® virtualization, provides the converged functionality needed in virtualized environments by offering on-chip processing to help free up processor resources and increase bandwidth and performance, as shown in Figure 1. Broadcom GbE and 10GbE iSCSI HBA functionality as shown in this figure is enabled by default in the VMware vSphere™ 4.1 platform on Dell PowerEdge servers.

Broadcom iSCSI HBA functionality enables on-chip processing of the iSCSI protocol (and of the TCP and IP protocols), helping free up host processor resources at 10 Gbps line rates over a single Ethernet port. This functionality provides extended performance benefits that help meet the demands of bandwidth-intensive applications requiring high-performance block storage I/O for the hypervisor, servicing all instances of the VM.

**iSCSI boot**

iSCSI boot allows a server to boot an OS over a storage area network (SAN), avoiding the need for local disk storage—a primary source of computer system failures. In addition to enhancing system reliability, the use of diskless servers helps simplify the IT administrator’s workload by centralizing the creation, distribution, and maintenance of server images; reducing the overall need for storage capacity through increased disk capacity utilization; and adding increased data redundancy through the use of data mirroring and replication.

As the use of SANs continues to grow in virtualized environments, and as administrators continue to recognize the advantages of moving local storage from individual servers to centrally managed storage arrays, network
boot options such as iSCSI boot are poised to become an increasingly common feature within the data center and throughout the enterprise. Broadcom, VMware, Microsoft, and Citrix are working to create simple yet richly featured iSCSI boot options that use iSCSI to replace local storage in virtualized environments. Broadcom GbE and 10GbE iSCSI boot functionality is enabled by default in VMware vSphere 4.1 on Dell PowerEdge servers, and Broadcom iSCSI HBA mode and iSCSI boot for 10GbE controllers in hypervisors are both supported on Dell platforms.1

Phase 2: Integrating SR-IOV enhancements

The second phase of Broadcom’s enhanced virtualization effort, now under way, focuses on Single Root I/O Virtualization (SR-IOV); these enhancements are expected to be available in Dell systems using Broadcom NetXtreme II 57712 controllers. SR-IOV-capable Ethernet network controllers are designed to enhance I/O throughput and reduce processor utilization while increasing scalability and devices’ sharing capabilities. SR-IOV allows the direct I/O assignment of an Ethernet network controller to multiple VMs, helping maximize the network adapter’s full bandwidth potential.

The PCI Express (PCIe) SR-IOV specification for PCI I/O virtualization and sharing technology is the basis for the SR-IOV implementation in SR-IOV-capable Broadcom controllers. The specification defines an extension to the PCIe specification that enables multiple system images or VMs to share PCIe hardware resources (see Figure 2). The Broadcom SR-IOV device presents a physical function (PF) having multiple virtual functions (VFs). A VF is a lightweight PCIe function, and resources associated with the main data movement of the function are available to the VM. The VF can be serially shared between different VMs—assigned to one VM, and then reset and assigned to another. In addition, a VF can be transformed from a VF into a PF.

Comprehensive support for PCIe SR-IOV involves both enhancing existing capabilities and adding new capabilities to the platform and OS. Network controller device drivers supporting SR-IOV also must be re-architected to support additional communication paths between PFs and VFs.

VMware VMDirectPath

High throughput and low latency are especially important in a distributed system, wherein the nodes’ I/O latencies affect the performance of the cluster and the overall application. Low latency is necessary to preserve data coherency in large database clusters implementing scalable SR-IOV network adapters.

Using the VMware VMDirectPath network plug-in architecture and an SR-IOV-capable Broadcom device, a VF can be directly assigned to a VM—yielding near-native performance, avoiding additional I/O copying in the hypervisor, and supporting a comprehensive array of virtualization features, including VMware vMotion™ technology and Microsoft Hyper-V live migration (see Figure 3). Direct assignment of PCI devices to VMs is necessary for I/O appliances and high-performance VMs.

With dynamic VMDirectPath or Uniform Pass-Through version 2 (UPTv2), the device interface is

---

1 For more information on iSCSI functionality in Broadcom adapters for Dell systems, see “A unified networking approach to iSCSI storage with Broadcom controllers,” by Dhiraj Sehgal, Abhijit Aswath, and Srinivas Thodali, in Dell Power Solutions, 2010 Issue 2, dell.com/downloads/global/power/ps2q10-20100411-broadcom.pdf.
split in two, enabling pass-through of performance-critical operations such as TX/RX producer index registers, interrupt mask registers, and emulated infrequent operations in the management driver running in VMware ESX. To implement live migration, the VF is acquiesced and switched to emulation mode from pass-through mode, allowing the minimal device state to be checkpointed or restored. Most of the state lives in the VM memory, and the guest operating systems are unaware of the migration.

Support for dynamic VMDirectPath requires re-architecting the OS platform and network device driver. The VMware platform implements a network plug-in architecture allowing pass-through of performance-critical parts by partitioning the vmxnet driver to include a VM-specific shell and hardware-specific module or network plug-in driver. The VM-specific shell implements the interface to the OS network stack and interacts with the hypervisor for configuration. The hardware-specific network plug-in driver interacts with hardware in the data path and uses the VM shell interface for OS-specific calls. VMware ESX controls the network plug-in used by the shell to load the plug-in into the VM based on the VF and to map the VF into VM address space.

Effective and efficient virtualization

The network is a key component of virtualized environments, and network controllers that are enhanced to meet the demands of virtualization can help maximize performance. Broadcom’s virtualization-focused efforts enable organizations using Dell systems to take advantage of offload technologies and flexible, real-time I/O—enhancements that facilitate effective and efficient virtualization. Broadcom capabilities in SR-IOV and I/O pass-through functionality for Ethernet network controllers with TCP and iSCSI offload can provide near-native performance and reduced latency. Looking ahead, Broadcom plans to continue to support and enable virtualization on Dell server platforms, helping IT organizations to accelerate their adoption of virtualized infrastructures while increasing performance and controlling costs.

Dhiraj Sehgal is a senior product line manager for Ethernet controllers at Broadcom.
Abhijit Aswath is a senior product line manager for Ethernet controller software at Broadcom.
Srinivas Thodati is a senior product marketing manager for PowerEdge M-Series servers at Dell.

Learn more

Broadcom Ethernet controllers: broadcom.com/products/Ethernet-Controllers
Dell PowerEdge servers: dell.com/poweredge
Designing seamless Microsoft Exchange deployments across data centers

By Kong Yang, Jeff Sullivan, and Fred Johnson

In conjunction with key Microsoft® Exchange Server 2010 features, F5® BIG-IP® application delivery controllers can help organizations create high-performance, highly available messaging infrastructures spanning multiple data centers.

Messaging applications have become a critical part of enterprise operations. Microsoft Exchange Server 2010 incorporates multiple features designed to increase availability and enhance management in these environments—helping to maximize uptime while simplifying deployment, administration, and capacity sizing for IT administrators.

Two key changes in Exchange Server 2010 now enable organizations to incorporate F5 BIG-IP application delivery controllers into their Exchange infrastructures to help optimize messaging traffic across multiple data centers. The first change is that end users no longer connect directly to the Exchange Mailbox servers, even when using the Microsoft Office Outlook® e-mail client in native Messaging Application Programming Interface (MAPI) mode rather than through Remote Procedure Call (RPC) over HTTP. Instead, this access is provided by the Client Access servers—an approach that allows organizations to use F5 BIG-IP systems to optimize and load balance end-user traffic.

The second change relates to the Exchange database availability group (DAG) capability, which provides mailbox availability and automated database recovery in the event of failure. Continuous replication and monitoring of group members enables quick detection and recovery of a mailbox database, if an active member fails, DAG brings up the passive database copy on another server and resumes services, helping minimize impact on end users. In Exchange Server 2010, DAG members can now be located at geographically separated sites interconnected by a wide area network (WAN), enabling organizations to use F5 BIG-IP WAN Optimization Module™ (WOM) technology to accelerate and encrypt DAG replication traffic.

F5 BIG-IP systems support a range of Exchange server roles, and can provide a variety of benefits depending on the specific deployment and configuration (see the “Enhancing performance and availability” sidebar in this article). By designing an Exchange infrastructure based on Dell™ and F5 BIG-IP systems, IT administrators can provide reliable e-mail and calendar access for end users while enhancing performance, availability, and management across their data centers.

Availability and failover for Client Access and Edge Transport servers

F5 BIG-IP systems can help organizations simplify and automate the management of Exchange Server 2010 data recovery configurations across multiple sites. F5 BIG-IP Global Traffic Manager™ (GTM) systems provide load balancing and failover across data centers, automatically updating Domain Name System (DNS) information based on application health. Administrators can define policies that take
into account the real-time availability and performance of Exchange Client Access and Edge Transport servers, plan and easily initiate local maintenance outages without disrupting service, and maintain high availability even in the event of a disaster.

Effectively implementing failover between data centers across a WAN may require accelerating and encrypting DAG replication traffic: poor WAN conditions can cause data transfer delays, and regulatory or compliance requirements often dictate the need for encryption. While GTM handles the data center availability and failover through DNS, F5 BIG-IP WAN optimization can accelerate and encrypt the DAG traffic, helping to secure the data and shorten replication times between sites. Because DAG replication can therefore complete in less time than it would otherwise, the passive Mailbox databases are more likely to be up-to-date when activated in the event of a failure of the primary database.

WAN optimization for DAG replication

WAN conditions and remote data transfer performance can vary widely depending on factors such as available network bandwidth, link type and quality, and distance between sites. WANs that have limited bandwidth, high latency, and packet loss can cause delays for DAG replication, and prolonged data transfer times between disaster recovery sites can put business continuity plans at risk.

Out of the box, Exchange Server 2010 provides compression and encryption for DAG partners located on different IP subnets. These features are built-in, cost-efficient, and effective at helping to reduce the amount of network traffic and ensure the privacy of the transfers, but both are resource intensive and take away server processing power from the primary application. In addition, compression alone does not address poor performance associated with problematic WAN conditions. Specialized technologies such as F5 BIG-IP WOM are required to effectively overcome poor WAN replication performance and offload the tasks of compression and encryption from the Mailbox servers.

WOM is designed to accelerate TCP traffic for data center applications and provide the scalability to meet high-bandwidth requirements. In addition to symmetric compression and hardware encryption processing, WOM provides symmetric deduplication, TCP optimizations, tunneling, and a single point of administration. Deduplication, a key acceleration feature, builds a cache on the device at each end of the WAN link, and when a duplicate pattern in the network traffic is found, a small reference to the cache is transmitted instead of the entire pattern—an important way to help reduce the amount of WAN traffic. F5 TCP Express™ technology applies advanced protocol optimizations to the LAN and WAN to help deal with latency and packet loss.

Enhancing performance and availability

F5 BIG-IP systems can offer a variety of advantages in Microsoft Exchange Server 2010 environments—helping administrators create an efficient, high-performance, highly available infrastructure.

- Simplify site-to-site failover and shorten disaster recovery times
- Minimize downtime in the event of a failure
- Accelerate and encrypt database availability group (DAG) traffic over wide area networks (WANs)
- Scale out Client Access and Edge Transport servers
- Support consolidation to help simplify management and save on hardware use, rack space, and power consumption
- Enable server offload using BIG-IP systems to help reduce hardware requirements and increase virtual machine server density
- Combine BIG-IP feature sets on a single platform, helping maximize the value of hardware investments
- Support multiple applications and multi-tenancy on a single BIG-IP appliance
- Protect Outlook Web App (OWA) services and support regulatory and Payment Card Industry Data Security Standard (PCI DSS) compliance
and increase the efficiency and reliability of network communications. Exchange Server 2010 administrators needing to implement DAG replication over WANs can benefit significantly from F5 WAN optimization technologies.

**Scaling and optimization for local Client Access and Edge Transport servers**

Another critical aspect of a scalable, highly available infrastructure is application delivery and load balancing within a local data center. Working together, global and local application delivery technologies can provide end-to-end high availability for applications. Administrators can load balance Client Access servers using Microsoft Windows® Network Load Balancing (NLB) clustering, which provides a cost-effective choice for some configurations. However, administrators should consider using F5 BIG-IP Local Traffic Manager™ (LTM) application delivery controllers for environments that contain eight or more Client Access servers, with servers running more than one Exchange server role, or when Exchange servers are running Microsoft Cluster Service (MSCS)—running NLB and MSCS on the same hardware is not recommended.

Scaling out an Exchange Server 2010 infrastructure requires the use of a hardware load balancer for Client Access and Edge Transport servers. The advanced features and benefits of BIG-IP application delivery controllers extend beyond those of software load balancers to include security, advanced persistence methods, application health check monitors, high availability, Secure Sockets Layer (SSL) acceleration and offload, TCP optimization and offload, and

---

Figure 1. Example Microsoft Exchange Server 2010 architecture based on Dell servers and storage and F5 BIG-IP application delivery controllers.
Web acceleration and offload with caching and compression—all of which enhance the end-user application experience and help reduce the Exchange server loads. F5 BIG-IP LTM and GTM systems are designed to complement each other to support high availability: LTM monitors the Client Access servers within a data center, while GTM monitors the health of the Client Access services and the LTM systems across multiple data centers. Together, they can make Exchange Server 2010 highly available both locally and globally.

The Exchange Outlook Web App (OWA) feature allows end-user access to Exchange messaging through a rich, full-featured interface on major Web browsers. Because OWA is a Web service, it can also provide an attack target, opening critical messaging systems to risk of data loss, compromise, theft, denial of service, and Web scraping, among other things. The F5 BIG-IP Application Security Manager™ (ASM) Web application firewall, which runs on BIG-IP systems alongside LTM and other modules, can help protect Exchange Web services from attack. Subscription-based updates are designed to keep ASM current to help ensure regulatory and Payment Card Industry Data Security Standard (PCI DSS) compliance. ASM also helps simplify audit efforts by producing an executive summary of requirements and recommendations for bringing application environments into compliance.

High-performance, highly available Exchange infrastructure

Combining Dell servers and storage, F5 BIG-IP application delivery controllers, and Microsoft Exchange Server 2010 can help organizations create high-performance, highly available enterprise messaging infrastructures. Figure 1, for example, shows one possible design based on Dell reference architectures for Exchange, illustrating how these components can link two data centers across a WAN while taking advantage of F5 BIG-IP modules to help maximize performance. Dell Services can also work directly with organizations to identify appropriate architectures that can meet the specific needs of their environment while helping simplify deployment and ongoing management (see the "Simplifying Exchange deployment" sidebar in this article). Through this type of design, organizations can create integrated multi-data-center messaging environments while supporting site-to-site failover, simplified disaster recovery, high levels of security, and enhanced performance.

Kong Yang is an evangelist for the Dell TechCenter online community.

Jeff Sullivan is a storage and Linux® OS evangelist for the Dell TechCenter online community.

Fred Johnson is a strategic partner engineer with F5 Networks dedicated to Dell Labs.

Learn more

F5 Networks and Dell: f5.com/dell

Dell and Microsoft Exchange: dell.com/exchange

F5 Networks and the Dell TechCenter on Twitter: twitter.com/f5networks twitter.com/delltechcenter

"Simplifying Exchange deployment" sidebar in this article. Through this type of design, organizations can create integrated multi-data-center messaging environments while supporting site-to-site failover, simplified disaster recovery, high levels of security, and enhanced performance.

Dell consulting services and Exchange reference architectures help ensure that e-mail and calendaring platforms based on Exchange Server 2010 are optimized, flexible, efficient, and secure.

Dell can provide a single point of contact for a comprehensive e-mail and calendaring package based on Exchange Server 2010, including hardware, software, services, and support.

The result is an integrated, end-to-end messaging system designed for maximum productivity, efficiency, security, and scalability.
A smart approach to application intelligence

By Patrick Sweeney and Matthew Dieckman

The SonicWALL® E-Class Network Security Appliance (NSA) Series provides comprehensive, flexible control over Web-based applications and other software—helping organizations to maintain security without sacrificing productivity or performance.

Web-based applications have become increasingly important in enterprise environments, offering the promise of enhanced collaboration, increased productivity, and reduced costs by connecting people and exchanging information in new and efficient ways. Yet many organizations are unaware of the risks that come with these benefits. Social networking and streaming media threaten to drain bandwidth and productivity while competing with mission-critical applications for resources and time. Although software as a service (SaaS) and service-oriented architecture (SOA) enable new ways of conducting business, they can also introduce new threats, just as personal Web-based e-mail, instant messaging (IM), and FTP can create new conduits for leakage of sensitive data.

Many IT departments may be unaware that their current firewalls are incapable of scanning application-layer traffic; even firewalls just two or three years old are typically unable to scan and defend against the full range of threats that exist today. Other organizations resort to restricting employee use of Web applications altogether, abandoning the potential benefits these applications offer. Either way, a next-generation firewall can help administrators to regain control of the application-centric network.

The ubiquity and complexity of Web applications require IT departments to take a smart approach to these challenges. The SonicWALL E-Class Network Security Appliance (NSA) Series can deliver comprehensive application intelligence and control in Dell™ hardware-based environments—enabling organizations to gain the benefits of these applications while still minimizing risk.

Security challenges in a Web app world

In response to a rapidly evolving Web application-based environment, IT departments must control and secure Web 2.0, cloud-based SaaS, and SOA software while at the same time managing usage and blocking potential data leakage.

Today, it is common for employees to download files from Web 2.0 social networking sites such as Facebook; stream rich media from social media sites such as YouTube; transfer information using personal e-mail accounts with Google Gmail, Yahoo! Mail, and other services; and download files using peer-to-peer (P2P) applications such as BitTorrent and Kazaa. Such uses of data networks can rob enterprises of bandwidth, productivity, and confidential data, and could lead to regulatory noncompliance.

The enterprise use of SaaS and SOA is also on the rise, with an increasing number of enterprises considering the use of cloud computing in the near future. Cloud-based applications are often prime targets for continuous, persistent criminal attack from sophisticated profit-driven or politically motivated hackers. In addition, prioritizing bandwidth for mission-critical...
cloud-based applications (such as Microsoft® SharePoint®, Oracle®, SAP®, and Salesforce.com software) is key to ensuring productivity.

The increase in Web-based application traffic has placed a heavy burden on network performance. Social networking traffic alone can consume a significant amount of bandwidth, and streaming music and video traffic (such as video of major sporting events) can overwhelm mission-critical application traffic. And non-work-related applications such as social media and online games can drain worker productivity.

The latest generation of Web applications takes advantage of communication techniques that share common ports, random port entries, and other evasive techniques along with Secure Sockets Layer (SSL) encryption. These techniques allow Web applications to evade network detection and control by traditional firewalls, which are limited to port- and protocol-based inspection.

**Comprehensive application intelligence**

Overcoming these multiple challenges can be daunting for IT administrators. To help address their concerns, SonicWALL has engineered next-generation firewall appliances—such as the E-Class NSA EB500—that enable administrators to establish application identification, control, visualization, bandwidth management, data-leakage prevention, and threat protection (see Figure 1). With multiple layers of protection delivered at Gigabit Ethernet speeds, the NSA EB500 helps identify and block threats without compromising performance.

Application identification, control, and visualization enable policy-based blocking or restriction of specific applications. Organizations may want to restrict access to applications such as bandwidth-intensive streaming audio, video, and P2P programs; restricted file types (such as .exe, .pif, .scr, and .vbs); or unauthorized Web 2.0 sites, Web browsers, or IM clients. For example, P2P applications like BitTorrent can steal bandwidth, and certain downloaded files may contain malware. Often, P2P developers update their applications with versions designed to evade firewall defenses. The SonicWALL Application Intelligence and Control feature set can restrict these dynamically changing P2P applications through automatic updates of the application signatures.

The Application Intelligence and Control capabilities can also secure bandwidth priority for critical applications and help control data leakage. For example, administrators could define
policies to prioritize bandwidth availability by date (for example, prioritizing sales-related applications at the end of each quarter), or to detect, block, or limit the bandwidth available to streaming video and audio sites and file downloads; they could also allow members of a predefined Microsoft Active Directory® group for marketing to have access to Twitter or YouTube for promotional activities while still restricting others’ access. To help control data leakage, administrators can define policies to block unauthorized outbound transmission of sensitive, proprietary, or watermarked data over FTP uploads, as attachments to enterprise Simple Mail Transfer Protocol (SMTP) and Post Office Protocol 3 (POP3) e-mail, and even through personal Web-based e-mail.

Equally significant, SonicWALL anti-malware and content filtering features can help protect against new and evolving channels for emerging threats. For example, a compromised Facebook page can suggest that a “friend” click a link to launch what appears to be a YouTube video—but is actually malware. SonicWALL’s patented Reassembly-Free Deep Packet Inspection™ (RFDPI) engine can detect that the file is malware and prevent it from downloading, thereby helping to protect both end users and the enterprise network.

Seamless integration
Unlike “application-control only” appliances, SonicWALL appliances seamlessly integrate application intelligence with intrusion prevention and advanced firewall defenses, forming a unified and comprehensive network security tool that helps ensure threat protection, regulatory compliance, network performance, employee productivity, and cost-effective management. Key advantages include the following:

• **Regulatory compliance:** Regulations can make Web-based application attacks particularly onerous for financial, health care, and application service providers, as well as for e-commerce businesses. SonicWALL Application Intelligence utilizes RFDPI and a dynamically updated signature database to help protect Web applications, including SSL virtual private network (VPN) portals.

• **Network performance:** Network performance is crucial for maintaining productivity, quality of service, and service-level agreements. SonicWALL Application Intelligence can allocate dedicated throughput levels for designated mission-critical applications, end-user groups, or times of day. SonicWALL appliances with this capability feature connection multiplexing, which enhances the performance of protected Web sites and helps significantly reduce transactional costs.

• **Streamlined management:** Simplified management helps to lower overhead and increase productivity. SonicWALL appliances ease management with a robust, intuitive Web-based management interface, automatic signature updates, flexible policy settings, session management, and comprehensive audit logs. In addition, the SonicWALL Global Management System (GMS) enables centralized management of multiple SonicWALL security appliances across multiple sites.

• **Enhanced security:** SonicWALL appliances help defend against sophisticated, dynamically evolving Web-based threats, including P2P programs, e-mail attachments, and Web 2.0 executable files. SonicWALL Application Intelligence is continually updated, leveraging more than 2,800 unique application signatures. In addition, the SonicWALL Comprehensive Gateway Security Suite (CGSS) offers not only Application Intelligence capabilities, but also the SonicWALL Gateway Anti-Virus, Anti-Spyware, and Intrusion Prevention Service (IPS) features; the SonicWALL Content Filtering Service feature; and more.

Powerful, versatile protection
Web-based applications are now leveraged by many enterprises—but in addition to expanding possibilities for productivity, these applications also introduce specific security and productivity challenges. SonicWALL Application Intelligence extends the protection of SonicWALL network security appliances beyond blocking traditional network threats to the management and control of data and applications that pass through the appliance. Application Intelligence capabilities are included in the NSA E8500 appliance and are available as a part of the CGSS suite, which includes the SonicWALL Gateway Anti-Virus, Anti-Spyware, IPS, and Application Intelligence features on SonicWALL NSA Series, E-Class NSA Series, and TZ 210 appliances. By employing SonicWALL E-Class NSA security appliances such as the NSA E8500 in Dell hardware-based environments, IT departments can focus on ways to control these applications while still empowering end users to make effective use of them—all without compromising performance.

**Patrick Sweeney** is vice president of the product management team at SonicWALL, where he drives the development road map for SonicWALL SSL VPN products and services.

**Matthew Dieckman** is the product manager for Secure Remote Access solutions at SonicWALL, where he oversees its network security, content security, business continuity, and policy and management product lines.

Learn more

**SonicWALL E-Class NSA E8500:**
www.sonicwall.com/8500

**SonicWALL Application Intelligence:**
www.sonicwall.com/applicationintelligence
Expanding the boundaries of GPU computing

Supporting up to 16 PCI Express devices in a flexible, highly efficient design, the Dell™ PowerEdge™ C410x expansion chassis helps organizations take advantage of the next step in high-performance computing architectures: GPU computing.

Flexible power
The Dell PowerEdge C410x provides a high-density chassis that connects 1–8 hosts to 1–16 GPUs and incorporates optimized power, cooling, and systems management features.

- Up to 16.5 TFLOPS of computing throughput
- Hot-pluggable components for simplified serviceability
- Highly efficient design to help minimize energy use and costs

Graphics processing units (GPUs) were originally designed to make the massive calculations required for rendering 3D images to a display. Because of the nature of processing and creating images today, GPUs must have a large number of cores that work in parallel to render models in photo-realistic detail. The growth of the gaming market, both for PCs and for gaming consoles, has driven a rapid pace of technological improvement, while the commodity nature of the gaming market has helped reduce the price of GPUs.

Researchers quickly discovered that GPUs could also be exploited for high-performance computing (HPC) applications to deliver potentially massive increases in performance. They found that in HPC application areas such as life sciences, oil and gas, and finance, GPUs could dramatically increase the computational speed of modeling, simulation, imaging, signal processing, and other applications—with some seeing software running up to 25 times faster than on conventional solutions.

“GPUs fundamentally offer much higher performance in servers,” notes Sumit Gupta, senior manager of Tesla™ products for NVIDIA, the company that invented the GPU and a leader in GPU computing. “And they offer this higher performance with lower overall power usage. This makes the performance per watt or per transaction of GPUs very compelling to IT managers deploying data center systems.”

Gupta notes that on the Linpack benchmark, which is used to judge performance for the TOP500 Supercomputing Sites list, systems that use both GPUs and CPUs typically outperform systems based solely on CPUs. “The performance on Linpack was eight times higher using a server with two GPUs and two CPUs compared to the same server with just two CPUs,” he says.1 “And in real applications, we’ve seen the GPU deliver even greater performance advantages over servers with only CPUs.”

The ability to deliver dramatic increases in compute performance at a reduced cost has positioned GPU computing at the forefront of the next wave of HPC architecture adoption (see

---

1 Based on NVIDIA testing using the Linpack benchmark to compare a 1U server with two quad-core Intel® Xeon® X5550 processors at 2.66 GHz and 48 GB of RAM against the same server with two NVIDIA Tesla M2050 GPUs, two quad-core Intel Xeon X5550 processors at 2.66 GHz, and 48 GB of RAM.
High-performance computing

Comparing CPUs with GPUs

Central processing units (CPUs) are highly versatile processors with large, complex cores capable of executing all routines in an application. They are used in the majority of servers and desktop systems. Compared with CPUs, graphics processing units (GPUs) are more focused processors with smaller, simpler cores and limited support for I/O devices.

Recent generations of GPUs have specialized in the execution of the compute-intensive portions of applications. They are particularly well suited for applications with large data sets. Application development environments for GPUs use techniques that allow the GPU to handle compute-intensive portions of applications that usually run on CPUs.

Accelerating processing speeds

Dell has been working toward accessible GPU computing for several years. Dell provided technology for high-performance GPU clusters with the Dell Precision™ R5400 rack workstation, and in 2008, Dell delivered some of its first GPU solutions with the National Center for Supercomputing Applications on Dell PowerEdge servers through hardware interface cards in PCI Express (PCIe) slots, validated with NVIDIA® interface cards (see the “Maximizing supercomputer performance and efficiency” sidebar in this article).

Now, Dell is helping make GPU processing power even more accessible through the Dell PowerEdge C410x PCIe expansion chassis, which enables organizations to connect servers through the appropriate host interface card to up to 16 external GPU cards. On the measure of peak single-precision floating point performance, a PowerEdge C410x with 16 NVIDIA Tesla M2050 GPU modules can deliver up to 16.5 TFLOPS of computing throughput.

The impetus for the creation of the PowerEdge C410x came from an oil and gas company that wanted to accelerate processing speeds for the complex seismic calculations used in the search for oil reservoirs, notes Joe Sekel, a systems architect with the Dell Data Center Solutions (DCS) team. “Given the industry they are in, they are focused on getting to their answers as fast as they can,” he says. “They are very motivated to use all means to accelerate the answer.”

In particular, the company wanted to investigate its options for increasing the ratio of GPUs to CPU sockets in its x86-based servers to help speed application throughput. “This company was currently running with two GPUs per two-socket server,” Sekel says. “However, they were projecting that if they kept tweaking their code, they could potentially bump that ratio up to four GPUs per two-socket server, so they could get to the answer faster. But that wasn’t something they were ready to do quite yet.”

The problem was that the company wasn’t sure of the right ratio. That’s because its ability to use the additional GPU processing power in its x86-based servers depended to a large degree on the ongoing optimization of its algorithms and software. So it didn’t want to lock itself into a specific configuration.

In response, Dell DCS system architects set off on a path that ultimately led to the...
development of the PowerEdge C410x. In addition to offering the flexibility to change the number of GPUs over time and to share GPUs among multiple host servers, the chassis also addresses fundamental problems that HPC users encounter when they add PCIe devices to existing servers. In simple terms, today’s dense, power-efficient servers have a limited ability to accommodate additional PCIe devices.

“Today’s servers are very optimized around density for x86 computing,” Sekel says. “Everything we do in there in terms of packaging, power, and the fan subsystem is really honed for maximum density given that particular set of components. We didn’t want to compromise server density by putting GPUs in the chassis. So this pointed to the need for an expansion chassis that talks to servers over PCIe.”

Moving PCIe devices out of servers allows them to maintain density, power, and thermal efficiency without sacrificing performance, while the purpose-built external expansion chassis helps optimize power and cooling for PCIe devices such as GPUs. In addition, the use of an external PCIe expansion chassis provides the flexibility to accommodate a wide variety and increased quantity of PCIe devices used with servers.

Designing for a wide range of applications

The PowerEdge C410x is a 3U external PCIe expansion chassis that allows host server nodes to connect to up to 16 PCIe devices; each individual host server can access up to 4 PCIe devices in the chassis. Although the chassis has optimized power, cooling, and systems management features, it does not have CPUs or memory. It simply provides optimized power and cooling in a shared infrastructure to support GPUs and other PCIe-based devices such as solid-state drives, Fibre Channel cards, and InfiniBand cards. The chassis also supports redundant power supplies and redundant fans.

“Aside from the flexibility, and the fact that we’ve put the GPUs in a high-density box that’s optimized for power and cooling of GPUs, we provide a serviceability model that is fairly unique in this space,” Sekel notes. The hot-pluggable PCIe modules, fans, and power supplies are individually serviceable while the chassis is in use—meaning that IT staff can pull individual components from the chassis for servicing without taking the entire unit down. “Given that the chassis and the GPUs in it are shared by multiple hosts,” Sekel says, “the last thing you want to have to do is take down the entire chassis when you need to service a single component.”

While delivering this high level of serviceability, the PowerEdge C410x also helps reduce costs. These savings stem from the increased density, the reduced weight of the chassis, and the reduced requirements for switches, racks, and power compared with competitive configurations.

Sekel considers the PowerEdge C410x to be well suited for a wide range of HPC applications, including oil and gas exploration, biomedical research, and work that involves complex simulations, visualization, and mapping. The PowerEdge C410x is also a good choice for companies that work in gaming or in film and video rendering, as well as those that simply require additional PCIe slots in an existing server, Sekel says.

The chassis is currently offered with the NVIDIA Tesla M1060 and M2050 GPU modules, with the Tesla M2070 expected to be added in
High-performance computing

Maximizing supercomputer performance and efficiency

The National Center for Supercomputing Applications (NCSA) is at the forefront of GPU computing. One of its supercomputers, named Lincoln, is a 47 TFLOPS peak computing cluster based on Dell hardware with NVIDIA GPU units and conventional Intel CPUs. By mixing GPUs and CPUs, Lincoln broke new ground in the use of heterogeneous processors for scientific calculations.

This combination allows NCSA to take advantage of the cost economies and extreme performance potential of general-purpose GPUs (GPGPUs), notes John Towns, director of persistent infrastructure at NCSA. “What we’re seeing, for the applications that have emerged on GPUs, are applications that on a per-GPU basis have an equivalent performance of anywhere from 30 to 40 CPU cores all the way up to over 200 CPU cores,” he says. “So this makes GPU platforms anywhere from 5 to 50 or more times more cost-effective than a CPU-only-based computing platform.”

Towns also notes that GPU-based systems have distinct advantages over CPU-based systems in terms of total cost of ownership, stemming from their reduced power and cooling requirements. “The compute power density is a lot higher with the GPUs,” he says. “They also have much greater heat density. The advantage is a smaller footprint and an attained performance per watt that is much greater than that of traditional CPUs. While there are some challenges in being able to cool and provide power, GPUs are more cost-effective because the total power per flop and total cooling per flop are less.”

In another important advance, the Tesla 20-series modules offer Level 1 and Level 2 cache memory, which helps increase system performance by reducing latency, Gupta says. These two levels of cache also give programmers increased flexibility in how they write programs for GPUs.

The PowerEdge C410x is qualified with the PowerEdge C6100 server, but is designed to connect to any server with the appropriate host interface card. In addition, although it initially targets the NVIDIA Tesla M1060 and M2050 GPU modules, the chassis can accommodate a variety of PCIe-based devices beyond GPUs, including network cards and storage devices—so the options for the chassis are expected to grow significantly over time.
Supporting GPU development
The GPU industry as a whole is working actively to support the efforts of organizations moving toward GPU computing. Software developers who want to create code for GPUs can take advantage of an ever-widening range of resources, including off-the-shelf compilers, tools, and libraries for GPU programming, along with hundreds of available applications. NVIDIA, for example, provides compilers and libraries for its CUDA parallel computing architecture, which supports standard application programming interfaces such as OpenCL and Microsoft® DirectCompute as well as high-level programming languages such as C/C++, Fortran, Java, Python, and the Microsoft .NET Framework. NVIDIA also maintains an online resource site, CUDA Zone, for GPU developers; programmers can visit the site at nvidia.com/cuda to obtain drivers, a CUDA software development kit, and detailed technical information.

The academic community is also moving into GPU computing, Gupta notes; more than 350 universities now offer courses in GPU computing. Looking ahead, Gupta sees GPUs playing an increasingly prominent role in computing as developers learn to take advantage of this parallel processing technology. “This will be for both classical scientific computing tasks and enterprise needs,” he says. “Today, the major use of GPUs is in scientific computing. But we are starting to see GPUs become more relevant to the traditional enterprise data center—for business analytics, for example. Business analytics tasks run very well on the GPU.”

Enabling accessible GPU computing
In HPC environments, GPU computing offers one of today’s most powerful computational technologies on a price/performance basis. To help organizations extend their use of GPU computing, Dell offers IT consulting services, rack integration (United States only), on-site deployment, and support services for organizations deploying and using GPU-based Dell systems. Taking advantage of these services and systems like the PowerEdge C410x expansion chassis can help organizations dramatically increase performance while maximizing efficiency.

Learn more

Dell PowerEdge C-Series:
dell.com/poweredgec

NVIDIA Tesla GPUs:
nvidia.com/tesla

Web 2.0, virtualization, cloud, mobility—market leaders continuously adopt new technologies, exposing organizations and their “secret sauce” to new threats. SonicWALL’s network security is intelligent enough to adapt as organizations and threats evolve—dynamically, globally.

Learn more at sonicwall.com/secret

© 2010 SonicWALL, Inc. SonicWALL and the SonicWALL logo are registered trademarks of SonicWALL, Inc.
Optimizing HPC clusters with 10 Gigabit Ethernet iWARP technology

By Tom Stachura

As high-performance computing experts push the limits of cluster efficiency and price/performance, Dell™ servers in an iWARP-enabled Intel® 10 Gigabit Ethernet fabric can help reach new performance and efficiency levels—and a TOP500 ranking.

New supercomputers are continually coming online as business and academic researchers strive to keep up with ever-growing scientific and engineering computational demands. In the persistent quest to do more work with greater efficiency and less cost than ever before, high-performance computing (HPC) has moved from mainframe computers to economical and easily maintained clusters, including clusters made up of cost-effective servers based on the x86 architecture.

Today, some of the world’s most powerful supercomputers are composed of x86-based clusters with performance delivered on the network side using high-speed InfiniBand connectivity. But for HPC experts striving toward reduced fabric costs and simplified use, InfiniBand can present several challenges. Now, Internet Wide Area RDMA Protocol (iWARP) provides a way to deliver Remote Direct Memory Access (RDMA) clustering on 10 Gigabit Ethernet (10GbE) network adapters—an approach that enables cluster users to overcome fabric challenges and continue to push the supercomputing envelope.

Assessing HPC connectivity challenges

InfiniBand connectivity presents several challenges for supercomputing. First, InfiniBand is a highly specialized switched-fabric communications link that requires special expertise and tools for setup, configuration, and management, and costs for tools, training, and outside expertise can be high. Second, because Ethernet is the de facto standard fabric for local networking traffic, using InfiniBand requires
the HPC team to maintain two networking technologies—InfiniBand connectivity to run the application traffic and Ethernet connectivity to manage the servers in the cluster. Third, InfiniBand remains relatively costly in terms of per-port pricing, so hardware costs can be an impediment to increasing cluster cost-efficiency. Despite these factors, InfiniBand connectivity has been a logical technology for HPC because of its high throughput, low latency, and scalability.

Ethernet, in contrast, is widely used for connecting users and network resources, but has not been traditionally preferred for low-latency supercomputing. Ethernet does have the advantage of being extremely cost-effective for general-purpose LAN traffic. The bandwidth of Ethernet has increased 10-fold with the mainstream availability of 10Gbe networking hardware, providing viable connectivity performance for HPC clusters. And Ethernet has broad scalability, providing the ability to dynamically add and remove nodes in cluster environments.

However, achieving low latency and high bandwidth for HPC applications requires enhancements to standard Ethernet. Standard Ethernet communicates using a kernel network protocol stack that adds overhead in terms of compute load, memory bandwidth, and network latency. In HPC environments, this overhead can greatly reduce performance, and is therefore unacceptable.

Avoiding Ethernet overhead barriers with iWARP

A full implementation of currently available iWARP technology helps avoid virtually all processor networking overhead, returning those cycles to the application. The Internet Engineering Task Force (IETF) standardized the iWARP specification in 2007; this standard specifies a set of extensions to the TCP/IP protocol that define a transport mechanism for RDMA. As such, iWARP provides a low-latency means of passing RDMA over Ethernet (see Figure 1). Together, these extensions address the three major sources of networking overhead: application context switches, intermediate buffer copies, and transport (TCP/IP) processing. These sources collectively account for nearly 100 percent of processor overhead related to networking.

The iWARP extensions help reduce processor overhead, memory bandwidth utilization, and latency using several advanced techniques:

- **Kernel bypass (OS bypass):** Context switching can be a costly process in terms of overhead. By allowing the application to communicate directly with the network controller, iWARP bypasses the kernel. This permits the kernel-to-user context switches to be avoided and helps reduce latency and processor load.

- **Intermediate buffer copies avoidance:** Data is placed directly in application buffers rather than being copied multiple times to driver and network stack buffers, which helps reduce latency as well as memory and processor use.

- **Transport (TCP/IP) processing acceleration:** TCP/IP processing is performed in hardware instead of the OS network stack software, enabling reliable connection processing at speed and scale. Data management and network protocol processing can be executed on the Ethernet adapter, which provides hardware acceleration of the process.

---

**Understanding iWARP**

In this Intel technology brief, learn more about how iWARP helps reduce Ethernet overhead and latency to enable organizations to gain the full network throughput benefits of 10 Gigabit Ethernet.

[download.intel.com/support/network/sb/understanding_iwarp_final.pdf](download.intel.com/support/network/sb/understanding_iwarp_final.pdf)

---

Reprinted from Dell Power Solutions, 2010 Issue 3. Copyright © 2010 Dell Inc. All rights reserved.
Using iWARP-enabled 10GbE fabrics in HPC clusters

Using these techniques, the iWARP standard enables low-latency network connectivity that can be well suited for HPC clusters. Intel’s NetEffect™ iWARP-enabled 10GbE server cluster adapters are specifically designed to deliver this capability in HPC environments.

In fact, a large biomedical research facility has achieved excellent performance and near-linear scalability using iWARP-enabled 10GbE adapters on a cluster of 4,032 cores, as measured using the High-Performance Linpack (HPL) benchmark. The cluster supports large-scale workloads in a range of critical research areas, including bioinformatics, image analysis, and sequencing, and was ranked at number 208 on the June 2010 TOP500 Supercomputing Sites list (see the “TOP500 Supercomputing Sites rankings for iWARP” sidebar in this article).

The cluster consists of 14 server racks with 36 servers per rack, for a total of 504 servers. The compute nodes are two-way Dell PowerEdge™ R610 servers based on the Intel Xeon® processor X5550 architecture at 2.66 GHz, with 24 GB of RAM and one 80 GB Serial ATA (SATA) hard drive in each server. Cluster RDMA network connectivity is provided by Intel’s NetEffect iWARP-enabled 10GbE server cluster adapters.

At the rack level, each server has two connections to one of two 48-port Arista 7148SX switches: one 10GbE link (using direct-attach twinaxial cable) for RDMA traffic and one Gigabit Ethernet (GbE) link for all other traffic. Each switch has eight 10GbE uplinks (16 per rack) to a group of additional switches. Software running on the cluster includes the Red Hat® Enterprise Linux® 5.3 OS, OpenFabrics Enterprise Distribution (OFED) 1.4.1, and Intel Message Passing Interface (MPI) 3.2.1.

In October 2009, project engineers running this cluster in the lab with the HPL benchmark measured excellent performance and near-linear scalability using iWARP-enabled 10GbE adapters on a cluster of 4,032 cores, as measured using the High-Performance Linpack (HPL) benchmark. The cluster supports large-scale workloads in a range of critical research areas, including bioinformatics, image analysis, and sequencing, and was ranked at number 208 on the June 2010 TOP500 Supercomputing Sites list (see the “TOP500 Supercomputing Sites rankings for iWARP” sidebar in this article).

The cluster consists of 14 server racks with 36 servers per rack, for a total of 504 servers. The compute nodes are two-way Dell PowerEdge™ R610 servers based on the Intel Xeon® processor X5550 architecture at 2.66 GHz, with 24 GB of RAM and one 80 GB Serial ATA (SATA) hard drive in each server. Cluster RDMA network connectivity is provided by Intel’s NetEffect iWARP-enabled 10GbE server cluster adapters.

At the rack level, each server has two connections to one of two 48-port Arista 7148SX switches: one 10GbE link (using direct-attach twinaxial cable) for RDMA traffic and one Gigabit Ethernet (GbE) link for all other traffic. Each switch has eight 10GbE uplinks (16 per rack) to a group of additional switches. Software running on the cluster includes the Red Hat® Enterprise Linux® 5.3 OS, OpenFabrics Enterprise Distribution (OFED) 1.4.1, and Intel Message Passing Interface (MPI) 3.2.1.

In October 2009, project engineers running this cluster in the lab with the HPL benchmark measured excellent performance and near-linear scalability using iWARP-enabled 10GbE adapters on a cluster of 4,032 cores, as measured using the High-Performance Linpack (HPL) benchmark. The cluster supports large-scale workloads in a range of critical research areas, including bioinformatics, image analysis, and sequencing, and was ranked at number 208 on the June 2010 TOP500 Supercomputing Sites list (see the “TOP500 Supercomputing Sites rankings for iWARP” sidebar in this article).

The cluster consists of 14 server racks with 36 servers per rack, for a total of 504 servers. The compute nodes are two-way Dell PowerEdge™ R610 servers based on the Intel Xeon® processor X5550 architecture at 2.66 GHz, with 24 GB of RAM and one 80 GB Serial ATA (SATA) hard drive in each server. Cluster RDMA network connectivity is provided by Intel’s NetEffect iWARP-enabled 10GbE server cluster adapters.

At the rack level, each server has two connections to one of two 48-port Arista 7148SX switches: one 10GbE link (using direct-attach twinaxial cable) for RDMA traffic and one Gigabit Ethernet (GbE) link for all other traffic. Each switch has eight 10GbE uplinks (16 per rack) to a group of additional switches. Software running on the cluster includes the Red Hat® Enterprise Linux® 5.3 OS, OpenFabrics Enterprise Distribution (OFED) 1.4.1, and Intel Message Passing Interface (MPI) 3.2.1.

In October 2009, project engineers running this cluster in the lab with the HPL benchmark measured excellent performance and near-linear scalability using iWARP-enabled 10GbE adapters on a cluster of 4,032 cores, as measured using the High-Performance Linpack (HPL) benchmark. The cluster supports large-scale workloads in a range of critical research areas, including bioinformatics, image analysis, and sequencing, and was ranked at number 208 on the June 2010 TOP500 Supercomputing Sites list (see the “TOP500 Supercomputing Sites rankings for iWARP” sidebar in this article).

The cluster consists of 14 server racks with 36 servers per rack, for a total of 504 servers. The compute nodes are two-way Dell PowerEdge™ R610 servers based on the Intel Xeon® processor X5550 architecture at 2.66 GHz, with 24 GB of RAM and one 80 GB Serial ATA (SATA) hard drive in each server. Cluster RDMA network connectivity is provided by Intel’s NetEffect iWARP-enabled 10GbE server cluster adapters.

At the rack level, each server has two connections to one of two 48-port Arista 7148SX switches: one 10GbE link (using direct-attach twinaxial cable) for RDMA traffic and one Gigabit Ethernet (GbE) link for all other traffic. Each switch has eight 10GbE uplinks (16 per rack) to a group of additional switches. Software running on the cluster includes the Red Hat® Enterprise Linux® 5.3 OS, OpenFabrics Enterprise Distribution (OFED) 1.4.1, and Intel Message Passing Interface (MPI) 3.2.1.

In October 2009, project engineers running this cluster in the lab with the HPL benchmark measured excellent performance and near-linear scalability using iWARP-enabled 10GbE adapters on a cluster of 4,032 cores, as measured using the High-Performance Linpack (HPL) benchmark. The cluster supports large-scale workloads in a range of critical research areas, including bioinformatics, image analysis, and sequencing, and was ranked at number 208 on the June 2010 TOP500 Supercomputing Sites list (see the “TOP500 Supercomputing Sites rankings for iWARP” sidebar in this article).

The cluster consists of 14 server racks with 36 servers per rack, for a total of 504 servers. The compute nodes are two-way Dell PowerEdge™ R610 servers based on the Intel Xeon® processor X5550 architecture at 2.66 GHz, with 24 GB of RAM and one 80 GB Serial ATA (SATA) hard drive in each server. Cluster RDMA network connectivity is provided by Intel’s NetEffect iWARP-enabled 10GbE server cluster adapters.

At the rack level, each server has two connections to one of two 48-port Arista 7148SX switches: one 10GbE link (using direct-attach twinaxial cable) for RDMA traffic and one Gigabit Ethernet (GbE) link for all other traffic. Each switch has eight 10GbE uplinks (16 per rack) to a group of additional switches. Software running on the cluster includes the Red Hat® Enterprise Linux® 5.3 OS, OpenFabrics Enterprise Distribution (OFED) 1.4.1, and Intel Message Passing Interface (MPI) 3.2.1.

Figure 2. Performance and efficiency test results for an HPC cluster using an iWARP-enabled 10GbE fabric

For more information on HPL, visit netlib.org/benchmark/hpl.
attained performance of up to 35.81 TFLOPS at 84.14 percent efficiency (see Figure 2). An HPL problem size of 1,200,000 was used, and the problem size necessary to achieve half the performance (n/2 problem size) was 300,000. The performance data scales in a nearly linear fashion as the number of cores applied to the benchmark workload increases. From an engineering perspective, the linearity of scaling in the results helps ensure the viability of the topology for large-scale computational problems.

Based on these results, the cluster ranks at number 84 for efficiency compared with other TOP500 clusters—a level more efficient than many InfiniBand clusters, and the highest of the listed Ethernet solutions.

Maximizing the advantages of iWARP and Ethernet

A key advantage of iWARP-enabled networking is its compatibility with existing network infrastructure, management tools, and solution stacks. Using mainstream Ethernet connectivity for compute clusters can now provide highly favorable performance, efficiency, and scalability. Taking advantage of iWARP-enabled 10GbE adapters allows RDMA traffic to be passed effectively over an Ethernet fabric. Organizations can now obtain the low latency that HPC clusters need while capitalizing on the ease of use and familiarity of Ethernet.

Using Ethernet connectivity as a unified fabric for cluster interconnects, LANs, and storage can help lower total cost of ownership by significantly reducing the number of switches and cables required. As 10GbE products and technology—including switches with high port density and technologies to further drive down latency—continue to evolve, future work can provide additional value in building supercomputing platforms on Dell PowerEdge servers interconnected with iWARP-enabled Intel 10GbE adapters.

Based on these results, the cluster ranks at number 84 for efficiency compared with other TOP500 clusters—a level more efficient than many InfiniBand clusters, and the highest of the listed Ethernet solutions.

Tom Stachura is the product line manager for HPC Ethernet products at Intel. He has over 17 years of industry experience in engineering, architecture, strategic planning, and product marketing.

Learn more

Intel Ethernet server adapters:
intel.com/go/ethernet
intelethernet-dell.com

Dell PowerEdge servers:
dell.com/poweredge

Tom Stachura is the product line manager for HPC Ethernet products at Intel. He has over 17 years of industry experience in engineering, architecture, strategic planning, and product marketing.
Managing the layers of a virtualized environment

By Ed Casmer

In virtualized environments, effective systems management encompasses much more than just virtual machines. Altiris™ Server Management Suite from Symantec enables a comprehensive approach to help streamline and simplify day-to-day operations.

Although virtualization promises significant benefits, it often requires IT administrators to reexamine their approach to systems management. How does the virtualization model affect typical best practices? How should administrators approach patching, inventorying, and deploying systems in a virtual world? Although it may seem that virtualizing an entire infrastructure would eliminate many management concerns, experience has shown that the same problems still exist—they simply shift from one category to another.

The Symantec™ Management Platform is designed with these issues in mind: instead of building a new set of virtualization-specific tools, Symantec has elected to extend existing tools such as Altiris Server Management Suite to adapt and specialize their behavior when they encounter virtual resources, allowing continued standardization on existing tools and processes. By abstracting away the differences between virtual and physical resources and supporting automated policies governing such differentiation, these tools can help reduce the overall time required for routing management and free administrators to focus on other initiatives.

Understanding the layers

Managing a virtualized environment requires first understanding its components. It’s tempting to think of the virtual machines (VMs) as constituting the whole virtualized environment, but what are the VMs running on? A hypervisor—a pseudo-OS that brings its own set of concerns and capabilities, distinct from those of a traditional Microsoft® Windows®, Linux®, or UNIX® OS. And what is the hypervisor running on? Hardware—yet another layer in the virtualized stack. Each of these three layers requires ongoing management to help ensure optimal performance (see Figure 1).

Properly running hardware serves as the foundation for a high-performance virtualized infrastructure. Firmware updates, BIOS updates and settings, driver updates, and physical device settings are typical hardware-level concerns, and some management systems may be unable to address this often vendor-specific aspect of managing infrastructure. It may also be difficult to identify needed updates and configuration options at this level—requiring someone to manually identify and download each update if the management tools cannot automate this process. The Dell™ Management Console plug-in for the Symantec Management Platform allows administrators to address these hardware-level concerns, helping them keep Dell PowerEdge™ servers up-to-date while managing other physical components such as Dell Remote Access Controllers (DRACs) or baseboard management controllers (BMCs).

The hypervisor is the next layer of the virtualized environment, and comes with its own deployment, patching, configuration, and monitoring concerns. Managing the hypervisor

Altiris Server Management Suite in action

Visit Symantec online to view detailed video demonstrations and to learn more about how Altiris Server Management Suite can enhance virtualization management.

dell.symantec.com/psq

Reprinted from Dell Power Solutions, 2010 Issue 3. Copyright © 2010 Dell Inc. All rights reserved.
breaks down into two main tasks: deploying it in a consistent, standardized fashion, and keeping it maintained and up-to-date. Just as with hardware, keeping the hypervisor updated generally offers distinct advantages, including bug fixes, performance increases, or entirely new features. Altiris Server Management Suite integrates with Dell Management Console and adds support for managing not only the hypervisor, but also the next layer in the stack—the VMs.

Once the VMs are up and running, however, does that mean that the infrastructure is a success? VM templates may have simplified deployment tasks, but administrators must also consider how they will patch the VM operating systems, inventory installed software, and monitor performance and configuration drift over time. In fact, most of the concerns attached to managing a physical system throughout its life cycle also apply to the VMs.

**Simplifying and centralizing management**
Understanding these three layers, as well as their specific management needs, is the key to gaining and keeping control over the environment. At minimum, administrators should consider several key questions. How can they quickly deploy the environment—hardware, hypervisors, and VMs—in a standardized and automated way? How do they know what they have and where it is? How do they know what is broken or about to break? And how can they fix what is broken?

Altiris Server Management Suite can help address these questions. For example, Altiris Deployment Solution, included with Altiris Server Management Suite, can manage automated deployments that include BIOS, DRAC, and RAID configuration; hypervisor deployment; VM creation; OS deployment; and the installation of applications and needed agents, all triggered by a single drag-and-drop operation. Altiris Server Management Suite also includes integrated workflow tools allowing the implementation of a server deployment process—complete with e-mail approvals and procurement authorizations to help protect against VM sprawl—as well as a VM manager dashboard providing virtualization-specific views into both Microsoft and VMware® virtual environments from a single location.

**Enabling a comprehensive approach to systems management**
IT staff spend much of their time on routine operations, and implementing a streamlined, comprehensive approach to systems management can enable them to focus on strategic initiatives to help their organizations succeed. Altiris Server Management Suite from Symantec incorporates robust options for managing both physical and virtual systems in a single tool, helping administrators to seamlessly manage the layers of their virtualized environments and increase overall operational efficiency.

---

*Ed Casmer is a technical strategist in the Partner Alliance Group at Symantec dedicated to the Dell Alliance.*
Individual PCs do not use a lot of power—but for midsize organizations and large enterprises that have hundreds or thousands of end users, each with his or her own computer, small reductions in power consumption can add up to annual savings that range from thousands to millions of dollars. In fact, the savings generated by reducing power consumption on individual PCs across a large enterprise can actually add up to more than the savings an organization can achieve by optimizing power management in its data center.

Power management features are available on virtually every PC, but are not always set up and managed in a way that minimizes energy use without reducing user productivity. Dell KACE K1000 management appliances can help IT organizations efficiently manage power configurations to take advantage of these features, helping to reduce power consumption while maintaining productivity across the enterprise.

Small power management changes lead to big savings

Automated PC power management helps organizations make minor changes that can result in significant cost reduction by enabling them to standardize, implement, and enforce power usage policies throughout the PC infrastructure. These measures can also help them meet significant energy-use reduction targets.

In many locations, utilities rebates are available to organizations that implement, document, and enforce power management policies (see the “Antioch Unified School District flexes its power with Dell KACE appliances” sidebar in this article). This utility rebate alone can be a tremendous incentive for organizations to implement a power management strategy for their PC infrastructures.

Power management techniques also help enterprises demonstrate environmental responsibility by reducing their carbon footprints and greenhouse gas emissions. In the public sector, many cities, counties, states, and federal government agencies are now actually required to implement energy-use reduction programs. And because heat can negatively affect PC reliability (which can consume help-desk and repair resources and keep employees from doing their jobs effectively), power management technologies can indirectly support high user productivity.

Deploying automated plug-and-play power management for PC environments

Enhanced power management can accrue significant savings and help IT staff efficiently control the PC infrastructure. The Dell KACE™ K1000 management appliance offers this capability in a flexible, easy-to-use package.
Dell KACE K1000 appliances streamline power management

The Dell KACE K1000 management appliance helps organizations discover and inventory devices as well as create, deploy, and enforce power configurations. Reports on power usage throughout the PC infrastructure helps administrators refine and optimize power management policies over time.

Available either as hardware or as a VMware® virtualization-ready virtual appliance, the Dell KACE K1000 appliance is designed to be simple to deploy—in fact, 68 percent of installations are completed in less than a week. Easy-to-use wizards allow administrators to control and enforce power settings remotely.

Dell KACE K1000 appliances support power management for computers running Microsoft® Windows®, Linux®, and Apple Mac OS X operating systems, enabling IT departments to cost-effectively manage power usage throughout their entire client infrastructure. For organizations running Windows XP, the appliances provide comprehensive support for the power management settings in that OS. For organizations running or planning a migration to the Microsoft Windows Vista® or Windows 7 operating systems, the appliances support the significantly expanded power management features available in those operating systems—including enhanced granular power control and the ability to develop multiple profiles for different conditions. For example, an end user could use one power profile when displaying a presentation, and then use a different power profile when attending a meeting.

“Antioch Unified School District flexes its power with Dell KACE appliances

Like many public school systems, Antioch Unified School District (AUSD) in California is always on the lookout for ways to reduce its infrastructure maintenance costs and divert those funds to the classroom. And as a forward-thinking and environmentally aware organization, the district saw enhanced PC power management as an opportunity to achieve two goals at once: save money and become more environmentally responsible.

“We chose the Dell KACE [K1000 management] appliance to help us manage our PC power usage because it gave us the visibility and tools we needed to identify computers that were left on nights and weekends—wasting energy, costing us money, and taking resources out of our classrooms,” says Tim Forrester, executive director of operations for AUSD. “It also allows us to monitor computers remotely without disrupting our classrooms.”

The AUSD IT team manages approximately 4,200 PCs scattered throughout the 26 schools in the district. “We encouraged teachers and students to turn off computers overnight and on weekends, but in the past, our staff had no way to know how many of these computers were actually left on,” says Bennie Driskell, supervisor of technology support for AUSD. “After we implemented the Dell KACE appliance, we discovered that about 800 computers were being left on overnight. Now that we’re using the auto-shutdown features of the appliance, we’re down to just 16 computers left on overnight.”

In addition to the direct savings from reducing its power bills, the district saves indirectly by reducing PC wear and tear and by cutting down on the heat generated by idling computers—thereby reducing the need for air-conditioning in its buildings during the hot summer months. What’s more, a US$61,500 rebate from Pacific Gas and Electric virtually offset the cost of the KACE management appliance—giving AUSD a nearly immediate return on its investment.

1 Based on KACE customer survey, November 2009.
Flexible policy management
Power management policies must be specific to each type of end user. How quickly and how often one user puts a system into a low-power state can be very different from another. For example, some may use their PCs a few minutes each hour, and do not necessarily need instantaneous access to their systems. Power users, in contrast, may be on their PCs continuously, and need immediate access to their systems at all times to remain productive.

Dell KACE K1000 management appliances allow IT administrators to group users logically, through user-assigned labels (logical groupings), and then apply different power policies based on those labels. This capability allows organizations to develop aggressive power policies that may, in a matter of minutes, put a system into a sleep state for users who use their systems only 10 minutes an hour or just a few times a day. At the same time, it enables far less aggressive policies for users who are on and off their systems constantly. In this manner, IT administrators can provide users with individualized service while still saving power enterprise-wide.

Cost-effective deployment
Because Dell KACE management appliances are designed to be both immediately productive as well as trouble free for the long term, they can help deliver low total cost of ownership. Plug-and-play deployment, one-click software updates, and automated nightly backups help to reduce installation and maintenance costs.

Also available as virtual appliances, Dell KACE management appliances can leverage an existing virtualized server environment and thereby avoid the need for additional hardware in the data center. In addition, organizations can reap potentially significant cost savings both directly (by putting PCs in a low-power state when they are not being used) and indirectly (by allowing the organization to save on heating and especially cooling).

Easy installation and utilization
Dell KACE management appliances are designed to take the complexity out of PC power management. A simple plug-and-play architecture helps virtually eliminate installation and maintenance, and the wizard through which IT administrators manage PCs provides a familiar, browser-style tabbed interface (see Figure 1). With its wide range of systems management features and easy-to-use browser-based administration interfaces, the Dell KACE family of appliances gives IT departments the ability to control and enforce power management policies remotely.

Efficient power management saves more than utility costs
Multiplied across thousands of PCs, small reductions in power consumption can generate significant savings in utility costs. But the benefits do not end there. The automated power management capabilities available in Dell KACE management appliances also help IT organizations achieve other energy-use reduction goals and demonstrate responsibility for the environment.

In addition, many power utility companies offer rebates to organizations that implement, document, and enforce power management policies—which can further justify deploying Dell KACE management appliances for client computers. For more information, visit kace.com/resources/power-management-webinar.

Learn more
- **Systems management cost calculator:** kace.com/cost-calculator
- **Dell KACE power management:** kace.com/power-management
- **Dell KACE green IT:** kace.com/green-it
Simplifying custom Microsoft Windows deployments

By Gong Wang and Wayne Liles

Dell™ Unified Server Configurator version 1.4 can help simplify and accelerate the deployment of customized Microsoft® Windows® operating systems on 11th-generation Dell PowerEdge™ servers.

The 11th-generation Dell PowerEdge server family introduced the Lifecycle Controller embedded management solution, which is designed to eliminate the media-based delivery of drivers, tools, and utilities necessary for systems management. One of its key components, the Dell Unified Server Configurator (USC) tool, can be used to configure basic device settings, diagnose systems, and deploy selected operating systems by providing the embedded device drivers for OS deployment. In addition to supporting OS deployment using standard OS media, USC 1.4 also supports customized media.

The Microsoft Windows Server® 2008 and Windows Vista® operating systems, meanwhile, introduced the Windows Automated Installation Kit (Windows AIK), a set of tools that assist with the installation, customization, and deployment of Windows operating systems. An updated and enhanced version of Windows AIK was later released with the launch of Windows Server 2008 R2 and Windows 7.

Administrators can take advantage of Dell USC to help simplify OS deployment, reduce deployment time, and eliminate potential problems caused by traditional media-based OS deployments. And by using it in combination with key Windows AIK tools, they can effectively and efficiently create and deploy customized Windows installations on 11th-generation PowerEdge servers.

Deploying Windows with standard media and a configuration set

In small organizations, Windows operating systems are often deployed directly using standard Windows media, rather than from the network. To help ensure consistency across systems, administrators can customize the Windows installation by using the Windows System Image Manager (Windows SIM) tool to create a configuration set. This configuration set comprises an answer file and a set of source files, which can include out-of-box drivers, applications, and packages such as security updates, hot fixes, and language packs. When using a configuration set, administrators can also automate the OS deployment process in an unattended mode and avoid the installation prompts.

Figure 1 illustrates the high-level workflow when using Dell USC to install the OS with standard media and a configuration set. Administrators use USC to configure the RAID settings, create a disk volume, and, by selecting the desired OS, provide the latest device drivers automatically at the beginning of the OS installation. This method helps greatly simplify OS installation.

Creating a configuration set

To create a configuration set, administrators would first use the Windows SIM tool to create a catalog file—a binary file that lists the settings and packages within a Windows image. A catalog file is automatically created when a Windows image
Systems management

Create answer file and configuration set → Copy answer file and configuration set to the root of a USB flash drive

Boot system with Dell USC → Configure RAID? → Yes
← Create RAID configuration → Select OS to install → Reboot system with OS media and USB flash drive → OS installation completes unattended → No

Figure 1. Workflow for deploying Microsoft Windows using Dell USC with standard media and a configuration set

(.wim) file is opened in Windows SIM. Different versions of Windows SIM have different restrictions on creating catalog files for different Windows image architecture types; the 32-bit version of Windows SIM is typically recommended because it can create catalogs for all supported Windows architecture types.

After selecting a Windows image and creating the catalog file, administrators can use Windows SIM to create a new answer file. An answer file is an XML-based file, typically named AutoUnattend.xml, that stores the custom settings used during Windows Setup. To complete an unattended installation, the answer file must at a minimum specify the Windows Setup language and location settings, accept the software license terms, provide a product key, configure the disk partition, and provide the location of the Windows image file to install (either by specifying the disk ID and partition ID or by telling Windows Setup to install the OS on the first available partition). Administrators can also specify other settings to apply to the installation, such as user account names, display settings, and Microsoft Internet Explorer® Web browser settings.1

The next step is to create a distribution share—the folder that hosts the additional source files for a Windows deployment. This share can be set up on a local folder or on a shared network folder. The source files can include third-party drivers, applications, and Microsoft update packages such as security bulletins. Administrators can create this folder using either Windows Explorer or the Windows SIM tool.

After the distribution share and answer file are in place, administrators would next customize the installation by adding applications, packages, and out-of-box drivers to create the configuration set. These files are hosted on the distribution share and referenced in the answer file.2

Finally, administrators should use Windows SIM to validate the settings in the answer file, save the answer file, and create the configuration set in a specified location. By default, the configuration set includes an answer file named AutoUnattend.xml and a folder named AutoUnattend_Files, which includes the distribution share content and its folder structure.

Deploying the OS

Now that the configuration set is in place, administrators can store it on a USB flash drive and use that drive to carry out customized OS installations. As Figure 1 illustrates, USC can assist with the major steps of an installation on 11th-generation Dell PowerEdge servers; after administrators have set the RAID configuration (if necessary) and selected the OS, USC prepares the drivers for the selected OS. When the system reboots from the Windows media, it automatically installs the device drivers provided by USC, configures the Windows settings, and installs the applications, packages, and additional drivers provided by the configuration set.

Although using USC for OS deployment is not required, doing so helps ensure that the latest certified drivers are injected during the OS installation, and avoids the need to assemble the driver packages and detail them in the configuration set. Before installation, administrators should be sure to verify that the latest USC OS driver packages (available from the Dell support Web site) are installed.

1 For more information on working with answer files, visit technet.microsoft.com/en-us/library/dd744318(ws.10).aspx.
2 For more information on adding applications and out-of-box drivers to configuration sets, visit technet.microsoft.com/en-us/library/dd799266(ws.10).aspx.
Deploying Windows with customized media

Administrators can also merge a configuration set with the standard Windows media by storing the configuration set directly on the media. To do so, they would create a copy of the master image from the Windows DVD as well as a copy of the configuration set, use the Windows AIK oscdimg tool to create a new ISO image containing these copies, burn this image to a DVD, and use Dell USC to deploy Windows from this customized media the same way they would with standard media. Figure 2 illustrates the high-level workflow when using this method.

The advantage of this approach is that it does not require a USB flash drive, avoiding a potential failure caused by inserting the drive into the non-primary set of USB ports for the system. However, one drawback is that it requires re-creating the customized media whenever the configuration set is updated to include newly released Microsoft security updates, change settings, and so on.

Dell USC includes a verification mechanism to help ensure that the appropriate drivers are prepared for deployment. If the deployment uses nonstandard or customized media, USC 1.4 allows the installation to continue after showing a confirmation prompt, and still prepares the driver set for installation.

Customizing a Windows image with offline servicing

In addition to merging a configuration set with standard media, administrators can also use two other methods to customize the Windows installation image with Windows AIK tools: offline servicing and online servicing. Offline servicing enables the injection of Microsoft update packages and hot fixes, updated drivers, setting changes, and language packs into a Windows image before installation. Using this method helps administrators efficiently manage existing customized Windows images by avoiding the need to deploy the image and then recapture it after the changes are made.

Figure 3 shows the high-level workflow when customizing a Windows image through offline servicing. Typically, administrators would mount the install.wim file, inject the required updates and make the necessary modifications, and then unmount that file. In Windows Server 2008 R2, Windows 7, and the latest version of Windows AIK, the traditional
Image servicing tools (including pkgmgr, PEImg, and IntlConf) have been replaced by the Deployment Image Servicing and Management (DISM) tool, which administrators can use to mount and service Windows images offline. The DISM tool does have some limitations, however: it can add only .cab files, .msu files, and .inf files offline. Adding system component files such as .msi and .exe files, or adding service packs, requires using the online servicing method.

Customizing a Windows image with online servicing

Online servicing refers to the process of modifying Windows while the OS is running, and then capturing the modified image for later deployment. This method allows administrators to install service packs, update packages, system components, applications, drivers, and language packs on a running Windows installation booted into audit mode.

A key difference from offline servicing is that applications can be installed and tested during this online process, which allows significantly increased flexibility. The drawback, compared with offline servicing, is that the image must be deployed, manipulated, and then recaptured. Both methods can be useful depending on the types of changes, updates, or additions that are required for a particular customization.

Figure 4 shows the high-level workflow when customizing a Windows image through online servicing. Administrators can boot Windows into audit mode by pressing Ctrl+Shift+F3 from the Windows Welcome screen after the installation completes, by opening a command prompt and running the command `sysprep /audit /reboot`, or (for unattended installations) by setting the Microsoft-Windows-Deployment\Reseal mode in the answer file to `audit`.

Simplifying customized Windows deployments

When choosing a method for deploying customized Windows operating systems, administrators should first identify the requirements of their specific organization and make sure that the selected method complies with the relevant license terms. In addition, they should keep the Dell USC firmware up-to-date to help ensure that the latest certified drivers are available. Following best practices and using USC in conjunction with Windows AIK can enable administrators to perform consistent, repeatable OS deployments on 11th-generation Dell PowerEdge servers, helping minimize possible problems while simplifying and accelerating installations.

Gong Wang is a software engineer in the Dell Server Operating Systems Group.

Wayne Liles is a systems management software strategist for the Dell Lifecycle Controller product.

Learn more

Dell embedded server management: dell.com/embeddedservermanagement

Dell PowerEdge servers: dell.com/poweredge
Well-balanced for business

The Dell™ PowerEdge™ R715 server: powered with up to 24 CPU cores and 256 GB of memory

With server technologies designed for energy efficiency without compromising performance, AMD and Dell help your business perform while meeting cost and power-usage goals.

The PowerEdge R715 also includes power-management features such as programmable voltage regulators, power-regulating processors, and an interactive LCD screen for easy access to power-consumption information.

Efficient, powerful, manageable—and a great choice for businesses of any size.

Learn more at www.dell.com/poweredge/amd
Applications

“Unlimited”

Oracle – Siebel – PeopleSoft – JD Edwards

✓ Continued New Releases
✓ Customer Driven Product Roadmaps
✓ Dedicated Development Teams
✓ No Forced Migrations

Get better results with proven applications tailored for your industry, processes and geography.

oracle.com
or call 1.800.ORACLE.1