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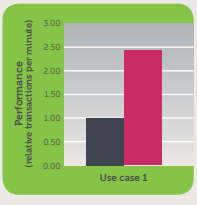
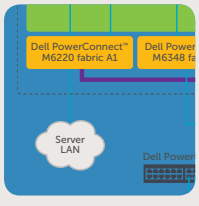
6 cover story

Accelerate the solutions journey

Gearing up with the right enterprise solution tools puts IT organizations on the fast track to building an Efficient Data Center. When those tools include Dell™ Intelligent Data Management and Next Generation Data Center solutions, the journey becomes a model of efficiency.





online exclusive

Enabling Intel Virtualization Technology features and benefits
By Marco Righini
Although virtualization has been accepted in most data centers, some users have not yet taken advantage of all the virtualization features available to them. This white paper describes the features available in Intel® Virtualization Technology that work with Intel's new CPUs and chipsets, showing how they can benefit the end user and how to enable them.

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departments

Managing unstructured data in **object-based storage**

By Derek Gascon and Greg White

Object-based storage offers an innovative approach to storing and managing vast amounts of unstructured data, from medical images to e-mail. The Dell DX Object Storage Platform can help preserve data, meet compliance requirements, and reduce costs.

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More from your mobile

Pervasive virtualization, cloud-based delivery, converged and unified infrastructure, unprecedented data growth, ubiquitous mobility, and billions of potential endpoints—these are but a few attributes of the Virtual Era, an exciting new phase of enterprise computing that's arrived at the doorstep of IT. While I won't drill into the details here, our recently published 2011 Issue of *Efficient Enterprise*, a special edition of *Dell Power Solutions* Magazine available at dell.to/bl0GzD, is all about helping you successfully make the transition.

Many of those endpoints will undoubtedly be mobile devices, ranging from traditional laptops to netbooks, smartphones, tablets, and other form factors yet to be imagined. Joining our *Dell Power Solutions* mobility pool recently was the Dell™ Streak, a pocket-sized tablet and smartphone running the Google Android OS—a sleek little powerhouse of a tool that bodes well for the future of anytime, anywhere access to information.

Multitouch gestures across the Streak's Gorilla® Glass screen can launch the usual app suspects, including Facebook, Twitter, YouTube, e-mail clients, and book readers, to name a few. And the Android Market has a rapidly expanding base of tens of thousands of apps available for download, just a few taps away.

Among the Android apps of most interest to enterprise IT may be the Citrix® Labs Receiver, a free download from the Android Market. The upshot of this is immediate and secure access from Streak-type mobile devices to Citrix farms where the already virtualized workhorse applications that run the business reside. But IT also needs to be prepared for the coming demand from the mobile workforce for native, in-house-developed Android apps. These thin, client-side apps will likely be built with tools like the Android SDK and distributed and managed through private clouds.

Mobile IT support professionals will also find some excellent tools at their disposal. I've been using LogMeIn Ignition, an elegant remote desktop app available from the Android Market that makes the most of the Streak's multitouch interface, and it works seamlessly with the LogMeIn Free client already running on my servers and workstations. The Streak's five-inch screen is just the right size for managing the usual Microsoft® Windows® devices, and much more satisfying to use for this purpose than the typical smartphone.

The Virtual Era is here, and a new wave of mobile devices, like the Streak, are primed and ready for delivering the next generation of enterprise apps to endpoints anywhere. Will you be ready?

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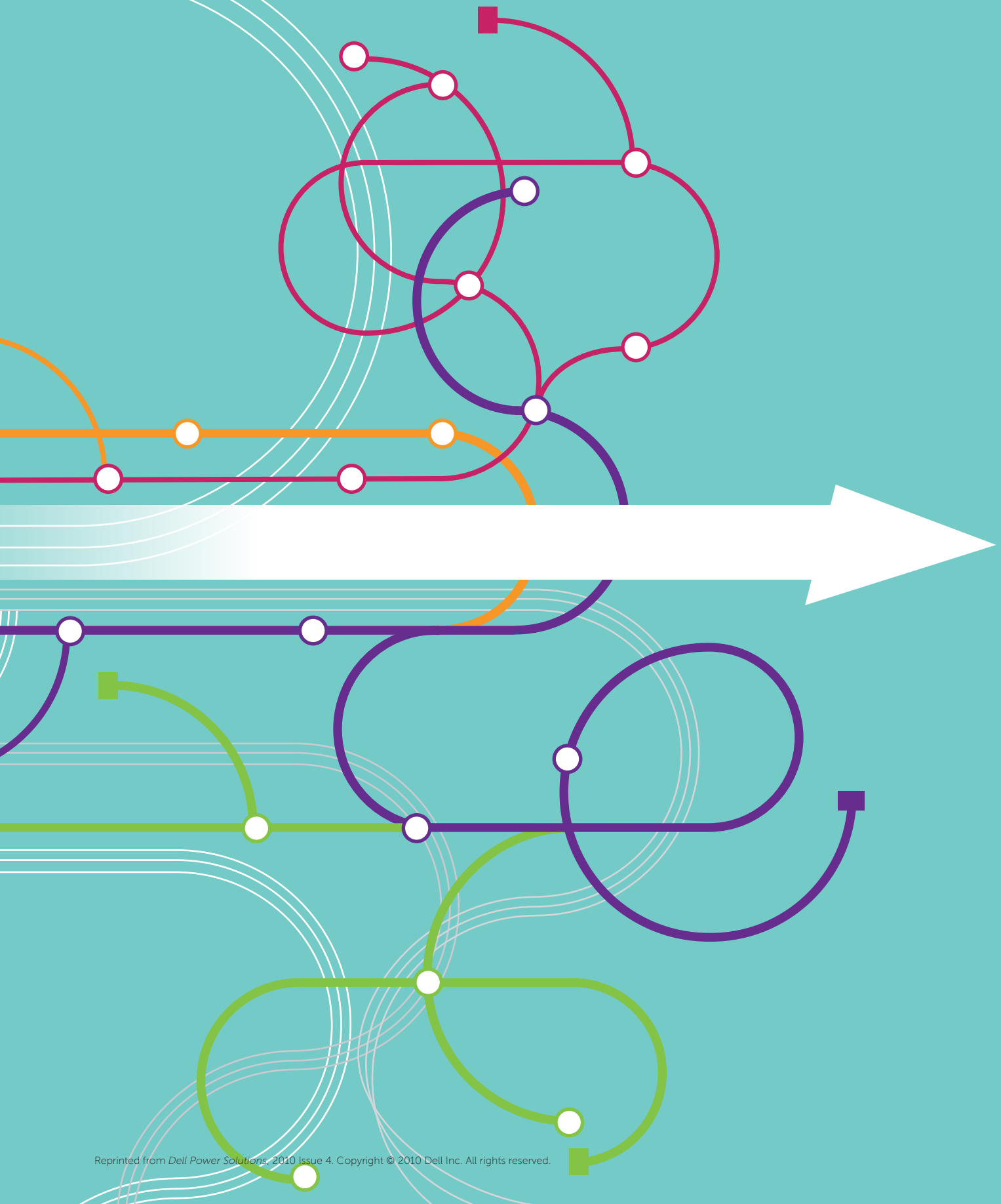
Accelerate the solutions journey

Gearing up with the right enterprise solution tools puts IT organizations on the fast track to building an Efficient Data Center. When those tools include Dell™ Intelligent Data Management and Next Generation Data Center solutions, the journey becomes a model of efficiency.

In their quest for enterprise efficiency, IT organizations find themselves at a crossroads. Faced with delivering on the expectation of anytime, anywhere access to systems, applications, and data—from virtually any device—what route does IT take in order to make good on that promise? Dell's answer to the question lies in an expanding portfolio of enterprise solutions that are designed from the ground up to be standards based, open, capable, and affordable. Focused around three core domains, including Intelligent Data Management (IDM), Next Generation Data Center, and Next Generation End User Computing, these transformative solutions are prime movers in accelerating the journey to the Efficient Data Center.

In this issue, our *Dell Power Solutions* editors and writers teamed up with subject-matter experts well versed in the IDM and Next Generation Data Center domains for an in-depth look at the four solutions overviewed here. Just turn to the highlighted page numbers to explore each area further.



Consolidating and archiving patient-centric medical images

By Craig Warthen and George Sadler

Managing rapidly growing medical image data can be challenging. The Dell™ Unified Clinical Archive platform helps health care organizations consolidate images and avoid forced data migrations when updating picture archiving and communication systems.

Health care is rapidly moving toward a future of highly personalized, predictive, and preventive medicine (see Figure 1). As part of this transformation, many hospitals and clinics are examining the efficiency of their current processes for storage, management, and retrieval of medical images and other relevant patient data.

With the growing emphasis on patient-centric care, medical images that once were the domain of diagnostic specialists are now routinely shared by doctors with their patients. Physicians frequently use X-ray, CT, PET, or MRI images to help patients understand the need for a medical procedure or to view the results of treatment. These medical images must be available in a matter of seconds for display through a picture archiving and communication system (PACS) in a variety of health care delivery settings.

However, current methods of storing and managing images are proving increasingly inefficient and costly as data volumes grow. As a result, hospitals and clinics are looking to consolidate and archive their data for long-term storage on more

easily managed, better performing, and less expensive platforms than current systems provide.

The Dell Unified Clinical Archive (UCA) platform addresses these concerns with a combined hardware, software, and services architecture designed to provide simplified and accelerated access to medical files and images. Built on object-based and metadata-aware disk storage, the Dell UCA platform enables health care organizations to efficiently store, identify, and share clinical content while providing ease of management and scalability.

Over the next several years, the introduction of true patient-centric medical image management is expected to require inclusion of all images—both compliant and noncompliant with the Digital Imaging and Communications in Medicine (DICOM) standard—to form a complete, holistic patient record. Data is expected to be shared across different PACSs, communicated to electronic medical record (EMR) systems, and mobilized electronically within a region or hospital enterprise through health information exchange (HIE) systems. New regulations are extending data retention periods by years or even decades.

Such advanced image management capabilities can provide significant benefits. Having the appropriate data in the appropriate place at the appropriate time enhances patient care and facilitates a patient's continuity of care when multiple providers are involved, and can also help reduce expenses associated with duplicate tests and time spent recovering missing patient information.

Identifying impediments to optimized image data management

Before organizations can fully realize the benefits of advanced medical imaging environments, they must overcome significant challenges, including exponential data growth. As data mounts—both in the number of imaging studies and in the size of each image—hospitals and clinics are rapidly running out of space for images on primary storage systems. Traditional file systems pose a scaling challenge, while tape archives can expose images to risk of damage, loss, or theft. And as the amount of data in primary storage continues to grow, PACSs can experience reduced performance, which in turn affects patient care.

Another challenge is presented by clinical silos, which make diagnostic collaboration among departments inefficient. PACSs implemented over the last decade do not interoperate well because of proprietary changes to standard protocols such as DICOM, leaving them unable to share with other PACS, EMR, and HIE systems. An organization may have separate PACSs for radiology, cardiology, and oncology, for example, and corresponding data silos on different archive storage platforms.

Additionally, PACS updates often result in costly and risk-prone data migrations. Many hospitals have mandated hardware updates every three to five years, and may also change PACS vendors periodically as technology improves. But images must be retained for a much longer period than the hardware life expectancy, making data migrations a painful fact of life under the current approach.

With archives and image sizes growing, these migrations have become long and difficult. Months may be required to prepare, inspect, and migrate data from legacy to updated hardware or from a previous vendor's application. Data loss during migration can mean that irreplaceable images from a patient's history are no longer available for comparison with current images for diagnostics and treatment evaluation.

This challenge is compounded by the fact that PACS vendors currently control the entire solution stack: because health care organizations cannot make choices about

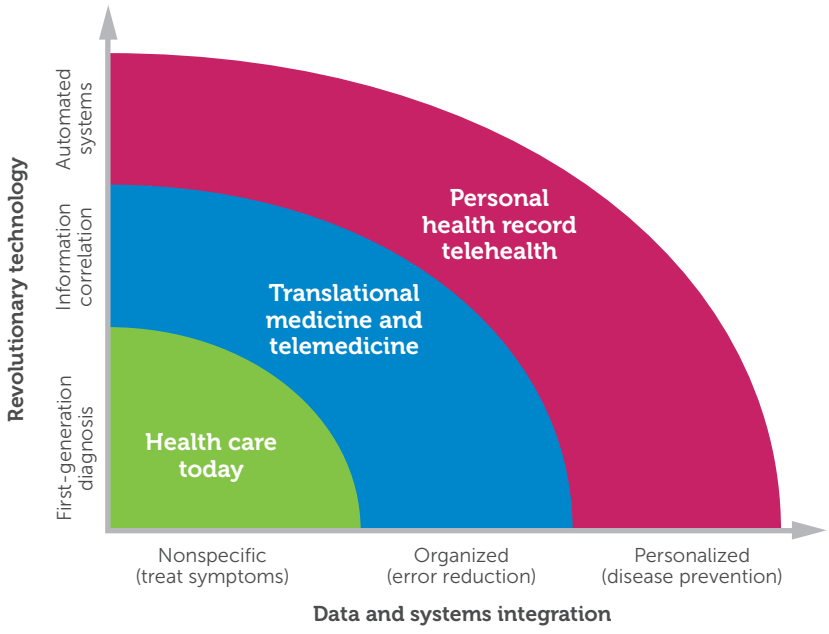


Figure 1. Transformation of medicine toward personalized preventive care accelerated by data and systems integration

individual stack elements, it is difficult for them to strategically manage their systems. Data is locked into the system, and many organizations feel that they do not own their own data. Proprietary systems also tend to be costly compared with open, standards-based systems.

Introducing the Dell Unified Clinical Archive platform

The Dell UCA platform makes it possible for organizations to store medical files on one massively scalable storage platform that is managed as a single entity. It enables IT departments to manage fixed content in a cost-effective tiered-storage architecture based on open standards, and facilitates the easy retrieval necessary for today's patient needs and the record authenticity required by regulatory-compliant environments. Most important, UCA can enhance care by empowering health care providers to make informed medical decisions.

The UCA platform consists of three key components:

- **Dell DX Object Storage Platform:** This core platform goes beyond long-term archiving of data—particularly unstructured data—to provide intelligent management, access, protection, and distribution of medical files and images. Organizations can quickly identify and retrieve patient information and automatically manage clinical objects from creation through deletion.
- **Unified archiving software:** Included with the UCA platform, this software manages user-defined archiving and access policies, continuously checks stored objects to repair errors, and interfaces with the imaging systems used by the organization.
- **Dell Services:** Consulting services help organizations identify and prioritize challenges—including the needs of clinicians, IT staff, and administrators—to meet their specific image archiving and retrieval goals. (For more information on archiving services, see the "Dell Services: Driving efficiency for archiving data" sidebar.)

The Dell UCA platform stores data as objects—one person's data grouped together in context. Its 128-bit flat address space has no file hierarchy to add complexity or limit scalability. Metadata accompanying each object enables automated, policy-based retention, deletion, and distribution.[1]

The UCA platform takes ownership of common data management elements between its front and back ends, elements that were previously handled by proprietary PACS solutions (see Figure 2). It places an application layer between the imaging system and the storage hardware environment, retranslates proprietary versions of PACS DICOM back into a standard DICOM format, and enables data and storage to be virtualized away from PACS applications and middleware. The result is freedom from the proprietary constraints and forced data migrations of today's PACSs.

Dell Services: Driving efficiency for archiving data

From start to finish, Dell Services can help organizations realize the full potential of a data archiving solution, enabling them to match the appropriate technologies with specific requirements. Features of this approach include the following:

- **Skilled solution architects:** Seasoned consultants identify high-impact, fixed-scope projects that can deliver measurable return on investment.
- **Automated tools, analysis, and industry best practices:** Expert analysis and actionable recommendations help speed time to value.
- **Modular, flexible approach:** The Dell consulting process can provide clear assessment, design, implementation, and support phases with built-in decision points.
- **Regulatory compliance:** Development of organization-specific access policies helps mitigate risk through enhanced data management.
- **End-to-end solutions:** Comprehensive data archive solutions can include hardware, software, and services.

A well-designed and implemented data archiving approach is integral to streamlined operations that help minimize risk and provide a flexible infrastructure for future growth. In addition to data archiving, Dell consultants can optimize data management with other offerings, including tiered storage as well as backup and recovery with deduplication. For more information, visit dell.com/services.

[1] For more information, see "Managing unstructured data in object-based storage," by Derek Gascon and Greg White, in *Dell Power Solutions*, 2010 Issue 4, dell.com/downloads/global/power/ps4q10-20100472-white.pdf.

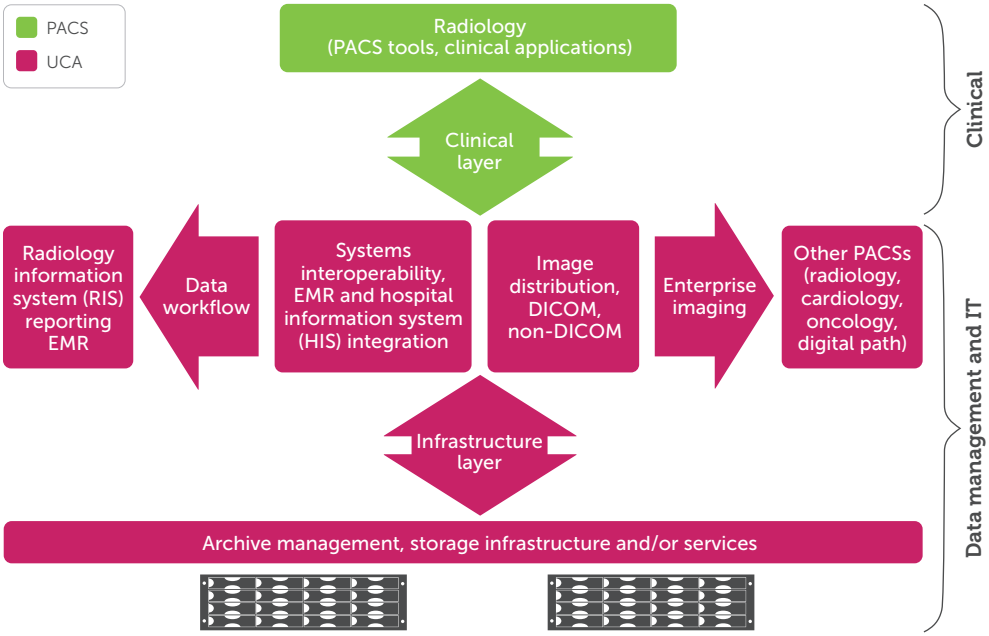


Figure 2. Dell UCA architecture with common data management elements between a front-end PACS and back-end storage

Moving to cost-efficient, patient-centric image management

As hospitals and clinics move toward more patient-centered care, the Dell UCA platform can help them transform their current image management processes. This platform helps health care organizations enhance patient care, increase efficiency, and reduce costs with a common, standards-based platform that works across diverse imaging systems.

Consolidate medical images on a common platform

The UCA platform enables health care organizations to manage a wide range of file types of medical images and relevant clinical objects—even scanned handwritten documents and e-mail—in a centralized clinical archive. This consolidation then enables hospitals and clinics to provide one holistic patient record, and also facilitates mergers and acquisitions for economies of scale. The UCA platform manages both DICOM and non-DICOM images, integrates easily with EMR and enterprise-wide HIE systems, and helps provide data security—all with onetime setup.

Scale storage to help meet fast-growing demands

The combination of unique IDs and flat addressing available on the UCA platform is designed to provide easy scalability from 6 TB to tens of petabytes and billions of objects. Standards-based hardware in combination with modular design enables IT departments to easily add, replace, and retire nodes across multiple hardware generations. Administrators can expand the UCA platform by as little as one node at a time, with no disruption, configuration, or provisioning required. Initial high performance only grows faster as storage nodes are added.

Make flexible imaging decisions

The UCA platform gives administrators the flexibility to make medical-imaging vendor decisions without worrying about the impact on archived data. IT departments have the freedom to choose the best PACS vendor solution for now, while retaining the freedom to change tomorrow. Because the data is now managed by the UCA software interoperability layer, administrators can simply swap out a PACS provider with little or no dependency on data.

Clinical archiving made simple

This 60-minute Webcast presents the Dell UCA storage platform for medical files, including the core Dell DX Object Storage Platform. Register to learn how to deploy UCA to store, access, and share medical files from medical imaging applications.

bit.ly/Dell-UCA-Webcast

"As hospitals and clinics move toward more patient-centered care, the Dell UCA platform can help them transform their current image management processes."

Avoid forced data migrations

Data is independent of the PACS, which means health care organizations no longer need to conduct forced data migrations because of a new PACS installation. With no migrations, organizations can realize significant savings and low total cost of ownership for managing medical imaging systems. Administrators are also freed from worry over the business risks of data migrations.

Enhance data integrity and regulatory compliance

The UCA platform helps health care organizations meet their data management and information governance needs. Policy-based retention and selectable content control permit only authorized users to reference, alter, and delete data. Self-healing functions help ensure that data integrity is preserved by continuously checking stored objects to detect and repair errors and automatically reconfigure and regenerate objects.

Standardize on a trusted platform

Dell is well suited to helping health care organizations move toward patient-centric medical image storage and management. Dell offers leading-edge worldwide health care IT services and support as well as enterprise-class storage and archive platforms.

In addition, Dell's Intelligent Data Management (IDM) approach enhances Dell's ability to deliver value in an optimized medical imaging solution. IDM offers a comprehensive way to manage information assets to promote optimal access, availability, protection, and low cost throughout the life cycle of an asset. It includes block, file, and combined block-and-file storage; tiering; deduplication; and archiving. IDM also incorporates the Dell DX Object Storage Platform as object-based storage for the archive tier and leverages UCA software.

Accelerating access to critical patient data

As medical imaging evolves in the digital era, images must be delivered through a single information network, and must be easily accessible for enhanced flow of clinical information. The Dell UCA platform is built on object-based and metadata-aware disk storage together with a PACS-neutral software layer, enabling doctors and clinicians to quickly identify and retrieve patient information. Using the UCA platform, health care organizations can also change PACS vendors without undergoing costly data migration; standardize clinical content on cost-effective, scalable hardware; and meet their data security and capacity requirements while helping improve the economics of data storage. PS

Craig Warthen is a product marketing manager for the Dell Enterprise Product Group. He has more than 16 years of experience in IT storage and archiving for multiple industries, including health care and life sciences.

George Sadler is a vertical solutions marketing strategist for the Dell Enterprise Solutions Marketing team, and has more than 20 years of experience spanning multiple industries.

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Why data archives make sense for preserving e-mail

By Kay Benaroch and Bob Ganley

Automated retention policies are essential to maintain today's growing volume of e-mail, attachments, and other unstructured data for future access. Learn the key factors to consider when planning an e-mail archive environment.

Recent years have brought an explosion of legal, regulatory, and industry-specific mandates requiring the long-term retention of business and customer data. Although some of this information is contained in structured databases that use archive policies, it also encompasses unstructured data such as e-mail messages and attachments—and the sheer amount of this unstructured content is growing even more rapidly than other data types. In fact, according to IDC, by 2012 over 77.8 percent of new storage capacity shipped will be dedicated to the storage, organization, and protection of files (see Figure 1).[1] Archive solutions from Dell can help alleviate the IT headaches associated with storing and managing this unstructured data while satisfying today's retention requirements.

Addressing the challenges of e-mail storage and retrieval

As critical business tools, e-mail and electronic messaging are a major part of the information deluge generated each year. This data is subject to industry and government regulations, including the Health Insurance Portability and Accountability Act (HIPAA), the Payment Card Industry Data Security Standard (PCI DSS), and the Federal Rules of Civil Procedure (FRCP) guidelines stipulating e-discovery requirements.

[1] "Worldwide file-based storage 2010–2014 forecast: Consolidation, efficiency, and objects shape market," by IDC, Doc #223558, June 2010.

E-mail, instant messaging, wikis, and blogs are all considered electronically stored information (ESI), which can be requested by a court of law to prove or disprove a point during litigation. This requirement can apply to lawsuits for virtually any reason, ranging from personnel issues to trade secrets. Many U.S. organizations have had litigation brought against them at some point, and the associated expenses—including costs for retrieving e-mail correspondence—are expected to continue growing for organizations of all sizes.

Failure to produce requested data can lead to lost cases and costly penalties (including fines and court sanctions), expensive third-party contracts for data search services, and damage to an organization's brand or reputation. CEOs and other executives may even face incarceration. Yet many organizations still have inadequate provision for storage and retrieval.

Storage capacity is one point of weakness: organizations often struggle to keep up with the mountain of ESI data they must preserve. This data includes not only e-mail messages and attachments, but also threads related to who received each message as well as calendar notations about when a particular topic was discussed. Also, non-executives are often assigned quotas on the amount of server space available to save their e-mail. These users may end up putting e-mail in personal files or deleting large numbers of messages to stay within their quotas—a practice that can be dangerous, because e-discovery may require access to information other than executive-level records.

Many organizations use tape backup systems for archiving, but because these systems are not designed for rapid file access, relying on them for e-discovery can be risky and costly. Tapes are also susceptible to accidental loss or damage, and even random events—such as tapes falling off the back of a truck during transport—can be enough to put an organization out of compliance with industry, legal, or regulatory requirements.

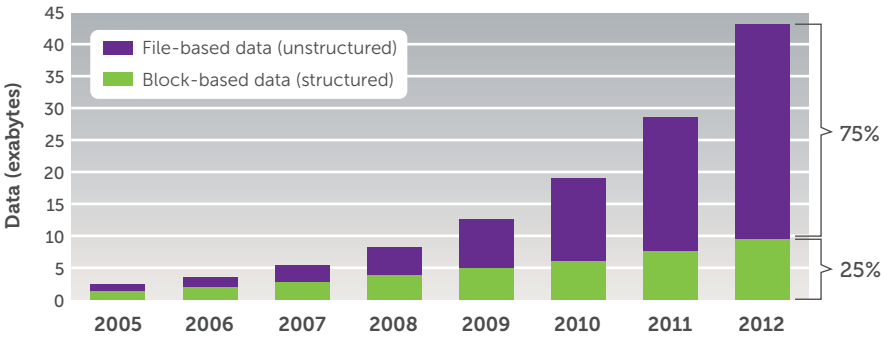
Distinguishing backup from archiving

Although many organizations believe that a good backup policy can also serve data archiving needs, the goals of each function are different. Backup volumes keep the most recent copy of data (including incremental changes) accessible for recovery purposes in primary data stores. Archives, on the other hand, use policies established by administrators to remove inactive data from primary data stores and deposit that data into cost-effective repositories and online media.

Archiving preserves critical information for long-term business continuity and e-discovery. It enables automated policies to classify and tag data objects for easy search, and helps reduce primary storage space requirements and the cost of storage. Archiving helps decrease backup times by reducing the amount of data in primary storage.[2]

Microsoft has recognized the need for archiving in its Exchange e-mail and calendar capabilities. Microsoft® Exchange Server 2007 and earlier versions allow end users to create .pst files when their mailboxes start to fill up. This file provides e-mail storage on the local disk instead of within the enterprise storage infrastructure. As a result, that information is outside the purview of the IT department, and cannot be backed up or searched to comply with an e-discovery request. In Exchange Server 2010, Microsoft

[2] For more information on the contrast between archiving and backup processes, see "Taking an intelligent data management approach to archiving data," by Kay Benaroch and Joe Colucci, in *Dell Power Solutions*, 2010 Issue 3, dell.com/content/topics/global.aspx/power/en/archiving_data.



Source: "Worldwide file-based storage 2010–2014 forecast: Consolidation, efficiency, and objects shape market," by IDC, Doc #223558, June 2010.

Figure 1. Estimate of annual growth for structured and unstructured data volumes

Archiving: A Dell point of view

This white paper defines the archiving business perspective and offers five key reasons why archiving is a mission-critical component in today's organizations.

dell.to/dx-archiving

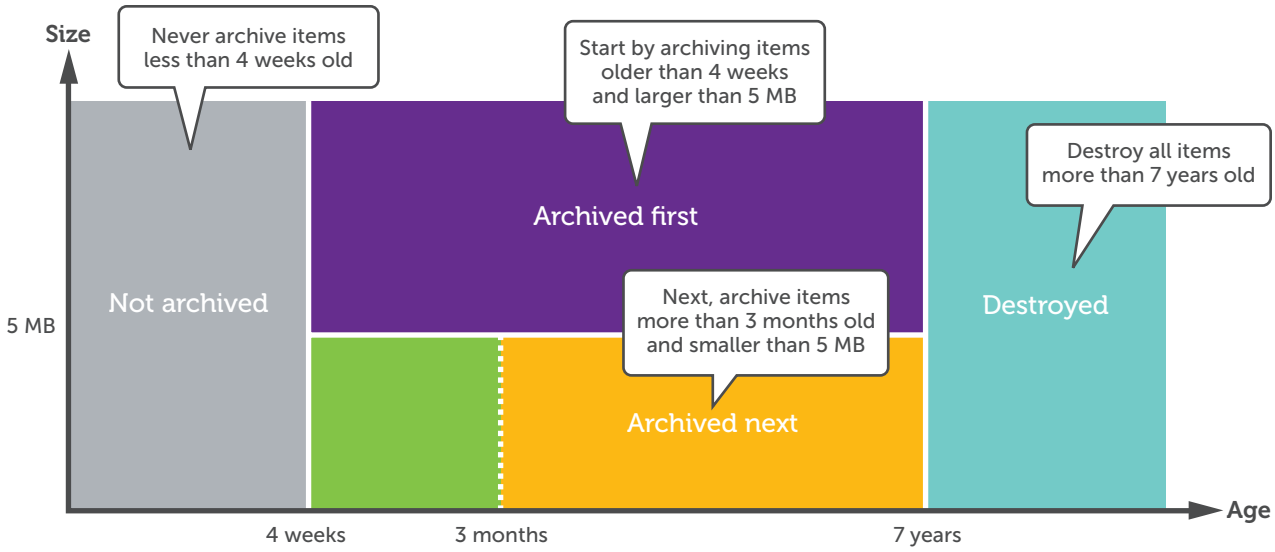


Figure 2. Example of automated data retention using age-based archive policies

introduced a personal archive feature that can validate the need for policy-based information management by allowing users to store e-mail outside the in-box while still keeping it accessible for searches. For most organizations, a comprehensive approach includes using Exchange in combination with specialized archiving hardware and software.

A viable alternative for many organizations is to centrally manage retention policies with a software-as-a-service (SaaS) approach such as Dell™ Email Management Services (EMS). The EMS Email Archive service, for example, is designed to provide near sub-second searches, flexible policy compliance, comprehensive storage management, and seamless end-user access. Data can be easily imported from legacy archives and .pst files. Many organizations prefer this cost-effective entry into a SaaS solution because they can start with a limited number of mailboxes and grow as needed.

Creating policies for archived information management

Archiving tools that enable centralized policy management, automated archiving, and power search capabilities are essential for coping with the volume of ESI data—data that now encompasses the rising tide of unstructured content generated by popular platforms like Microsoft Office SharePoint® Server. IT departments must also protect information for an increasing number of users and employee types, including anyone who tracks contracts, corresponds with customers, or handles outside business partners.

Determining which information to keep and for how long can be challenging. Organizations must apply retention and deletion policies consistently across a range of information types, and must be able to show for legal and regulatory purposes that they did so. These processes can be automated based on different metrics—for example, by using age-based archive policies (see Figure 2).

Policy-based management can also save time, reduce costs, and help ensure compliance when an organization involved in a lawsuit is required to place a hold on its e-mail data. Requirements may include maintaining e-mails and other documents without change for long periods, and can even apply to incoming e-mail. Automated retention policy control makes it easy to set legal holds of specific durations and change them as needed for specific users, groups, or servers.

Built-in e-discovery capabilities make it possible to quickly and accurately search archives. The latest retrieval methods—including text indexes of message headers, bodies, and

attachments—enable full-featured archive search tools to quickly retrieve e-mails based on virtually any criteria or search terms. An enterprise-wide archive search can be accomplished in seconds, and in many cases in less than a second.

The complexity of the data management challenge requires specialized tools and resources. An effective archive approach must accommodate differences in data types, applications, and IT environments. For example, SharePoint is a distributed, multilayered application with no centralized storage controls. E-mail data stores must take into account both the structured nature of e-mail database logs and the unstructured content of messages. ESI files can exist in multiple server locations and can vary dramatically in size and relative value to the organization.

Implementing an archive deployment

When developing a strategy for preserving critical e-mail, file attachments, and other electronic messages, organizations must consider several important factors. Dell storage consultants can offer expertise and experience in all aspects of archive planning and deployment. (For more on how Dell can help organizations address data retention and management requirements through innovative technologies, see the "Building on innovation: The Dell DX Object Storage Platform" sidebar.)

Managing retention and deletion. An important first step is to create policies that classify data based on business requirements and then define how archiving systems retain and delete that data. Age-based retention rules can be further segmented by subject, user, and type of information. Many organizations choose to initially implement retention policies for a subset of users for pending litigation or a key set of executives, and then later expand policy implementation to the entire organization.

Preparing for growth. While the need for overall storage capacity is growing, the number of individual data containers such as files, images, and videos is growing even faster. Managing this growth requires a modular storage architecture for easy expansion that can scale to billions of

Building on innovation: The Dell DX Object Storage Platform

To help organizations address the explosion of retention and management requirements, Dell offers an Intelligent Data Management (IDM) strategy that includes the Dell DX Object Storage Platform. This platform incorporates a variety of innovative technologies for storing unstructured information, including the following:

- **Scaling:** Peer scaling architecture designed to support billions of stored files and multiple petabytes of capacity under a single address space
- **Automated management:** Policy-based classification, retention, access, deletion, replication, and distribution processes
- **Data protection:** Redundant array of independent nodes (RAIN) architecture, designed to ensure continuous data protection and availability
- **Ease of management:** One-click node retirement and self-healing capabilities
- **Security and integrity:** Selectable write-once, read-many (WORM) functionality as well as content integrity seals—digital signatures created to prove the immutability of objects and authenticity for use in evidentiary proceedings
- **Standardized interface:** Open HTTP standard leveraged by applications and services providers to interact with cloud storage and containers

As a pillar of Dell's IDM strategy, the DX Object Storage Platform provides a cost-effective object storage architecture based on industry-standard hardware. The platform is designed to deliver a life cycle approach to information that manages capacity optimization along with automated policies that utilize metadata.

items. A tiered approach that moves infrequently used data to slower drives can help to simplify capacity planning, optimize storage, and reduce expenditures for costly high-performance drives. As part of an overall strategy for managing data growth, organizations should also consider using data deduplication to help reduce the volume of data being placed in the archive.

Protecting data. Data management plans must incorporate a data protection scheme. This scheme may mean replicating copies of archived data for recovery purposes in the event of damage to one copy. Features such as content integrity seals can help organizations demonstrate that data cannot be modified from its original state—an important consideration during e-discovery processes.

Implementing authentication and user access. Some archive systems are designed to move older and larger files off primary storage while still providing access to those files through an e-mail client. However, organizations must ensure that only authorized users can access the archived messages. If these messages are later submitted to a court or regulatory body, authentication is required to certify that no one has touched the specific information after it was originally created. This authentication typically means giving most users access to only their own e-mails, while still enabling attorneys or compliance auditors to search the entire archive if necessary.

Achieving retention and access goals

To help organizations cope with the challenges of intelligently managing data, Dell delivers solutions that align with the concept of information life cycle management. This approach is designed to manage data from creation to deletion based on its value to the organization, and to meet retention and discovery requirements by protecting data throughout its life cycle.

The Dell storage portfolio includes Dell EqualLogic™ PS Series Internet SCSI (iSCSI) storage area network (SAN) arrays, Dell/EMC NS unified storage, and Dell PowerVault™ DL backup-to-disk appliances, which support features such as deduplication applications for secondary storage tiers. To cover the full data life cycle, Dell has also introduced the DX Object Storage Platform for data archiving. This platform is designed to satisfy scalability and management requirements for growing volumes of unstructured information. It is integrated with leading independent software vendor (ISV) archive applications to enhance data access and retention at a low total cost of ownership.

The DX platform's comprehensive archiving functionality includes using application software to review messages, files, and associated metadata, and then move them to a scalable cluster for long-term retention. Dell also offers the EMS Email Archive service as part of its portfolio of IT Management SaaS offerings.

Benefiting from an innovative archiving strategy

An effective archiving strategy for e-mail and other ESI content can help organizations satisfy retention requirements and optimize their storage infrastructure. Dell archiving solutions are designed to meet these needs—enabling the long-term preservation of data and infrastructure value through storage platforms that facilitate data migration, encryption, and replication. Other practical benefits include enhanced control over unstructured data, simplified management based on automated policies, reduced costs using scalable x86-based hardware platforms, and accelerated e-discovery response. Ultimately, archiving can lead to improved knowledge about an organization and its competitive environment through fast, cost-effective access to massive amounts of valuable information. PS

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.

Bob Ganley is applications lead for storage marketing at Dell, and is responsible for workload-specific storage solutions. His experience in both engineering and marketing provides a unique perspective.

Learn more

- **Dell Intelligent Data Management:** dell.com/datamanagement
- **Dell EMS:** dell.to/Email_Mgmt_Svcs
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DELL

The power to do more

Transforming IT service delivery with on-demand workload provisioning

By Ganesh Padmanabhan

A key part of the Dell™ Virtual Integrated System (VIS), the Dell VIS Self-Service Creator enables end users to automatically provision workloads on demand, enhances administrator control, and helps accelerate IT response to business requests.

The Dell Virtual Integrated System (VIS) brings together an end-to-end solution comprising state-of-the-art servers, storage, networking, and software tools that work as a single dynamically configurable entity that is both open and pragmatic. The result is a fast-to-deploy and responsive infrastructure that helps organizations respond to customers' and employees' changing needs. VIS represents a distinct alternative to the closed nature of proprietary and vertically integrated stacks.

With the economic challenges facing most companies today, IT departments have adopted virtualization as a way to help lower their operational costs while enhancing overall business agility. Although virtualization has largely delivered on its promises, the management of virtualized infrastructures has become increasingly challenging—IT staff may be contending with long lead times when provisioning virtual machines (VMs), a lack of governance and compliance enforcement by current tools, VM sprawl due to the relative ease of deployment, and a lack of support for heterogeneous environments.

The VIS architecture consists of three key components that help organizations address these challenges: Dell Advanced Infrastructure Manager (AIM), the Dell VIS Self-Service Creator, and the Dell VIS Director. AIM provides a single management point for physical and virtual resources that helps to accelerate provisioning of new hardware and applications, increase efficiency, maximize flexibility, and simplify the process of making changes in the data center. The VIS Director is the command center for the next-generation data center, offering high levels of visibility, automation, and customization to help administrators optimize performance and resource utilization, meet service-level agreements, and quickly resolve problems.

The VIS Self-Service Creator—the focus of this article—is an automated workload deployment and management platform for virtual servers and desktops. It provides authorized users with a self-service portal through which they can select and deploy resources automatically, and then manage those resources throughout their life cycles. IT administrators can customize an extensive set of out-of-the-box workflows to automate many of the

day-to-day tasks associated with service delivery across multivendor components including hardware, hypervisors, connection brokers, image deployment technologies, and other management systems. The VIS Self-Service Creator is designed to increase access, control, and flexibility, which can add up to accelerated service delivery and significant savings on both capital and operational expenditures.

Flexible platform to meet different needs

IT organizations generally need to serve multiple groups within the organization, each with different requirements. The challenge is mapping workload services to users with as much flexibility as possible to accommodate each group.

The VIS Self-Service Creator provides a highly flexible platform for rapidly automating the delivery and management of virtual workloads. It maps virtual workloads to users based on policies and processes established by IT departments. Moreover, these policies automate and manage the workload life cycle from requisition through retirement. These capabilities enable IT staff to be responsive to the diverse needs of business lines, server and desktop users, development and production staff, and other groups.

Role-based Self-Service Portal

The Self-Service Portal in the VIS Self-Service Creator allows IT users to view and self-provision application workloads from a service catalog (see Figure 1). This self-provisioning process allows for automated service delivery by taking advantage of predefined configuration blueprints and application workload templates, helping reduce the time and effort required for provisioning while enhancing IT control.

Out-of-the-box integration with role- and identity-managed systems like the Microsoft® Active Directory® directory service enables administrators to configure the service options in the catalog based on user roles. End users also have a view into the cost and the capacity of the virtual workloads, enabling them to choose the one that best meets their requirements.

The portal is also the single point of management for application workloads provisioned by end users. Users can view all the workloads owned by them, connect to any of those workloads, and perform operations such as turning them on and off, reprovisioning them to their initial state, expiring them, and even destroying them. Administrators can make further actions or workflows available to end users if needed. Users can also check the lease status of a workload and ask the group's managers to extend the lease if necessary. The always-available, on-demand capability of the portal results in a significant improvement in the end user's experience.

Governance with policy-based automation

The ability to integrate both IT and business policies into workload-delivery workflows is a cornerstone capability of the VIS Self-Service Creator. Administrators can implement policy-based automation by creating groups that map a specific set of users to a predefined set of workloads that can be deployed on a predefined allocation of hardware resources. Before users can access resources, administrators define policies that limit resource access, help ensure that builds are configured to standards, and enforce process workflows, including approvals.

Administrators can customize the VIS Self-Service Creator for their specific environment by creating policies based on four components (see Figure 2):

- **Business groups:** Allows the grouping of virtual workloads, resources, policies, processes, and

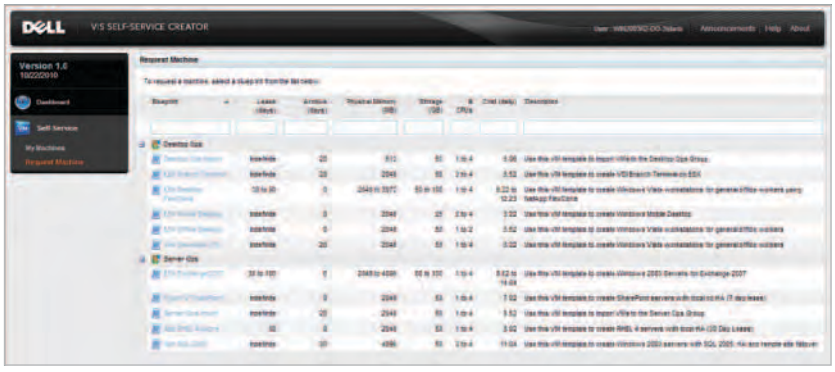

Figure 1. The Self-Service Portal in the Dell VIS Self-Service Creator enables users to easily view and provision workloads from a catalog

management access controls, enabling IT staff to support a range of functions

- **Authorized users:** Identifies users authorized to access workloads and utilize physical resources, and specifies the rights of each user
- **Service blueprints:** Provides a catalog of available virtual workloads, and contains plans and specifications for building, managing, reclaiming, decommissioning, and archiving each workload
- **Resource reservations:** Reserves dedicated compute resources from shared physical infrastructure, which can then be allocated to business groups

Extensive support for existing tools and heterogeneous software

Process changes are often more challenging than technological changes. The VIS Self-Service Creator helps organizations adapt to new workload-delivery paradigms without significantly changing the way they operate. The software's extensibility helps avoid the need to rip and replace existing management tools and processes, thus allowing the organization to quickly increase efficiency and productivity. Administrators can use policies to customize standard process automation without needing to implement code changes.

The VIS Self-Service Creator works with a variety of virtualization platforms (including Microsoft Hyper-V™, VMware® ESX, and Citrix® XenServer® hypervisors) and with imaging processes such as Microsoft Windows® Imaging (WIM), Linux® kickstart, SUSE® Linux AutoYaST (Yet Another Setup Tool), and hypervisor cloning. Out-of-the-box plug-ins facilitate image deployment using tools from vendors such as BMC Software, CA Technologies, Hewlett-Packard, and IBM, as well as virtual desktop delivery using Citrix XenDesktop® software. An extensibility framework based on Microsoft .NET and Windows Workflow Foundation enables administrators to design and manage custom data models and workflows.

Virtual desktop delivery

Compared with servers, desktop environments typically have more components, greater scale, and a higher rate of change, and often demand a faster time to delivery—exacerbating the need for automation, orchestration, and control. The VIS Self-Service Creator helps to simplify and abstract the complexity associated with managing a multivendor desktop solution, automating and orchestrating the tasks required to deliver the desktop service without requiring IT staff to use separate element managers.

Support for virtual desktop delivery is enabled through plug-in modules that automate

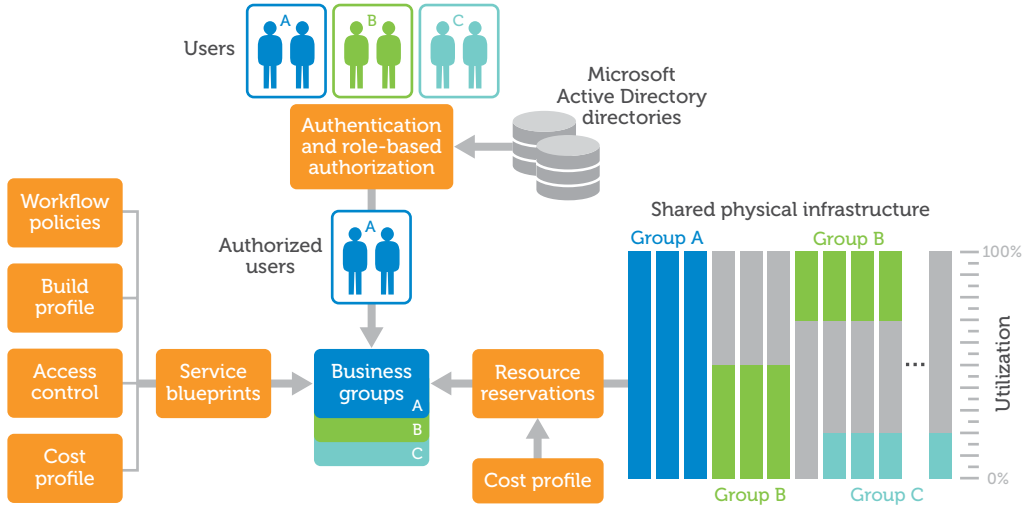

Figure 2. The Dell VIS Self-Service Creator can be customized for the needs of each environment

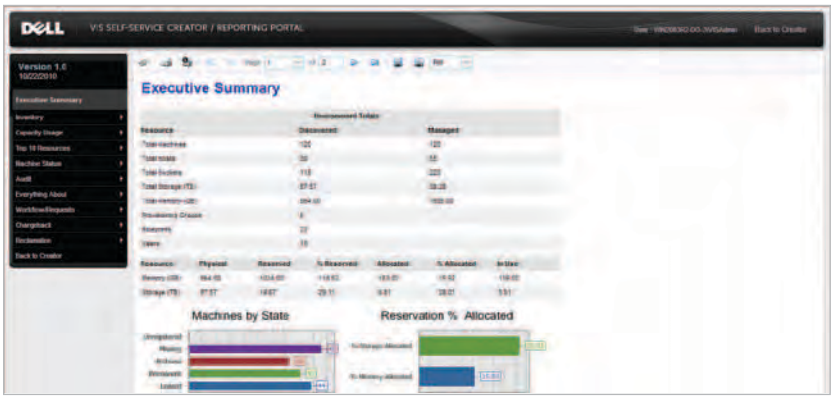

Figure 3. The Dell VIS Self-Service Creator provides detailed reports to facilitate capacity planning

provisioning and ongoing management of virtual desktop devices from a single management console. Using the VIS Self-Service Creator, administrators can deliver and manage virtual desktops independent of the hypervisor, connection broker, and image deployment technology, all through a single management interface.

Virtual machine sprawl control

VM sprawl is a common concern for organizations that have deployed desktop or server virtualization, where it is not uncommon for 10–20 percent of VMs to be overprovisioned, inactive, or abandoned. The ability to quickly create VMs without the discipline and control typical of physical infrastructures results in VMs being provisioned without proper approvals, being overprovisioned, and consuming resources after they are no longer needed. Reclaiming this underutilized capacity can be such a labor-intensive and time-consuming process that it is performed rarely, if at all. The VIS Self-Service Creator enables organizations to control VM sprawl and optimize resource utilization by helping them to reduce waste, reuse resources, and reclaim unused resources.

Business reporting

The VIS Self-Service Creator provides detailed reports on provisioning and resource utilization, costs of usage, and user and group metrics to IT operations managers, helping them plan for service delivery capacity (see Figure 3). This detailed reporting capability allows for control and transparency of this radical new method of service delivery.

Effective automation for virtual workloads

The Dell VIS Self-Service Creator is an automated way of delivering and managing IT services, and organizations are already seeing the benefits of this approach—including reducing service delivery times from days to minutes, and successfully controlling VM sprawl while increasing utilization and reducing costs. The VIS Self-Service Creator is a powerful building block of the Dell VIS architecture, one that helps reduce management complexity in virtualized environments while enabling IT organizations to meet business needs quickly and efficiently. PS

Ganesh Padmanabhan is a technical marketing manager for Dell's next-generation data center solutions. He has previously held many positions across the enterprise product portfolio.

Learn more

Dell VIS:
dell.com/vis

Enhancing endpoint security by deploying appliance-based PC lockdown

A flexible PC lockdown policy can tighten security. The Dell KACE™ family of systems management appliances applies best practices for PC lockdown that do not hinder user productivity or overburden service desks, while helping improve network security.

As end users become increasingly mobile and reliant on Web-based applications, guarding sensitive information against security threats becomes a crucial consideration for IT departments. Security lapses can lead to customer privacy violations, loss of user and community trust, heavy fines and compliance penalties, negative press, and significant damage to the financial health of an organization.

Network endpoints—including desktop and workstation PCs, laptops, servers, and other connected devices—are all vulnerable to security threats. Of course, managing security policies effectively across an entire business or institution is not as simple as installing firewalls and other safeguards to protect against external network intrusions. Comprehensive security measures need to be applied using a layered approach. These measures may involve increasingly effective patch management, security auditing and enforcement of allowed applications, device discovery and inventory capabilities to help ensure only authorized devices are network attached, the use of a self-service user portal for approved software distribution, and the implementation of a flexible but viable PC lockdown policy.

Tools designed to support an integrated, collaborative approach to security and systems management can help IT departments manage security effectively. PC lockdown capabilities such as those included in Dell KACE K1000 Management Appliances can play a critical role by balancing added security controls without negatively affecting user productivity (see the "Taking a holistic approach to endpoint security" sidebar).

Enhancing security without sacrificing flexibility or user productivity

PC lockdown involves controlling endpoint systems to varying degrees. This capability can range from removing local administrative rights to restricting Internet browsing abilities and standardizing PC configurations. IT professionals can choose the appropriate lockdown approach for individual users or groups, so that they can maintain an acceptable level of security while still allowing users to be productive. In addition, lockdown helps administrators simplify the management and servicing of PCs.

Taking a holistic approach to endpoint security

Dell KACE Management Appliances are designed to be an easy-to-use, cost-effective complement to traditional software security packages. Taking an integrated, collaborative approach to security and systems management, Dell KACE Appliances help organizations provide a holistic way to manage endpoint security—whether those endpoints are located in a business, agency, classroom, or on the road.

Through its appliance-based approach, the Dell KACE solution helps make added security capabilities, including PC lockdown, available to organizations of all sizes. Designed to allow administrators of all skill levels to learn and use the appliance easily, these appliances also offer service desk functionality that merges seamlessly with the systems management console—enabling IT staff to view end-user requests regarding user privileges and address them from a single location. In tandem, the Dell KACE Appliance offers a self-service user portal that enables organizations to publish approved applications, license keys, files, and scripts that users can access to install software or configure their systems—regardless of whether they have local administration rights on their PC.

In addition, the appliance's Secure Browser feature allows for creating a virtualized instance of the Mozilla Firefox browser, essentially isolating the browser from the OS and associated computer to help prevent hostile changes that might otherwise be inadvertently downloaded from the Internet. White lists and black lists can be created to limit the sites users can visit and the processes their browsers are permitted to run.

As organizations migrate to the Microsoft® Windows® 7 OS platform, many of them are also reevaluating their PC lockdown strategies to increase configuration controls. In the fourth quarter of 2009, Gartner surveyed audiences at events composed mainly of individuals in IT infrastructure and operations organizations about their lockdown policies. In response to the question "What is the trend at your organization with respect to controlling the PC?," 52 percent of organizations indicated they are increasing the percentage of (PC) users that are locked down.[1] At the same time, overly strict controls can often outweigh their intended benefits. For example, unilaterally rescinding users' administrative rights can cut productivity, create backlash, and increase the number of support calls received.

However, when used appropriately, PC lockdown helps avoid rigid all-or-nothing policies that hamper the ability of IT organizations to meet their goals. It enables IT administrators to implement flexible and effective controls, regardless of the number of managed systems. End-user software requests can be fulfilled with self-service capabilities. In addition, PC lockdown facilitates secure Internet access and helps shield endpoints from corrupt downloads without blocking access to Web pages.

Despite its significant advantages, PC lockdown is not a magic bullet for efficiency. Restricting software installations can hamper user productivity, and support issues may simply shift from security

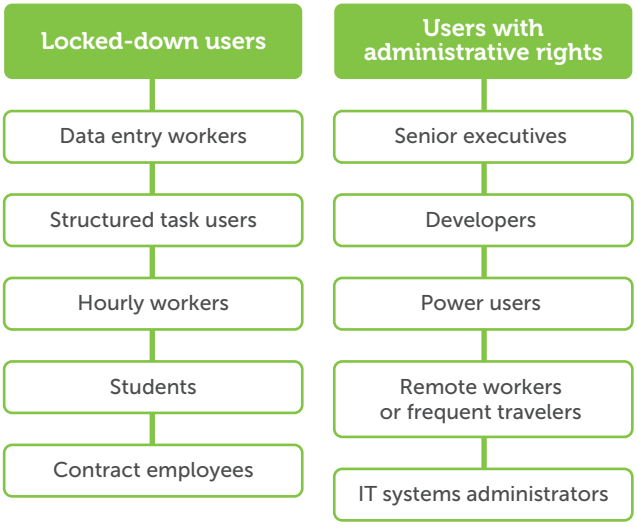

Figure 1. Role-based privileges allowing some users to customize PCs while locking down others

[1] "Organizations are increasing PC lockdown," by Terrence Cosgrove and Ronni J. Colville, Gartner, Inc., February 2, 2010.

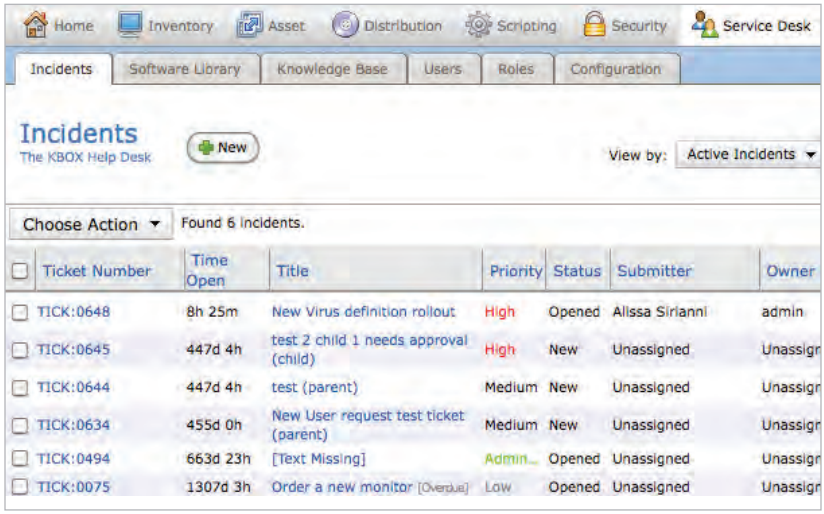

Figure 2. Service desk integration for modifying PC lockdown from a single console

to usability. Certain applications can still be installed without administration rights, which may allow security breaches to occur even with a PC lockdown policy in place. In addition, some users need to be locked down, while others require flexibility in configuring software for their particular roles within the organization. Some common best practices can help enterprises get the most value out of an enhanced endpoint security strategy:

- **Assign role-based privileges:** Assigning role-based privileges helps prevent users such as data entry workers, structured task users, hourly workers, and students from executing custom software installations (see Figure 1). Role-based privileges allow users that need the power to customize their PCs (including systems administrators, senior executives, developers, power users, remote workers, and frequent travelers) to install the software they require to be productive.
- **Apply Internet and application lockdown:** The increasing popularity of Web-based applications means that PCs can easily get corrupted by user activity on the Internet. IT departments can enhance security levels by preventing access to personal e-mail, known corrupt sites, and peer-to-peer sites to help block malicious file downloads and prevent bandwidth saturation. Managing access in this way helps IT departments to ensure standardization and maintain the business or classroom functionality of organization PCs by preventing access to consumer applications, games, and nonstandard applications.
- **Integrate the service desk for PC lockdown:** Service desk capabilities allow users to make requests to ask for changes in their privileges. Administrators can grant or deny privilege change requests from across the organization using a single console (see Figure 2).
- **Allow locked-down users to install approved software:** A base system image may not contain all the software that users need—and IT administrators frequently do not have the time to install or distribute every piece of custom software. By allowing employees to install their own software from a list of approved applications, IT organizations can provide flexibility for end users while still maintaining security.

Deploying a secure PC lockdown policy

Controlling which applications end users can install and access on their PCs, laptops, and other devices is a critical factor for maintaining strong network security in organizations. However, overzealous restrictions can negatively affect user productivity. PC lockdown capabilities like those built into the Dell KACE K1000 Management Appliance provide flexibility while allowing IT organizations to maintain centralized control over security policies. By implementing the best practices explored in this article, enterprises can maximize end-user productivity while also protecting against security threats. PS

Learn more

Dell KACE K1000 Management Appliance:
kace.com/systems-management-appliance

Dell KACE endpoint security:
kace.com/endpoint-security

Dell KACE security audit and enforcement:
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Efficient Enterprises do more with Dell EqualLogic

From luxury cruise lines and weather forecasting to online hosting and manufacturing, organizations are using Dell™ EqualLogic™ iSCSI SANs to transform the way they store and manage data, increase efficiency, and enhance reliability and performance.

The IT infrastructure never sleeps in today's always-on, data-driven world. Unprecedented expansion of digital content and delivery systems requiring real-time data access has many traditional storage environments bursting at the seams. Virtualized Internet SCSI (iSCSI) storage area networks (SANs) help enterprises cost-effectively address the many challenges and opportunities of rapid data growth in a consolidated storage environment through accelerated deployments, automated storage optimization, and intuitive administration.

The success stories highlighted here demonstrate how companies in five different industries are using Dell EqualLogic PS Series iSCSI SANs in virtualized environments to provide an efficient storage platform for fast, flexible expansion that can meet changing requirements. Their results show that regardless of data type, virtual storage can help to simplify storage management, enhance performance, increase availability, and reduce total cost of ownership (TCO) in virtually any IT environment.

Dell EqualLogic PS Series iSCSI SANs provide an easy-to-manage storage platform to help meet the challenges of data growth. Find out more at dellenterprise.com/equallogic.

Carnival

38%

In proof-of-concept tests, an EqualLogic hybrid array achieved a 38 percent performance improvement over Carnival's current production data warehouse environment.

Carnival Cruise Lines: Smooth sailing to storage efficiency

From menu selections to activities with the kids, the logistics that make a getaway cruise run smoothly require responsive, reliable data storage. Each Carnival Cruise Lines ship operates as a self-sufficient environment in which power and floor space are limited, making IT efficiency a critical requirement. Several years ago, Carnival engaged Dell Consulting Services to evaluate its options, and began virtualizing shipboard servers using the VMware® vSphere™ platform running on Dell PowerEdge™ servers with Intel® Xeon® processors and EqualLogic PS Series storage arrays.

Not only does the virtualized server and storage platform help Carnival deliver high availability and redundancy for its floating data centers, but the implementation was so successful at boosting efficiency that Carnival also adopted PowerEdge servers and EqualLogic storage in its shoreside data center and remote office operations. Now, Carnival is moving its critical Oracle® Database 10*g* data warehouse from a Sun Solaris and Fibre Channel platform to the Red Hat® Linux® OS running on PowerEdge servers and an EqualLogic iSCSI SAN. Driven by the combination of storage automation and intelligence in the EqualLogic SAN along with advanced VMware vStorage Application Programming Interfaces (APIs) for Array Integration (VAAI), Carnival's virtualization strategy is designed to extend efficiency throughout its IT infrastructure.

"Across our fleet, the combination of VMware running on efficient Dell servers with EqualLogic storage arrays is proving to be a green solution, while also greatly reducing the cost of running our ships' critical applications," says Doug Eney, vice president of information systems engineering at Carnival Cruise Lines.

Xtium: Cloud computing with a silver lining

Infrastructure-as-a-service provider Xtium offers private cloud, virtual hosting, and disaster recovery services. Its operations centers in Valley Forge, Pennsylvania, and Las Vegas, Nevada, offer 10 times the service at one-third of the legacy costs, 100 percent recovery, and 99.999 percent availability. When Xtium needed to deliver SAP® "test drive" environments complete with Microsoft® SQL Server® databases to enable SAP customers to try and buy software, the company turned to Dell to help meet SAP's requirement that customers be fully provisioned within 24 hours.

Xtium was already using more than 18 EqualLogic PS Series storage arrays, including EqualLogic PS5000X, EqualLogic PS5000XV, EqualLogic PS5500E, EqualLogic PS6000E, and some older models, together with PowerEdge R610 servers with the Intel Xeon processor 5500 series as VMware ESX hosts. The company simply upgraded to EqualLogic firmware version 5.0 to enable the use of thin clones—thin-provisioned, writable copies of data volumes—and leveraged direct integration with its VMware vSphere 4.1 environment through the vStorage APIs. The company can now make copies of golden images for SAP customers as well as for virtual desktop infrastructure projects with unprecedented speed and efficiency, using optimized disk space.

"We wanted to provide a platform that we could easily support with lean, expertly focused staff and still provide the very robust services that you would find in a high-end environment—and provide it cost effectively," says Xtium CTO Tim Vogel. "As we build from each customer storage footprint to one with more and more storage, we're just adding building blocks. The Dell EqualLogic platform is a perfect fit. It provides very high-scale functionality that we're very pleased with. It scales easily without ripping and replacing."

Xtium

95%

Advanced EqualLogic firmware helped Xtium reduce SAN network traffic by 95 percent for its copy process using Xcopy.

AccuWeather

80%

AccuWeather reduced storage administration time by 80 percent using an EqualLogic SAN, and is saving five figures a year by eliminating calls to external storage experts.

Dell

90%

By deploying a virtualized storage and server infrastructure on an EqualLogic SAN, Dell IT accelerated application deployment by 90 percent.

Pacific Sunwear

106 TB

A unified, virtualized SAN deployment of EqualLogic arrays enabled the Pacific Sunwear IT group to accommodate approximately 106 TB of data.

AccuWeather: Sunny forecast for growth

Producing localized weather forecasts every hour for 2.7 million locations worldwide is a data-intensive business. More than 125 million Americans receive an AccuWeather-generated forecast each day, and the company's Web portal alone receives as many as 18 million daily hits, with major spikes during severe weather. As the company grew, it encountered challenges of increased space, power, and cooling requirements for its legacy server environment.

To meet these rapid growth requirements, AccuWeather consolidated its legacy systems onto PowerEdge servers and deployed a VMware ESX cluster of 150 virtual machines on six PowerEdge R900 rack-mounted servers with Intel Xeon E7330 processors. These servers connected to three iSCSI arrays: an EqualLogic PS5000XV Serial Attached SCSI (SAS) array along with EqualLogic PS5000E and EqualLogic PS6000E Serial ATA (SATA) arrays. In total, the SAN provides about 20 TB of shared storage.

The VMware virtual disk images are stored on the SAN, and the EqualLogic Auto-Snapshot Manager/VMware Edition software leverages native VMware technology to create hypervisor-aware, SAN-based snapshots of virtual machines, helping to automate data management and enhance backup and recovery.

Christopher Patti, AccuWeather's director of technology, notes that the EqualLogic SAN is incredibly easy to use. "We can very quickly create a point-in-time snapshot, do all our work on it, upgrade it, and then roll it out to production," he says. "A major system upgrade that would have previously taken three people a week can be done by our server administrator in one day."

"We're growing by leaps and bounds, both domestically and globally. We need to have an IT infrastructure that is capable of supporting extremely fast growth."

—Steven Smith
AccuWeather CIO
August 2010

Dell: Dynamic and cost-effective operations

The Dell IT group understands the challenges of increasing IT efficiency very well. A few years ago, it was faced with managing a complex, rapidly growing IT infrastructure that was beginning to demand increases in budget just to preserve the status quo. So when it came time to refresh hardware, Dell IT looked for innovative ways to accommodate expansion and improve business agility while reducing costs. The Dell IT staff worked with the Dell Infrastructure Consulting Services team to create an efficient model for data center virtualization running VMware virtualization software on PowerEdge servers and EqualLogic PS Series storage arrays.

Today, Dell IT uses EqualLogic SANs to provide a shared pool of storage. Virtualized storage provisioning enables Dell IT to maximize hardware consolidation and reduce hardware acquisition costs. For example, adopting VMware vStorage Thin Provisioning has enabled administrators to oversubscribe storage capacity by creating virtual logical storage volumes and assigning them to applications. Physical storage is then allocated only when data is actually written to the storage space—an approach that allows each server to host an increased number of virtual machines.

"Dell EqualLogic PS Series storage systems are the perfect fit for our deployment model," says Matt Brooks, senior enterprise architect in the Dell IT group. "PS Series systems provide virtualized storage resources that adjust dynamically according to changing application needs, without manual intervention. The PS Series also provides easy scalability, which is essential for protecting our investment."

PacSun: Unified storage to keep tabs on fast-changing trend data

Pacific Sunwear (PacSun) started as a little surf shop in Newport Beach, California, and has grown to become one of the top names in teen clothing, with nearly 900 stores nationwide. This growth is due in part to the company's ability to keep up with the latest trends in teen fashion, which relies heavily on collecting data on a daily basis from all stores, and designing clothing lines to the latest styles. Supporting and provisioning this amount of data for key business applications requires a flexible and highly scalable storage system. With terabytes of data slowing down the previous storage system, the IT team decided that virtualizing its data center with VMware vSphere could help unify storage while reducing management costs.

PacSun created a virtualized data center by deploying vSphere on PowerEdge blade servers and an EqualLogic PS Series SAN. To accommodate approximately 106 TB of data, the IT group deployed a total of nine EqualLogic arrays in a unified, virtualized SAN. The ability to support both Microsoft Windows® and Apple Mac OS X environments has made the EqualLogic SAN an outstanding fit for the company. The tiered storage capability built into the EqualLogic arrays enabled the PacSun team to match drive performance and capacity to specific application demands.

"We compared several of the top systems in the market," says Ira Ham, director of network and information security at PacSun. "For us, the Dell EqualLogic PS Series offers the best features, reliability, and ease of use, and it provides compatibility with our Apple Macintosh environment, which was a requirement for us."

Smart storage

In this video, learn how a tiered storage strategy based on EqualLogic PS Series iSCSI SAN arrays can help organizations cost-effectively meet the performance and capacity needs of enterprise workloads.

equallogic.com/whytier

Dell EqualLogic iSCSI SANs: Defining storage efficiency

Dell EqualLogic PS Series iSCSI SAN arrays provide a solid foundation for data growth designed to withstand the test of time. The virtualized peer storage architecture enables the arrays to scale seamlessly, while intelligent software integrates with tier 1 applications and virtual environments. Advanced storage management technologies such as automatic configuration, load balancing, and performance optimization help avoid downtime when increasing capacity, moving data between storage tiers, or load balancing storage. By offloading management tasks from administrators to intelligent storage arrays, enterprises can streamline operations and free up resources to drive productive business projects. And with industry-leading TCO, comprehensive software features, and seamless scalability through flexible iSCSI networking, it's no surprise that Efficient Enterprises like Carnival, Xtium, AccuWeather, Dell, and Pacific Sunwear can do more with EqualLogic. PS

Storage smarts: Improving IT efficiency with Dell EqualLogic

At the recent Dell Storage Forum: EqualLogic User Conference, attendees learned best practices for optimizing virtualized storage, networked with peers, experienced hands-on lab training, and picked the brains of Dell experts and technology partners.

Following the resounding success of the first Dell Storage Forum: EqualLogic User Conference in March 2010, Dell hosted an expanded October conference in San Diego, California. This weeklong invitation-only event focused on a key area of concern for over 25,000 users in the Dell™ EqualLogic™ storage community: how EqualLogic Internet SCSI (iSCSI) storage area network (SAN) arrays and software tools can advance organizational goals to increase IT efficiency and flexibility in the Virtual Era.

Conference attendees explored best practices and storage optimization techniques as they networked with peers, technology solution partners, and Dell engineering, support, and service experts. The event offered more than 40 technical breakout sessions ranging from introductory discussions to deep-dive tutorials, as well as hands-on instructor-led lab training by the Dell Education Services (DES) team with EqualLogic technical support. The hands-on courses included a half-day basic configuration and management course tailored for users new to EqualLogic storage, and two-day intensive courses that covered advanced management and data protection as well as VMware® vSphere™ integration. (For more information on training available from DES, see the "Continuing education" sidebar.)

Storage optimization in the Virtual Era

The conference offered three content tracks. The core product track started with the basics of EqualLogic storage, then moved on to topics such as EqualLogic Host Integration Tools, the SAN HeadQuarters (SAN HQ) tool, storage tiering, and SSDs in a SAN. From there, it delved into an engineering tutorial on emerging storage array offloads such as the VMware vStorage Application Programming Interfaces (APIs) for Array Integration (VAAI). The most popular single breakout session at the conference—not surprisingly—was the Engineering Innovation session, where attendees were treated to demonstrations of upcoming features and products that combine EqualLogic technology with other areas of the Dell portfolio and with solutions from virtualization partners.

In addition to best-practices sessions for iSCSI deployments with server and desktop virtualization,

the Accelerating Virtualization track included in-depth sessions on application best practices. One great session, presented by a storage engineer from Dell's internal IT operations team, detailed Dell's own deployments of EqualLogic storage for Microsoft® Exchange services, as well as the team's future plans.

In the Networking Infrastructure track, attendees followed a learning path starting with the basics of iSCSI networks and how the important elements of IP and Ethernet networking apply to SANs. Other sessions looked at iSCSI initiators, EqualLogic multipath I/O tools, scaling iSCSI switch fabrics to meet heavy workload demands, and migrations to 10 Gigabit Ethernet storage networks.

In response to suggestions from March conference attendees, Dell established formal feedback sessions on future products, technical support services, and current product features, and hosted numerous networking events that fostered informal conversations between EqualLogic engineers and customers. These networking sessions notably included an Ask-the-Expert evening reception and a closing party on the flight deck of the USS *Midway* aircraft carrier floating museum. Many ideas were swapped, and at least one enhancement discussed with the EqualLogic team is already planned for a major 2011 software release. For conference feedback and comment postings from conference attendees and Dell experts, visit twitter.com/equallogic and follow #eqlconf.

Executive highlights

Darren Thomas, vice president and general manager of Dell Storage, welcomed conference participants and shared Dell's vision for building an efficient data structure through deduplication, wide area network (WAN) optimization, thin provisioning, and intelligent data management. He also touched on how solutions such as Dell Advanced Infrastructure Manager (AIM) can help transform an enterprise's data management strategy.

The next day, chairman and CEO Michael Dell opened his keynote with a little-known story about how Dell actually started out as a storage company, and entered the PC market accidentally—basing its original business model on hard drive upgrade kits at a time when IBM® PCs came only with floppy drives. Fast-forwarding to today, he said that since the acquisition of EqualLogic in 2008, the company has added more than 22,000 customers (now more than 25,000 at press time). He also shared that Dell is installing petabyte EqualLogic configurations, planning to expand the Dell storage portfolio to include combined block and file services based on acquired Exanet technology, and furthering its development in IP-based storage with lossless Ethernet based on Data Center Bridging.

Attendance on demand

EqualLogic users who were unable to attend the conference can access the presentations and other information by logging onto the EqualLogic support site at equallogic.com/support and going to the Resources tab. Monthly Dell educational Webcasts, available by requesting an invitation through the EqualLogic support site, also leverage content from the conference. Planned future Webcast topics include using SAN HQ to understand storage performance and using Microsoft SharePoint® software with EqualLogic storage.

Dell storage teams have already begun planning for the next conference, expected in the first half of 2011. EqualLogic users interested in attending should be sure to reserve their travel budgets: the next event promises to have more sessions on a broader set of storage and enterprise technologies, more seats, and more flexible options for hands-on lab training. PS

Continuing education

In addition to conducting popular hands-on labs at Dell Storage Forum: EqualLogic User Conference events, the Dell Education Services (DES) team offers many other online self-paced and instructor-led classes worldwide focusing on Dell storage. Current EqualLogic storage courses cover topics such as basic configuration and management, advanced features, and business continuity and disaster recovery, and can benefit those new to EqualLogic arrays as well as experienced IT professionals. To learn more about DES training for EqualLogic storage, visit learndell.com/equallogic.

Learn more

EqualLogic User Conference:
bit.ly/edy4fJ

Choosing a storage ecosystem for transaction-intensive Oracle database applications

By Suresh Jasrasaria, Chidambara Shashikiran, and Chris Almond

Dell™ EqualLogic™ PS Series arrays can be an outstanding match for OLTP applications based on Oracle® Database 11*g* with Oracle RAC running on Red Hat® Enterprise Linux® platforms.

Best practices for Oracle databases

This white paper from the Dell EqualLogic Best Practices Series offers guidelines for deploying Oracle Database 11*g* R2 RAC for OLTP on EqualLogic storage. It also provides results of various benchmark tests conducted on an optimum EqualLogic storage configuration.

dell.to/11g-EqualLogic

Online transaction processing (OLTP) is at the heart of most enterprise functions. As the foundation for a wide range of mission-critical applications—including e-commerce, vertical-industry-specific applications, and horizontal functional applications for areas such as human resources and finance—OLTP operations, particularly those utilizing Oracle database platforms, depend on exceptional storage performance and reliability.

But high storage performance and reliability are not the whole story. Over time, the data generated by OLTP applications can grow exponentially—which means that the storage ecosystem must be able to sustain the high performance as storage capacity requirements expand over time. And as globalization continues, organizations are facing demanding service-level agreements (SLAs) in which 24/7 operation has become the de facto standard for mission-critical applications—which means that performance and capacity scalability must be achieved nondisruptively.

One way to cost-effectively accommodate exponential OLTP application data growth is to design and manage the Oracle database storage ecosystem for not only nondisruptive performance and capacity scalability, but also flexibility, where older and less frequently accessed data can be moved to less expensive online storage (see Figure 1).

Dell EqualLogic PS Series Internet SCSI (iSCSI) storage area network (SAN) arrays offer a set of innovative features and options to help organizations cost-effectively deploy Oracle database storage for OLTP applications. In addition, several best practices—developed by Dell during extensive Oracle database performance benchmark testing at Dell Labs—can help enterprises ensure that their storage ecosystem is optimized for OLTP applications on Oracle databases with Oracle RAC running on Red Hat Enterprise Linux platforms.

Utilizing flexible, scalable EqualLogic storage for Oracle databases

Deploying an appropriate storage system to support Oracle databases for OLTP applications is important because OLTP applications can generate large volumes of data and create heavy I/O demands. An OLTP application requires the database to process many concurrent transactions with low latency. Unlike data warehousing workloads, which involve sequential I/O and large block sizes, OLTP workloads tend to involve random I/O and small block sizes. I/O operations in OLTP workloads are mostly reads, although in some cases the writes can also be high. The database is operated in real time by end users, who issue data modification statements directly on the data. A typical data warehouse transaction requires reading a large amount of information from a database containing historical data that is refreshed periodically (for

example, every night) using automated scripts. A typical OLTP transaction, in contrast, needs only a small amount of recent or current data from a database that has older data online for regulatory compliance or fraud detection and occasional query.

Flexibility is the key to handling these OLTP-specific demands on the storage ecosystem. IT professionals typically approach scalability in terms of capacity. But for OLTP workloads that create a large number of user-generated queries requiring quick response, the ability to nondisruptively scale performance with capacity is critical as well.

Traditional storage systems are often not well suited to meeting these flexibility demands. Performance tends to degrade as systems are scaled up for additional capacity. Traditional storage also does not provide sufficient flexibility to tier storage across multiple RAID and drive types without disruption, and as a result, these systems can incur high total cost of ownership when used to support OLTP applications. Tiering requires moving old or infrequently used data to slower, less expensive storage media based on administrator-defined business rules; traditional scale-up storage requires manual movement of data from Serial Attached SCSI (SAS) drives to Serial ATA (SATA) drives, or from SAS drives to solid-state drives (SSDs).

Dell EqualLogic PS Series iSCSI SAN arrays support Oracle deployments through a scale-out peer storage architecture that helps simplify the deployment and administration of consolidated storage environments. This architecture is designed to provide cost-effective support for flexible capacity expansion and outstanding OLTP performance. Perpetual self-optimization with automated load balancing across disks, RAID sets, connections, cache, and controllers further facilitates exceptional capacity and performance scalability.

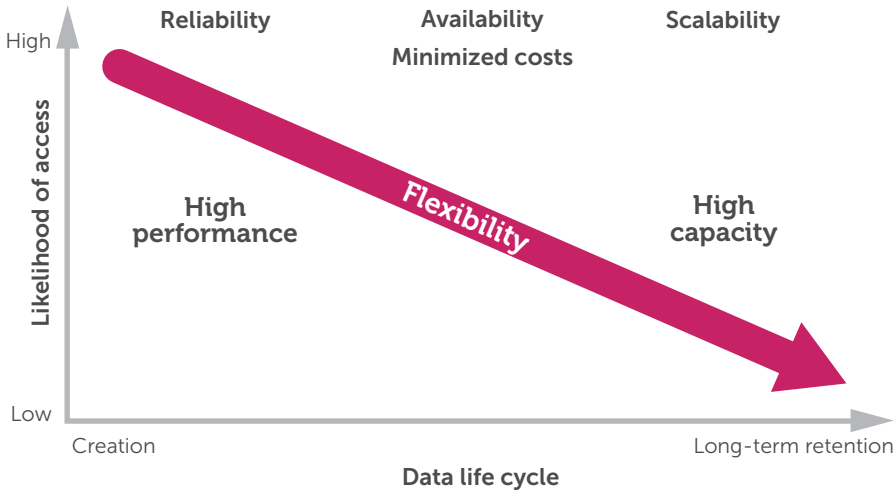

Figure 1. Flexible, cost-effective tiered storage helps avoid database performance erosion throughout the data life cycle

EqualLogic storage supports the simultaneous scaling of both performance and capacity to help organizations provide uninterrupted support for critical OLTP applications without downtime. IT staff can easily create snapshots, clones, and replicas for backup and recovery and testing without incurring additional software costs. In addition, these arrays help streamline management of elastic pools of storage through a Web browser–based graphical user interface or a command-line interface.

Enhancing database performance with load balancing

Oracle Automatic Storage Management (ASM), introduced in Oracle Database 10*g*, is designed to simplify management of underlying storage systems and improve database performance through load balancing. Dell EqualLogic PS Series iSCSI SAN arrays support load balancing among all available disk drives within a storage pool, and ASM enhances this capability by providing I/O load balancing across ASM disk groups. These two features complement each other to enhance the performance and flexibility of the configuration. For example, test results from Dell Labs have shown that using Oracle ASM in combination with EqualLogic load balancing can provide a significant increase in I/Os per second (IOPS) compared with EqualLogic load balancing alone (see Figure 2).[1]

Benchmarking storage performance for OLTP applications

In September 2010, Dell Labs performed a series of tests to measure how well Dell EqualLogic storage arrays can handle the demands of OLTP applications based on Oracle Database 11*g* with Oracle Real Application Clusters (RAC) running on a Red Hat Enterprise Linux platform on Dell PowerEdge™ servers. These tests, based on the Oracle I/O Calibration (ORION) and Quest Benchmark Factory for Databases tools, were designed to validate the I/O capacity of the EqualLogic arrays in an OLTP environment and the response times experienced by end users of a typical application.[2]

Although the benchmarks used only one EqualLogic array, because of the innovative EqualLogic peer storage

[1] For more information on these tests, see "Performance implications of running Oracle ASM with Dell EqualLogic PS Series storage," by Raghunatha M., Ramappa Ravi, and Wendy Chen, Dell Product Group, July 2009, equallogic.com/resourcecenter/assetview.aspx?id=8743.

[2] For more information on these tests, see "Sizing and best practices for deploying Oracle 11*g* transaction processing databases on Dell EqualLogic storage," by Chidambara Shashikiran, Dell Product Group, September 2010, dell.to/11g-EqualLogic.

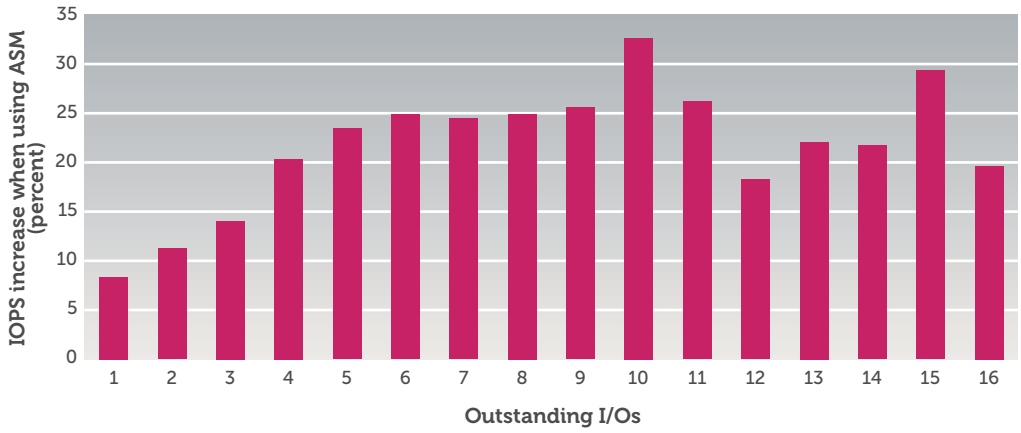

Figure 2. Oracle ASM complements Dell EqualLogic load balancing to help improve OLTP application performance

architecture, the results obtained in these benchmarks would scale linearly when additional arrays are added to the test configuration.[3]

ORION I/O profiling test results

The ORION I/O profiling test simulates workload-specific I/O patterns to gauge the raw I/O capacity of a storage system. OLTP workloads typically involve random I/O operations with small data blocks and a read/write ratio of approximately 70:30.

The ORION tests were executed on both EqualLogic PS6010XV and EqualLogic PS6010S array models. The EqualLogic PS6010XV array used fourteen 300 GB, 15,000 rpm SAS disks in a RAID-10 configuration, with two of the same SAS disks as hot spares; the EqualLogic PS6010S array used fourteen 100 GB SSDs in a RAID-10 configuration, with two of the same SSDs as hot spares.

In these tests, the EqualLogic PS6010XV array produced approximately 4,800 IOPS for 100 percent read I/O with an 8 KB block size and 4,000 IOPS for OLTP-type transactions while staying within the generally accepted disk latency limit of 20 ms for both read and write IOPS. For block sizes as large as 64 KB, this single EqualLogic PS6010XV array was able to sustain approximately 3,000 IOPS for a typical OLTP workload.

The EqualLogic PS6010S array provided outstanding performance with very low corresponding latencies. For 100 percent read I/O with an 8 KB block size, this array sustained a maximum of approximately 34,000 IOPS—approximately 7 times the performance of the EqualLogic PS6010XV array. For a workload with a read/write ratio of 70:30 and an 8 KB block size, the array sustained a maximum of approximately 16,000 IOPS—approximately 4 times

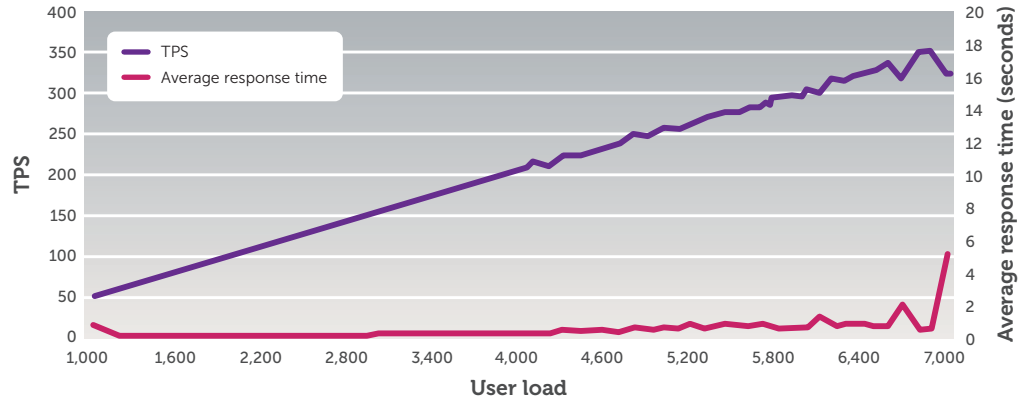

Figure 3. A Dell EqualLogic PS6010XV array can deliver sub-second application response times with thousands of concurrent users

[3] For more information on the EqualLogic peer storage architecture, see "Inside the Dell EqualLogic PS Series iSCSI storage arrays," available at equallogic.com/resourcecenter/assetview.aspx?id=5419.

the performance of the EqualLogic PS6010XV array. And for block sizes as large as 64 KB, the EqualLogic PS6010S array provided 3.3 times the performance of the EqualLogic PS6010XV array.

During both 8 KB ORION test runs, the EqualLogic PS6010S array never exceeded the generally accepted disk latency limit of 20 ms even at a very high queue depth level (which simulates load). This result indicates that when using the EqualLogic PS6010S, even at a very high I/O load, end users would not experience delays for OLTP-driven applications supported by the Oracle database.

Quest Benchmark Factory for Databases test results

Because I/O capacity depends on both the size and randomness of the data blocks, as well as on the read/write ratio of the I/O operations, it is important to test storage systems within the specific transaction processing environment they will support. Dell Labs used Quest Benchmark Factory for Databases to simulate a Transaction Processing Performance Council Benchmark C (TPC-C)–style workload using a two-node Oracle Database 11*g* R2 database with Oracle RAC, with the goal of measuring how well storage system performance translates to performance at the application level. The tests used the same EqualLogic PS6010XV array as in the ORION tests, along with two PowerEdge R710 database servers. The database elements, redo logs, archive logs, flash data, and Oracle Clusterware were managed using Oracle ASM.

With an Oracle Automatic Memory Management (AMM) MEMORY_TARGET setting of 40 GB and four ASM database volumes in use, the EqualLogic PS6010XV array produced approximately 348 transactions per second (TPS) at a load of 6,900 users with a response time of 0.671 seconds (see Figure 3). This result indicates that even with several thousand concurrent users, the average response time for the application would be well within the generally accepted application response time limit of less than 1 second.

Supporting Oracle databases with flexible, cost-effective storage

Designing storage infrastructures to support Oracle databases requires careful storage system selection and configuration to help ensure high OLTP application performance. By using Dell EqualLogic PS Series iSCSI SAN arrays that offer nondisruptive high performance and capacity scalability as well as exceptional flexibility, organizations can cost-effectively implement their key mission-critical OLTP applications on Oracle databases. PS

Learn more

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

Oracle solutions from Dell:
dell.com/oracle

EqualLogic storage at the Dell TechCenter:
delltechcenter.com/page/equallogic

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Managing unstructured data in object-based storage

By Derek Gascon and Greg White

Object-based storage offers an innovative approach to storing and managing vast amounts of unstructured data, from medical images to e-mail. The Dell™ DX Object Storage Platform can help preserve data, meet compliance requirements, and reduce costs.

Dell DX Object Storage Platform demos

These Dell TechCenter demonstration videos provide an overview of the management interface and configuration of the DX platform and the process for retiring a drive.

dell.to/f8CD3S

The amount of data created each year is growing exponentially, and most of this data comes in unstructured form such as e-mail, instant messages, graphics, images, and video. A substantial portion of this unstructured data is also subject to industry or government regulations for access and long-term retention, and must be appropriately classified, managed, and placed in storage systems that are easily accessible for search and discovery.

However, today's file systems are not well suited to the long-term storage of massive amounts of unstructured data. The Dell DX Object Storage Platform gives organizations the ability to cost-effectively store digital content on a large scale, easily manage files, add descriptive metadata, and scale capacity in a modular way without the challenge and complexity of hierarchical file structures.

Overcoming the limitations of file-based storage

Today, most data is stored and accessed using traditional file-based systems. These systems are based on file hierarchies that are complex in structure and limited in the number of files that can be stored. Additionally, file-based storage provides only very basic metadata, limiting management capabilities.

Object-based storage is designed to overcome these limitations. Unlike traditional methods that organize data as an array of unrelated blocks, object-based storage allows access to data by means of a unique identifier that helps avoid the need to know the specific location of a data object. Another important difference is that data can be stored with a much richer set of metadata in an object-based model than in a file-based model. Information stored with the object can include the application of retention and deletion policies and other associated descriptors in addition to the content type and the time and date of creation.

Keeping track of content objects using these metadata descriptors and policies makes access, discovery, replication, distribution, and retention much more practical than in traditional approaches. For example, organizations can meet data governance needs with automated policies regarding file retention and rules that permit only authorized users to reference, alter, and delete data. Ultimately, the metadata facilitates enhanced business intelligence and decision-making capabilities by enabling refined data discovery precision.

Object storage also uses a flat address space, without the complexity and management overhead of a file hierarchy. Files are stored in contiguous disk space rather than relying

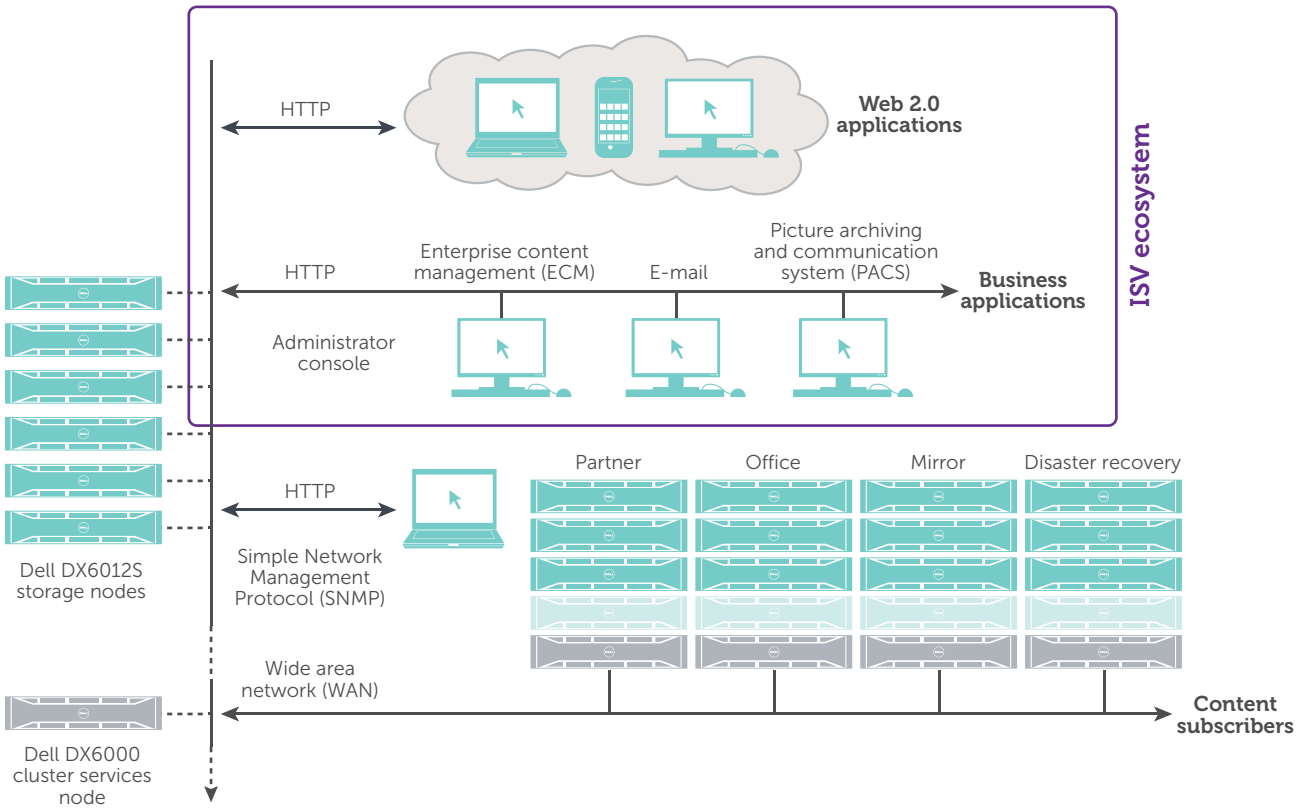

Figure 1. Dell DX Object Storage Platform architecture

on file trees and disk locations. This approach allows billions of objects to be stored in a single namespace and helps make it easy to scale out the infrastructure (see the "Taking the complexity out of storage" sidebar).

Implementing object-based storage

The object-based storage access model is the underlying design of the Dell DX Object Storage Platform. Object storage software built to Dell's specifications resides on industry-standard Dell hardware, and the integration of the software allows management through the standard Dell administrative console.

A basic configuration consists of one DX cluster services node (DX6000) for out-of-band management along with two DX storage nodes (DX6012S or DX6004S) based on Dell energy-optimized, rack-based x86 server platforms (see Figure 1). Storage nodes include 12-drive, 2U systems that can be populated with up to 24 TB of raw storage per node, and 4-drive, 1U systems that can scale up to 8 TB per node. Built-in management capabilities include unified event notification and centralized cluster management. A simple architecture and flat address space help avoid file management complexity: the cluster services node sees one large storage pool, with all objects having the same peer status.

The DX platform is designed to protect the integrity of stored data. A health processor runs continuously in the background, checking stored objects to help detect and repair errors. This health processor automatically reconfigures and regenerates objects without the need for IT intervention.

Intelligently managing the data life cycle

Life points—metadata stored with each object—can be set that describe the desired handling of a particular content object throughout its life

A fresh approach to long-term file storage

This white paper explores object storage, compares it with traditional NAS, and demonstrates the policy-based data management strategy for determining when to use object storage and when to continue using NAS.

dell.to/gGz5PS

Added storage nodes scale the Dell DX Object Storage Platform base configuration

Taking the complexity out of storage

The Dell DX Object Storage Platform helps simplify storage with several features and capabilities, including the following:

- Self-managing and self-healing functionality
- Intelligent, policy-based, and automated data management
- Sophisticated local and/or wide area replication and distribution
- Extensive metadata support
- Nondisruptive capacity expansion and storage node upgrade or retirement

Because there is no database complexity and no file system, the DX platform also helps significantly simplify deployment and management. There are no logical units (LUNs) or RAID groups required. Setup uses a single configuration, including network services. The simple architecture of the DX platform offers IT organizations massive storage scalability without complexity.

cycle. For example, an application can submit an object to the DX Object Storage Platform along with life points indicating the following:

- Four replicas of the object must be accessible for the first 60 days, because there is an expectation that the data will be in high demand.
- After 60 days, the number of replicas will be reduced to two, because the object will no longer be used as actively.
- The object is to be retained for 12 years to fulfill enterprise and regulatory requirements, after which it can be deleted.

The built-in health processor looks continuously at the metadata for each object and then determines, based on the life points, what needs to be done with a particular object at a given point in time. This processor also helps ensure the integrity of objects by checking to verify that the data is intact, with no corruption on disk. If corruption is detected, a new replica is created from the existing known-good replica in the cluster.

Additional data protection comes from automated, policy-based replication and distribution options between local clusters and across multiple distributed sites. Using the DX platform, administrators can define rules for individual objects or groups of objects based on the metadata that is stored with the object. For example, administrators can define a rule that all objects or those of a certain type need to be replicated to a remote site for disaster recovery. The DX platform then continuously looks for objects that meet the rule criteria.

The DX platform also supports sophisticated data replication and distribution. Organizations can have a DX cluster at the main data center and then distribute content to, or replicate content from, remote offices that have smaller DX clusters, providing automated control of the flow of content. An expected upcoming capability allows for moving content back and forth between the DX platform, storage area network (SAN), network attached storage (NAS), and other file systems based on user policies.

Exploring a variety of use cases

Dell is developing solutions with an ecosystem of partners for medical archiving, file, e-mail, Microsoft® Office SharePoint® Server document archiving, e-discovery, and enterprise content management. Data retention, through archiving and tiering, is currently the main use for the DX Object Storage Platform. Organizations across industry verticals use secondary storage for tiering and archiving to help free up capacity on costly primary storage, enhance access compared with using tape, comply with regulatory requirements, and obtain increased value from data.

The DX platform is well suited for archiving large-scale digital content and for long-term data storage, especially unstructured data that does not change after it is stored. Designed to easily integrate into existing storage infrastructures, it is often part of an overall storage architecture that includes other storage types or tiers. For example, in an environment that has SAN and NAS storage, the DX platform provides secondary storage and archiving.

Incorporated into the design of the DX platform is a simple HTTP storage interface to help make it easy for individual users and independent software vendors (ISVs) to integrate with the platform. For example, through partnerships with TerraMedica, BridgeHead Software, and Acuo Technologies, Dell has created an enterprise archive solution that enables health care data such as imaging and patient records to be stored together in a common storage infrastructure. Other application categories include e-mail, file, and SharePoint document archiving with partners such as Symantec, CommVault, Iron Mountain, and Stealth Software, as well as e-discovery with StoredIQ.

Cloud computing is another promising use case for the DX platform. Providers of cloud services and cloud storage can benefit from both the object-based access and automatic failover capabilities of the DX clustered storage technology. It provides seamless scalability to help meet dynamic demands for capacity, and a self-managing design with automatic failover and load balancing for access and storage utilization. The DX platform is designed to provide a clustered storage infrastructure on standard x86-based Dell servers, which can provide an architecture well suited for Web 2.0 and cloud storage service offerings that support the business models of new and existing service providers.

Meeting the next generation of data management requirements

The Dell DX Object Storage Platform is designed to meet today's exploding data management and retention requirements through an intelligent, automated, policy-based retention and deletion platform. As an organization's archiving environment grows, the DX platform can scale seamlessly to store billions of files or petabytes of information, while helping avoid the cost and complexity involved in major upgrades. Additionally, an object-based storage approach can provide the appropriate balance of automation and manual intervention to give organizations comprehensive control over their archiving environment and help them reduce management costs. PS

Derek Gascon is a product marketing strategist at Dell with over 15 years of experience in information management, object storage, and archiving technologies.

Greg White is a storage marketing manager in the Dell Storage Product Group, and specializes in helping organizations solve their data management and storage challenges.

Learn more

Dell Intelligent Data Management:
dell.com/datamanagement

Dell DX Object Storage ISV partners:
dell.com/dxpartners

ISV portal:
dell.com/isv

Reducing I/O latency with automatic extension to system cache

By Annette Cormier, Jason Kotsaftis, and Radhakrishnan Manga

EMC® FAST Cache technology can utilize enterprise flash drives to provide an extra layer of cache that helps optimize performance, streamline management, and reduce I/O latency for mission-critical applications.

Efficient virtualization

This video explores how New York City–based applications service provider Data Guard Systems virtualized its data center with Dell PowerEdge servers and Dell/EMC storage.

dell.to/videoDataGuard

Addressing issues of I/O latency in online transaction processing (OLTP) database application environments can be accomplished through combinations of technologies within the information infrastructure. Enterprise flash drives (EFDs), also known as solid-state drives (SSDs), are well suited to helping meet the performance and response time requirements of mission-critical applications. This storage medium can provide high I/Os per second (IOPS) and extremely low-latency performance.

OLTP database applications can also benefit from automatic increases to cache because they require frequent, highest-priority access to data as well as a high-availability architecture. However, adding cache to OLTP database servers requires downtime, and adding cache to storage is not supported in many arrays. Additionally, identifying frequently accessed data to move to EFDs can be a complex and repetitive task because of constant data temperature changes, virtualization driving massive data consolidation, and ever-increasing data growth.

EMC FAST Cache technology, included with the EMC Fully Automated Storage Tiering (FAST) suite, combines both these concepts into one integrated solution, enabling organizations to leverage EFDs as an automatic extension to database cache. Organizations can now enjoy the performance advantages of EFDs without the manual effort required to manage them as a separate storage tier. In addition, EMC FAST Cache allows OLTP database applications to be rebalanced across different tiers of storage continuously to not just optimize performance, but also maintain cost control.

Extending the cache layer

FAST Cache technology utilizes EFDs as an extended cache layer between dynamic RAM (DRAM) cache and rotating disk spindles. It automatically and continuously identifies the hot (most frequently accessed) data and copies it onto EFD-based extended cache, while cold (less frequently accessed) data is stored on drives using rotating spindles such as Fibre Channel or Serial ATA (SATA) drives.

FAST Cache enables applications such as Oracle® OLTP database software to deliver excellent performance and response time using a reduced number of EFDs. In fact, in EMC benchmark tests, using FAST Cache more than doubled throughput and reduced latency by approximately two-thirds compared with a baseline configuration that used Fibre Channel drives without FAST Cache (see the "Benchmarking FAST Cache performance" section).

In addition to helping increase performance and accelerate response times, FAST Cache can also enhance storage utilization, and the targeted, automated use of EFDs enabled by

FAST Cache helps organizations deploy EFDs cost-effectively. Performance enhancements enabled by FAST Cache can often result in the need for fewer drives using rotating spindles. For example, improved latency often helps avoid the need to implement performance enhancement strategies such as short stroking, which in turn enables increased drive utilization. These enhancements can also help provide excellent performance with lower-cost storage—for example, using SATA drives instead of Fibre Channel drives. Deploying FAST Cache technology in a Dell/EMC storage environment can help organizations running mission-critical applications such as Oracle OLTP database software to streamline management and reduce total cost of ownership.

Enabling performance acceleration

In midrange storage systems, DRAM caches are often relatively small in proportion to the active data being accessed by the host applications. As a result, the duration of data residency in DRAM is short, which can lead to performance degradation and slow response times. Expanding DRAM cache, however, can be a disruptive and often cost-prohibitive approach.

By using EFDs as an extended cache, FAST Cache technology enables organizations to extend cache size without needing to invest in additional DRAM. EFDs are designed to offer improved performance and sub-millisecond response times, and can be more cost-effective than utilizing DRAM and additional drives with rotating disks.

FAST Cache technology works by building a caching area for frequently accessed data on EFDs, allowing hot data to be available longer and on a faster medium than disk-based storage. FAST Cache tracks the access rates of data in 64 KB chunks and caches data chunks in the EFD tier after the data temperature reaches a certain threshold. Data temperature is tracked and data chunks are migrated to and from the FAST Cache automatically and nondisruptively, and administrators can create and modify FAST Cache without requiring any downtime.

FAST Cache technology is well suited for applications with small random I/O and relatively small working sets relative to overall database size, as is often the case in OLTP database applications. In particular, OLTP databases often have small working sets because they tend to be temporal in nature—that is, recently added data is generally more heavily accessed than older data. Also, some object tables are generally accessed much more often than others, and some objects, such as index tables, are accessed significantly more often relative to object size than regular tables. These characteristics generally lead to small working sets that are well suited for the performance acceleration enabled by FAST Cache.

FAST Cache technology is available on Dell/EMC NS unified storage arrays and Dell/EMC CX4 Series storage area network (SAN) arrays. Dell/EMC NS unified storage and Dell/EMC CX4 Series SAN arrays support EFDs as separate tiers or as extended cache as well as Serial Attached SCSI (SAS), SATA, and Fibre Channel drives. Both storage array families offer extensive performance, efficiency, and management features designed to deliver reliable, scalable enterprise storage.

Benchmarking FAST Cache performance

To help quantify the performance improvements enabled by FAST Cache technology, in June 2010 EMC engineers benchmarked the performance of an Oracle OLTP database application with and without FAST Cache.[1] The tests were performed on a single-instance Oracle Database 11*g* R2 database application deployed on a Dell/EMC CX4-960 SAN array and a Dell™ PowerEdge™ R900 rack server. The database size was 1.2 TB, configured using Oracle Automatic Storage Management (ASM) groups, and the storage container size was 2.0 TB configured on eight 250 GB or four 600 GB logical units (LUNs).

Reliable e-mail infrastructure

In this case study, discover how the city of Baton Rouge, Louisiana, enhanced its infrastructure by rolling out a Microsoft® Exchange upgrade on a cluster of Dell PowerEdge servers attached to Dell/EMC storage arrays.

dell.to/batonrougecity

[1] For the complete report, including detailed information on the test environment, benchmark workloads, methodology, and results, see "Leveraging EMC FAST Cache with Oracle OLTP database applications," by EMC Corporation, August 2010, emc.com/collateral/software/white-papers/h8018-fast-cache-oracle-wp.pdf.

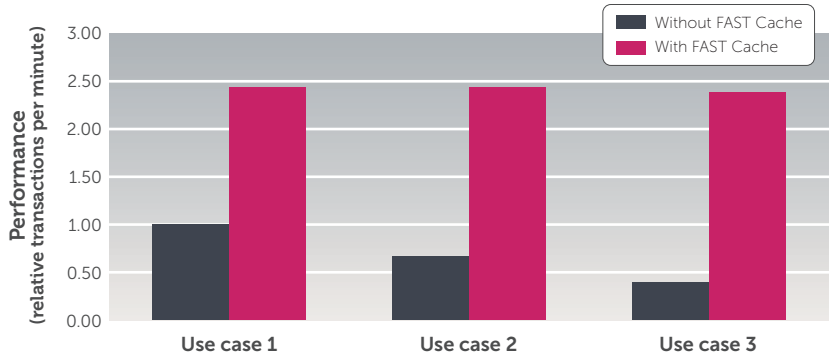

Figure 1. Relative transactions per minute compared with baseline measurements

Annette Cormier is a global storage solutions marketing manager at Dell with 20 years of experience creating growth markets for storage, cloud technologies, network management, and security.

Jason Kotsaftis is a director in EMC Technology Alliances with 14 years of experience developing and bringing to market integrated solutions for Oracle environments.

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The benchmark utilized an Oracle OLTP database workload designed to simulate an order-entry system with 100 concurrent users. The working set (most heavily accessed) data was approximately 200–300 GB of the total 1.2 TB database, and the test scenario utilized a read/write ratio of 60:40. To test the impact of FAST Cache on this Oracle OLTP environment, the tests benchmarked database application performance and response time in four different configurations:

- **Baseline:** Forty-five 600 GB, 15,000 rpm, 4 Gbps Fibre Channel drives without FAST Cache
- **Use case 1:** Forty-five 600 GB, 15,000 rpm, 4 Gbps Fibre Channel drives plus eight 73 GB EFDs with FAST Cache
- **Use case 2:** Twenty-five 600 GB, 15,000 rpm, 4 Gbps Fibre Channel drives plus eight 73 GB EFDs with FAST Cache
- **Use case 3:** Forty-five 2 TB, 7,200 rpm SATA drives plus eight 73 GB EFDs with FAST Cache

In all three use cases, the results showed that adding FAST Cache increased transactions per minute by more than a factor of two (see Figure 1), and reduced average latency by approximately two-thirds (see Figure 2).

In use case 1, which was a direct comparison with the baseline configuration, adding FAST Cache increased transactions per minute by 2.43 times. Use case 2, which reduced the number of Fibre Channel drives by nearly half in addition to incorporating FAST Cache, achieved a similar gain in transactions per minute and reduction in latency despite deploying fewer drives than the baseline configuration. Use case 3, which replaced Fibre Channel drives with lower-cost SATA drives in addition to incorporating FAST Cache, increased transactions per minute by 2.38 times—an increase that represents nearly the same performance improvement as that achieved with Fibre Channel drives, while delivering a similar reduction in latency.

The results of this benchmark indicate that FAST Cache helps organizations not only increase performance and reduce latency, but also reduce overall storage costs. By offering targeted, automatic partitioning of hot data onto EFD-based cache, organizations using FAST Cache can reduce the number of EFDs in their storage environments. FAST Cache technology can also help organizations increase utilization by enabling the same application performance and response time benefits with a reduced number of drives and/or cost-effective storage media. Additionally, because FAST Cache is automatic and requires no manual intervention to partition and manage data, it helps streamline management and reduce administration costs.

Boosting Dell/EMC storage with FAST Cache

EMC FAST Cache technology, available on Dell/EMC NS unified storage and Dell/EMC

	Waits	Time (seconds)	Average wait (milliseconds)	Percentage total call time
Baseline configuration				
Database file sequential read	23,587,547	332,923	**14**	88.5
Database file parallel read	638,376	32,504	**51**	8.6
CPU time		6,254		1.7
Log file sync	1,467,120	1,738	1	0.5
Log file parallel write	1,358,604	1,062	1	0.3
Use case 1				
Database file sequential read	61,974,617	315,080	**5**	82.9
Database file parallel read	1,706,375	33,122	**19**	8.7
CPU time		19,226		5.1
Log file sync	3,891,237	9,359	2	2.5
Log file parallel write	1,938,577	2,479	1	0.7
Use case 2				
Database file sequential read	62,248,605	315,144	**5**	82.9
Database file parallel read	1,696,368	32,107	**19**	8.4
CPU time		20,112		5.3
Log file sync	3,863,427	9,428	2	2.5
Log file parallel write	1,972,955	2,427	1	0.6
Use case 3				
Database file sequential read	63,197,071	315,353	**5**	83.1
Database file parallel read	1,730,796	30,801	**18**	8.1
CPU time		19,818		5.2
Log file sync	3,945,794	10,397	3	2.7
Log file parallel write	1,922,923	2,469	1	0.7

Figure 2. Oracle database event waits and latency

CX4 Series SAN arrays, helps increase application performance and reduce latency by extending DRAM cache using EFDs. This targeted, automatic use of EFDs helps organizations not only to reduce the number of EFDs in their storage environments, but also to enhance the utilization and cost-efficiency of storage that uses rotating disks. In combination with the extensive performance, reliability, and efficiency features of Dell/EMC storage arrays, FAST Cache helps organizations support mission-critical applications while also streamlining management and reducing costs. PS

Learn more

- **Dell/EMC alliance:** dell.com/emc
- **Dell/EMC and Oracle Database 11*g*:** dellenterprise.com/goto/emcoracle
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For more information, visit dell.to/PowerVault-tape-automation

Green
Tape uses zero energy when stored, making it naturally "green."

Secure
Tape encryption provides security and helps reduce the risk of data being misused. LTO-4 and LTO-5 encrypted data is unreadable to people without a key.

iSCSI attachment
An iSCSI-to-SAS bridge card supplements the growth of your iSCSI SAN.

Performance
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Dell™ PowerConnect™ J-EX Series Ethernet switches running Juniper Networks® Junos® OS deliver a unified platform for high-performance networking in highly virtualized data center environments—helping to reduce IT complexity, simplify management, and lower operational costs. No-fuss PowerConnect J-Series switches are designed for seamless interoperability with Dell PowerEdge™ servers and Dell EqualLogic™ iSCSI SAN arrays. Mix and match GbE and 10GbE solutions for optimal flexibility while consolidating the number of managed switches by up to 10x.[1]

Interoperable

PowerConnect J-EX Series switches connect efficiently with PowerEdge servers and EqualLogic iSCSI SAN arrays to scale networks quickly and confidently.

Virtualization-ready

Both GbE and 10GbE PowerConnect J-Series switches are optimized to handle the traffic patterns and performance requirements of a highly virtualized environment.

Manageable

Reduce network complexity and consolidate the number of managed switches by up to 10x[1]—also easing power, cooling, and space requirements.

Single common OS

Juniper Networks Junos OS supports routing, switching, and security for PowerConnect J-Series devices, offering a single software platform for network operation and management.

For more information, visit dell.com/PowerConnect-J-Series

[1] Juniper Networks Virtual Chassis technology and two-tier network designs can reduce the total number of devices deployed and can reduce the number of switches to manage by 10x, lowering operational costs and simplifying management, versus a traditional architecture employing separate edge and access devices.

SAN best practices for deploying Microsoft Exchange with VMware vSphere

By Ananda Sankaran, Chris Almond, and Puneet Dhawan

Following best practices for Dell™ EqualLogic™ SANs can help organizations design, size, and implement an optimized Microsoft® Exchange Server 2010 deployment based on the VMware® vSphere™ virtualization platform.

Many organizations are looking to move to Microsoft Exchange Server 2010 to help lower total cost of ownership (TCO) while taking advantage of capabilities that enhance performance, reliability, and scalability. To optimize mailbox resiliency features such as database availability groups (DAGs) and online mailbox moves, it is critical to design and size the database storage infrastructure to meet the environment's storage and I/O performance requirements.

Although architectural changes in the Exchange Server 2010 I/O stack make local or direct attach storage (DAS) an interesting option for hosting Exchange data, the inherent challenges of scaling DAS capacity and performance as well as the overhead of managing silos of storage pools cannot be dismissed. The overall cost of DAS may be attractive initially, but over time, the complexity and cost to manage, maintain, and scale DAS quickly increase. According to a July 2009 study by the Enterprise Strategy Group, the TCO over five years of DAS was about 1.4 times more than the TCO of a comparable Dell EqualLogic Internet SCSI (iSCSI) storage area network (SAN) solution.[1] Using an EqualLogic SAN in a virtualized Exchange environment can provide multiple benefits, including a dynamic infrastructure that supports quick provisioning and flexible deployment; high performance; seamless capacity and performance scalability with a single point of management; comprehensive Exchange-aware data protection and granular data recovery; network path redundancy and I/O load balancing; and a storage platform designed with fully redundant components to help ensure that the messaging infrastructure is available without any compromise.

In July 2010, Dell engineers performed a series of tests to develop storage sizing guidance and demonstrate best practices for designing and running Exchange Server 2010 in a virtualized environment based on VMware vSphere 4.1, Dell PowerEdge™ blade servers, and a Dell EqualLogic PS Series SAN. Solution architects, storage network engineers, system administrators, and IT managers can take advantage of the practices outlined in this article to help them design, size, and implement an optimized Exchange Server 2010 infrastructure in their own environment.[2]

Test environment and results

Figure 1 shows the major system components used in the tests. Following a baseline test to determine the I/O profile of this configuration, the Dell team carried out several rounds of testing designed to evaluate the effect that array type, RAID configuration, database volume layout, and number of arrays had on storage I/O performance. The Microsoft Windows Server® 2008 R2 iSCSI software initiator within the virtual machine (VM) guest OS was used to connect to the external SAN.

Array type

To help meet different organizational needs, the EqualLogic PS Series SAN family includes multiple array models that use a range of different disk types and numbers of disks per array. The results of this test can help solution architects choose the appropriate PS Series array in accordance

[1] "Dell EqualLogic TCO analysis: The economics of EqualLogic virtualized iSCSI storage," by Brian Garrett with Tony Palmer, Enterprise Strategy Group, July 2009, dell.com/downloads/global/products/pvaul/en/equallogic-tco-analysis.pdf.

[2] For the full version of this guide—including additional test details and results, guidance on the sizing process, best practices for Exchange DAGs, and resources for more information—see "Sizing and best practices for deploying Microsoft Exchange Server 2010 on VMware vSphere and Dell EqualLogic storage," by Ananda Sankaran, Dell Product Group, July 2010, available at equallogic.com/resourcecenter/assetview.aspx?id=9771.

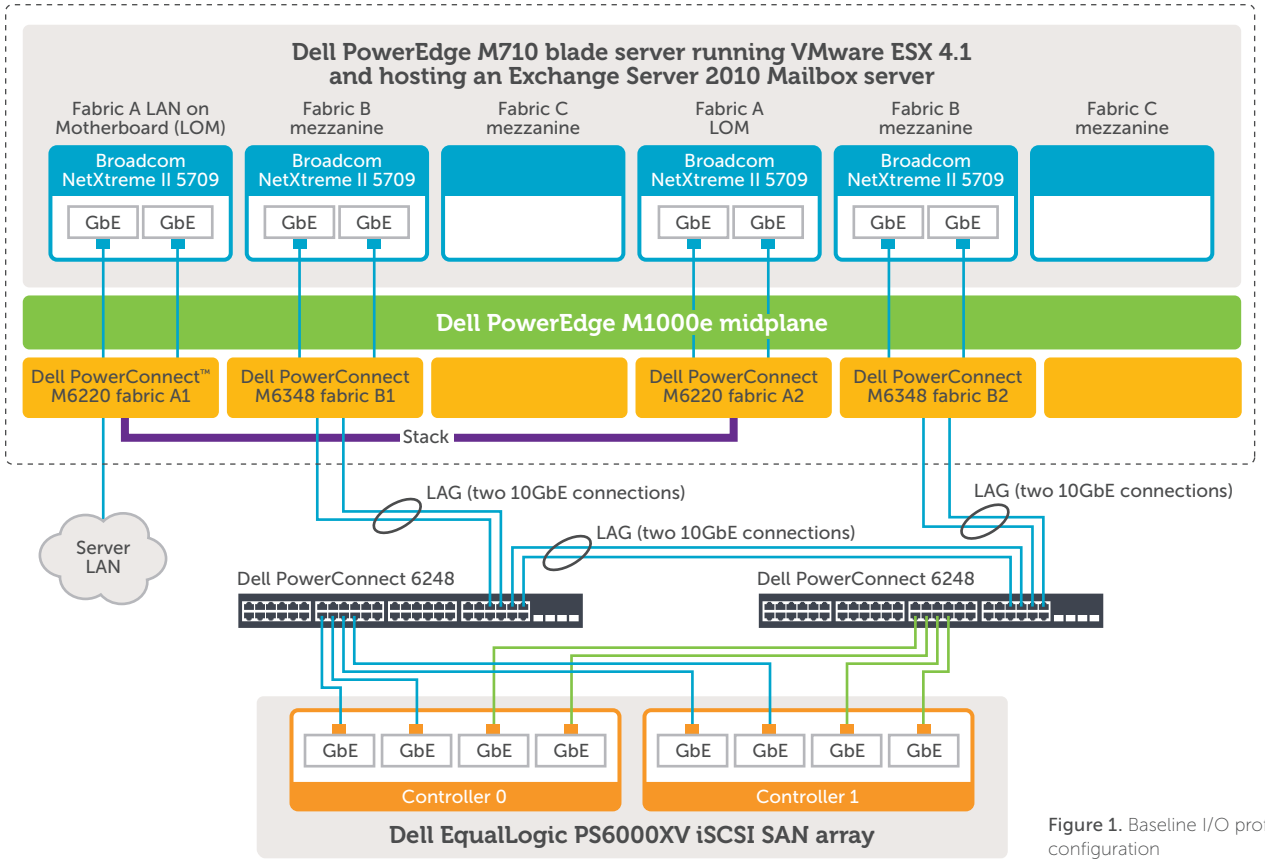

Figure 1. Baseline I/O profiling test configuration

with the target Exchange I/Os per second (IOPS). This test measured storage I/O performance for three EqualLogic array types and configurations: an EqualLogic PS6000XV with sixteen 15,000 rpm, 450 GB Serial Attached SCSI (SAS) drives; an EqualLogic PS6500E with forty-eight 7,200 rpm, 1,024 GB Serial ATA (SATA) II drives; and an EqualLogic PS6000X with sixteen 10,000 rpm, 600 GB SAS drives.

As shown in Figure 2, the EqualLogic PS6000XV array provided more IOPS than the EqualLogic PS6000X array, which was due to the 15,000 rpm SAS drives. The EqualLogic PS6500E array with the SATA II drives provided similar IOPS to the PS6000XV, which was due to the increased drive count. Random IOPS performance over time typically depends on the rotational speed of the available drives; in general, faster drives yield more IOPS.

RAID configuration

Although Exchange Server 2010 can run on storage that is not protected using RAID, availability at the storage layer is the key to minimizing downtime and simplifying resolution in failure scenarios. The choice of RAID type and its impact on Exchange performance are important aspects that solution architects must consider.

This test measured storage I/O performance for RAID-10 and RAID-50 volumes on an EqualLogic PS6000XV array and an EqualLogic PS6500E array. Figure 3 shows the results: using RAID-10 on the EqualLogic PS6000XV provided approximately 25 percent more IOPS than using RAID-50, while using RAID-10 on the EqualLogic PS6500E provided approximately 33 percent more IOPS than using RAID-50.

Database volume layout

While designing the layout of Exchange databases and logs, solution architects often face questions on how performance is affected by the placement of Exchange data in storage volumes or logical units (LUNs). This test measured storage I/O performance for different database and log volume placement strategies. The volume layouts were as follows:

- **Layout 1:** Four database volumes (1,250 users, 1,024 GB each) and four log volumes (150 GB each)
- **Layout 2:** Four combined database and log volumes (1,250 users, 1,024 GB each)
- **Layout 3:** Two database volumes (2,500 users, 2,048 GB each) and two log volumes (300 GB each)
- **Layout 4:** One database volume (5,000 users, 4,096 GB) and one log volume (600 GB)

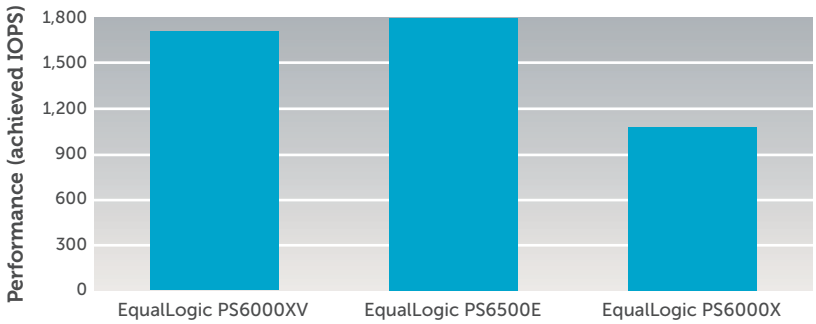

Figure 2. Average storage I/O performance for different array types configured in RAID-50

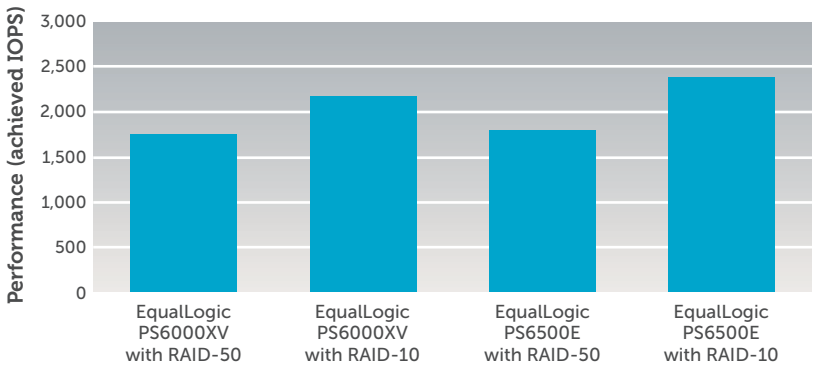

Figure 3. Average storage I/O performance for different RAID configurations

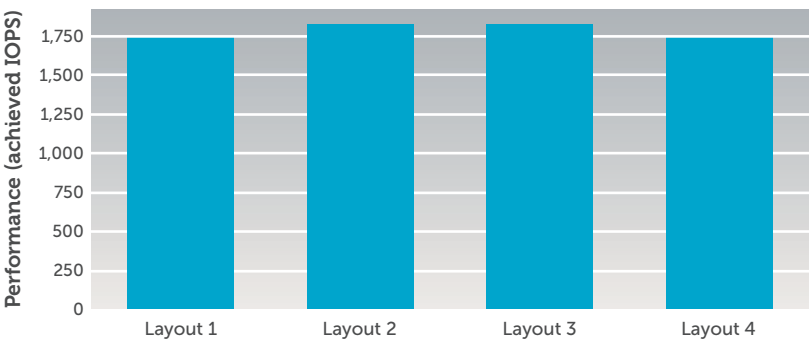

Figure 4. Average storage I/O performance for different RAID-50 database volume layouts

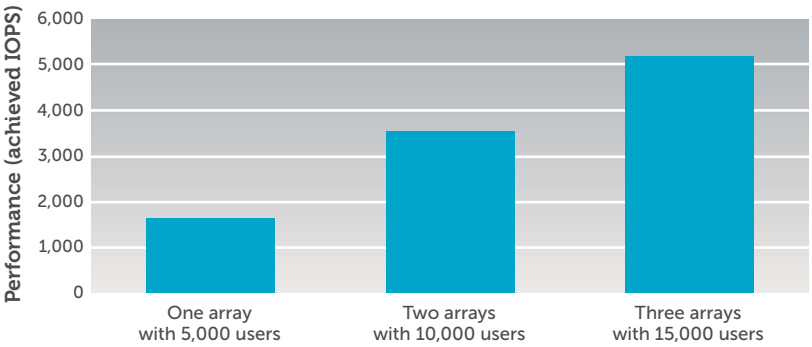

Figure 5. Average storage I/O performance scalability with increases in the number of RAID-50 arrays in a pool

All tests were performed on an EqualLogic PS6000XV array configured in RAID-50. As Figure 4 shows, all four configurations achieved IOPS within a 5 percent range, indicating that for a given number of databases, placement within one or more volumes does not cause a noticeable change in average IOPS.

Number of arrays

Often, the need to support more users and data increases with time. To help avoid increases in complexity and costs, it is imperative to choose a storage architecture that can linearly scale in both capacity and performance without introducing management overhead. Built with this goal in mind, EqualLogic SANs fully meet this requirement.

To measure how effectively Exchange performance scales when adding storage resources, this test measured storage I/O performance as the number of EqualLogic arrays (members) in a pool increases. The tested configurations used one, two, or three EqualLogic PS6000XV members, configured in RAID-50, within the pool. The user mailbox transactional I/O load was increased linearly during the tests along with database size, keeping the database count constant. As Figure 5 shows, the EqualLogic peer storage architecture was able to scale the available storage resources linearly to provide the required IOPS. The number of network interfaces on the server side was kept constant, and the network switches were able to support the arrays under test. If additional arrays are deployed, a different network switch configuration may be required based on port count requirements and workload characteristics.

Recommended best practices

This section provides a summary of best practices developed by Dell engineers to run Microsoft Exchange on top of an infrastructure based on a Dell EqualLogic SAN, Dell PowerEdge servers, and the VMware vSphere virtualization platform. Each of the component layers in the stack requires careful design and configuration to ensure optimal system performance. Within each layer, administrators must consider how the

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design affects availability, scalability, and performance.

Best practices for configuring the EqualLogic storage include the following:

- Use an appropriate disk drive speed, number of disk drives, RAID policy, and array model, and be sure to take into account the arrays' usable capacity, Microsoft guidelines for Exchange sizing, database and log capacity, and database and log I/O performance.
- When using a DAG, host active and passive database copies on separate disk drives—for example, by storing the active database and log volumes in one EqualLogic pool, and the passive or copy database and log volumes in a separate EqualLogic pool. If databases are deployed in a DAG, then hosting the database and log volumes on the same physical drives would be acceptable without compromising recoverability.
- Deploy separate volumes for databases and logs. Doing so supports the isolation of respective entities for backup and storage-based recovery options such as snapshots and clones.
- Host the EqualLogic storage volumes as Microsoft Windows® basic disks. Globally Unique Identifier (GUID) Partition Table (GPT) is recommended when configuring partitions for Exchange Server 2010 volumes. Using an NT File System (NTFS) allocation unit size of 64 KB is also a best practice.

Best practices for designing the SAN infrastructure include the following:

- Design redundant SAN component architectures. This design should include the network interface cards (NICs) on the servers and switches for the storage network (including both the server blade chassis switches and the external switches).
- Ensure that the server NIC ports and storage NIC ports are connected such that a single component failure in the SAN does not disable access to any storage array volumes.
- Enable flow control on both the server NICs and the switch ports connecting to server and storage ports.
- Enable jumbo frames on the server ports and the switch ports. Exchange Server 2010 storage I/O is primarily random in nature and uses a 32 KB block size; however, nightly database maintenance and backup operations create sequential I/O patterns. Within VMware ESX, be sure to also set the jumbo frame maximum transmission unit (MTU) value on the virtual switches and the vmkernel interfaces, including for the virtual NIC device used by the VM guest OS.
- Disable Spanning Tree Protocol (STP) on switch ports connecting to end devices like server ports and storage ports, and enable PortFast for these ports.

Best practices for configuring PowerEdge server resources include the following:

- Configure the servers to provide dedicated NICs for Exchange client/server I/O, and separate dedicated NICs or host bus adapters (HBAs) for iSCSI SAN I/O.
- Provision at least two NICs per server for each path to provide redundancy.
- If possible, segregate Exchange Mailbox server replication traffic onto separate dedicated NICs. This approach helps ensure adequate connection bandwidth for replication operations in a DAG, and helps increase replication performance where database changes caused by user operations are high.
- Provision additional NICs or HBAs for iSCSI SAN I/O as needed based on throughput and IOPS requirements.

Best practices for configuring VMware ESX hosts include the following:

- To take advantage of EqualLogic-aware connection and path management, load balancing, and enhanced performance, install the EqualLogic Host Integration Tools (HIT) for Microsoft Windows in the VM and the EqualLogic Multipathing Extension Module (MEM) plug-in for vSphere on ESX hosts connecting to an EqualLogic SAN.
- Deploy guest operating systems for Exchange server VMs on physical disk drives separate from those hosting the Exchange server data, per Exchange storage requirements.
- Do not use the VMware High Availability (HA), Distributed Resource Scheduler (DRS), and Fault Tolerance (FT) features for Exchange Mailbox server VMs. Host-based availability solutions such as these are not supported by Microsoft for the Mailbox server role.
- Configure separate virtual switches for VM network traffic and iSCSI storage traffic on the ESX hosts. When using both guest and host software initiators, configure separate virtual switches for each connection path.
- Enable jumbo frames on the iSCSI virtual switch. At least two server NICs dedicated to iSCSI traffic must be configured as uplink NICs to the iSCSI virtual switch. When using the ESX iSCSI initiator or iSCSI HBAs on the host, install the EqualLogic MEM plug-in for vSphere.

Best practices for configuring the VMs and guest operating systems include the following:

- Allocate sufficient processor, memory, and disk space resources to the VM and guest OS.
- Apart from using load balancing and automated iSCSI connection management, to take advantage

of Exchange Server 2010–aware EqualLogic protection features such as application-consistent snapshots, clones, and tools such as Auto-Snapshot Manager/Microsoft Edition (ASM/ME), use the iSCSI initiator within the VM to connect to Exchange data and log volumes. Enable the host software initiator along with the EqualLogic MEM plug-in for other applications or VMs when using a guest OS iSCSI initiator.

- When using the guest OS iSCSI initiator, create virtual NICs of type vmxnet3 within the VM; enable jumbo frames, TCP segment offload (TSO), and large receive offload (LRO) in the VM NICs for iSCSI traffic; and use the EqualLogic Multipath I/O (MPIO) Device Specific Module (DSM) installed as part of the EqualLogic HIT in the guest OS.
- Create one virtual NIC for each uplink to the iSCSI virtual switch (for iSCSI traffic from VM to SAN). A given VM cannot use more than one physical uplink on a switch if it has only one virtual NIC.
- In addition to hosting the guest operating systems and data on separate physical drives, configure the guest OS system drives with at least 15 GB of space plus the size of the memory assigned to the guest VM, to reserve disk space for guest memory swaps.
- Install the latest version of VMware Tools in the guest OS.

Best practices for configuring the Exchange servers include the following:

- In general, deploy database copies using a DAG for high availability and resiliency.
- Implement a backup strategy that includes scheduled copying of databases to secondary storage. ASM/ME can support instant Exchange protection and recovery options using application-consistent snapshots and clones; it also integrates with the Windows Volume Shadow Copy Service (VSS) framework to provide application-consistent data copies on the EqualLogic SAN when used with the guest OS iSCSI initiator.

Optimized Exchange infrastructure

Microsoft Exchange Server 2010 and VMware vSphere 4.1 each incorporate features designed to increase the performance, reliability, and scalability of messaging infrastructures. By following the best practices outlined in this article and deploying these platforms on a foundation of Dell EqualLogic PS Series iSCSI SAN arrays and Dell PowerEdge blade servers, organizations can create a robust, reliable, highly scalable Exchange infrastructure to help meet enterprise messaging needs. PS

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Dell EqualLogic PS Series:
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Dell and Microsoft Exchange:
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Dell and VMware:
dell.com/vmware

Creating a manageable, responsive Microsoft SharePoint infrastructure

By James Hendergart and Fred Johnson

Combining F5® BIG-IP® devices with F5 management packs for Microsoft® System Center can help organizations create high-performance, highly available, and secure Microsoft SharePoint® 2010 infrastructures that are both agile and manageable.

Online reader survey

Take F5's reader survey to share your top data center priorities and how you're using virtualization in your current IT environment, then check back in the next issue of *Dell Power Solutions* for results.

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Organizations around the world use Microsoft SharePoint to develop intelligent portals that seamlessly connect users, teams, and knowledge. Efficiently managing and monitoring these growing environments is essential to controlling operational costs and evolving toward a mature data center that incorporates patterned, elastic enterprise cloud management solutions.

The F5 application-ready solution for SharePoint Server provides a way for organizations to meet these goals, offering a set of management and monitoring features to support cloud-computing-based SharePoint infrastructures. The F5 iControl® application programming interface (API) is both powerful and flexible, supporting multiple options for interoperability with IT systems management tools such as Microsoft Windows PowerShell™ commandlets and F5 management packs for Microsoft System Center. This integration offers visibility into 160 F5 BIG-IP application delivery objects that can be captured and used inside the management console to help administrators identify and plan infrastructure capacity needs. Increased visibility into application health and network statistics can result in an enhanced view of the SharePoint operating environment and the ability to effectively allocate IT resources. And management actions taken as a result of this comprehensive view can be initiated programmatically, making F5 integration a two-way communication with BIG-IP systems that can be fully automated to provide efficient and responsive management of SharePoint services.

Managing F5 BIG-IP systems using Microsoft System Center

The F5 Management Pack for Microsoft System Center Operations Manager provides a comprehensive view of health data for F5 BIG-IP Local Traffic Manager™ (LTM®) and Global Traffic Manager™ (GTM™) systems as well as virtual server, pool, and pool member data. Administrators can use this critical information to make improved resource allocation and management decisions for their application delivery infrastructure and enable seamless control of the BIG-IP device when management operations are executed.

The F5 Performance and Resource Optimization (PRO)–Enabled Management Pack for Microsoft System Center Virtual Machine Manager extends BIG-IP management into virtualized environments. The quick migration and live migration features are supported as manual or automatic operations within Virtual Machine Manager, and BIG-IP systems are updated automatically to maintain client connections throughout the operation.

The F5 Application Designer Pack for SharePoint provides a high level of visibility into SharePoint, with network objects and application objects unified into a single view—helping to increase monitoring accuracy and reduce

the management complexity of SharePoint deployments. Application Designer packs for SharePoint 2007 and SharePoint 2010 provide a composite view of SharePoint application services, including Microsoft Windows Server®, Internet Information Services (IIS), SharePoint, SQL Server®, and virtual machine (VM) objects. Using advanced diagnostics, Application Designer queries physical hosts for actual resource allocation (as compared with VM-allocated resources) to further inform resource-related decisions. This pack also enables administrators to easily repurpose heterogeneous hardware across an application service such as SharePoint 2010.

These F5 management packs are available as complimentary downloads from F5 DevCentral at devcentral.f5.com/mpack; license keys can be obtained through a simple online registration process. Operations Manager administrators can install the management packs and securely discover BIG-IP devices over the iQuery protocol (TCP port 4353). Once discovery is complete, the iControl API (TCP port 443) is used to manage and monitor the discovered BIG-IP systems. Administrators can assign granular security access to accounts and groups to support reduced permissions levels and the safe delegation of operational tasks, and can add BIG-IP systems to diagrams using the Microsoft Visio® Add-in for Operations Manager 2007 R2. Examples of data center orchestration using automated BIG-IP actions through Operations Manager include the following:

- **Add and remove:** Provision pool members as virtual or physical servers are moved in and out of the SharePoint environment
- **Maintenance mode:** Place pool members in maintenance mode to avoid alerts during planned downtime
- **Orchestrated failover:** Fail over a BIG-IP high-availability pair in response to an event or threshold detected by Operations Manager (for example, when the bytes-out statistic drops below a critical threshold)

F5's vision for IT on demand aligns with Microsoft's vision of the dynamic data center, in which elastic allocation of IT resources is

Securing the data center

F5 BIG-IP systems support a range of security features and modules to help protect enterprise networks, including the BIG-IP SSL Accelerator™, Access Policy Manager™ (APM), and Application Security Manager™ (ASM) modules. SSL Accelerator helps free servers from processor-intensive encryption and decryption tasks:

- Enable hardware-assisted Secure Sockets Layer (SSL) encryption to achieve significant server offload benefits
- Take advantage of support for both 2,048-bit and 1,024-bit keys to help with migrations and legacy applications that lack support for longer keys
- Use the BIG-IP system as a single point for certificate management

BIG-IP APM offers a flexible, high-performance access and security solution:

- Pre-authenticate users in the Microsoft Active Directory® directory service before allowing connectivity to a SharePoint server pool
- Simplify management and help reduce costs with policy-based access and a central point of control through the Visual Policy Editor, which provides an intuitive graphical interface for modifying policies
- Dynamically assign Web access control to networks and applications based on user identity
- Enable comprehensive authentication, access, and accounting (AAA) control directly on the BIG-IP system; replace extra Web access tiers; and apply repeatable access policies to help reduce infrastructure and management costs
- Secure SharePoint using endpoint security checking to validate client security postures before granting application access

BIG-IP ASM provides a comprehensive, highly scalable application firewall:

- Help protect SharePoint with an F5 Web application firewall that runs on BIG-IP systems alongside LTM and other modules, and shield SharePoint Web services from risk of data loss, compromise, theft, denial of service, Web scraping, and more
- Simplify deployments using the built-in policy template for SharePoint, allowing auto-configuration to help protect against a range of attacks
- Keep ASM current with subscription-based updates to help ensure regulatory and Payment Card Industry Data Security Standard (PCI DSS) compliance

accomplished automatically with little or no human interaction. Integrating BIG-IP systems with Operations Manager helps automate the deployment of new physical and virtual SharePoint servers and the migration of workloads between VMs, including disaster recovery. Using F5 SharePoint application templates, the F5 Management Pack for Operations Manager, and the F5 SharePoint deployment guide for step-by-step configuration can help to increase administrator efficiency and reduce deployment cycles.

Enhancing application performance and user productivity

Increasing the performance and reliability of SharePoint applications can help to improve the end-user experience and increase productivity—one of the most powerful and effective ways to achieve return on an IT investment. F5 BIG-IP systems perform application delivery at the critical point where the network, storage, servers, and security come together, performing application-level health monitoring and intelligent load balancing, enabling session persistence, and offloading SharePoint Server tasks to help increase the availability of SharePoint services.

Rich health monitoring keeps track of SharePoint Server responsiveness across multiple ports and protocols, giving a clear picture of application responsiveness and driving intelligent traffic management decisions. Secure Sockets Layer (SSL) acceleration offloads the encryption processing burden from the server to the BIG-IP system, which can help significantly reduce SharePoint Server processor utilization, page load times, and document transfer times. (For more information on BIG-IP security features, see the "Securing the data center" sidebar.)

BIG-IP LTM intelligent load balancing enables SharePoint services to be scaled out across multiple servers and helps ensure that the most available server is used to service new incoming client requests. Session persistence preserves user state information that is not normally shared across front-end servers by directing existing session packets to the same server where the session is hosted.

BIG-IP GTM provides 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 front-end SharePoint servers, plan and easily initiate local maintenance outages without disrupting service, and maintain high availability even in the event of a site-level outage.

BIG-IP systems also help make it easy for administrators to deploy and configure different types of acceleration for transparent, automatic use as clients interact with SharePoint. For example, TCP protocol optimizations can be tailored for local area network (LAN) and wide area network (WAN) conditions, while Web caching and compression can be deployed on the server side of a WAN link (asymmetric) or on both sides (symmetric). Regardless of the types of acceleration involved in specific operations, BIG-IP systems can help optimize the end-user experience through effective, powerful application delivery networking.

Maximizing performance, security, and availability

Combining Dell™ servers and storage with F5 BIG-IP application delivery controllers and Microsoft System Center can help organizations deploy manageable, automated SharePoint applications to enhance the end-user

Simplifying SharePoint deployment

Dell can provide a single point of contact for the entire Microsoft SharePoint infrastructure—from high-performance hardware to consulting, application development, and systems integration related to business processes, architecture, operations, and life cycle management. The SharePoint Standardized Consulting IP Set developed by Dell Services includes reference architectures as well as design and implementation templates that incorporate tested, repeatable best practices. By efficiently delivering SharePoint services and solutions, Dell can help organizations create SharePoint implementations cost-effectively, minimize risk, and accelerate time to value. For more information, visit dell.com/sharepoint.

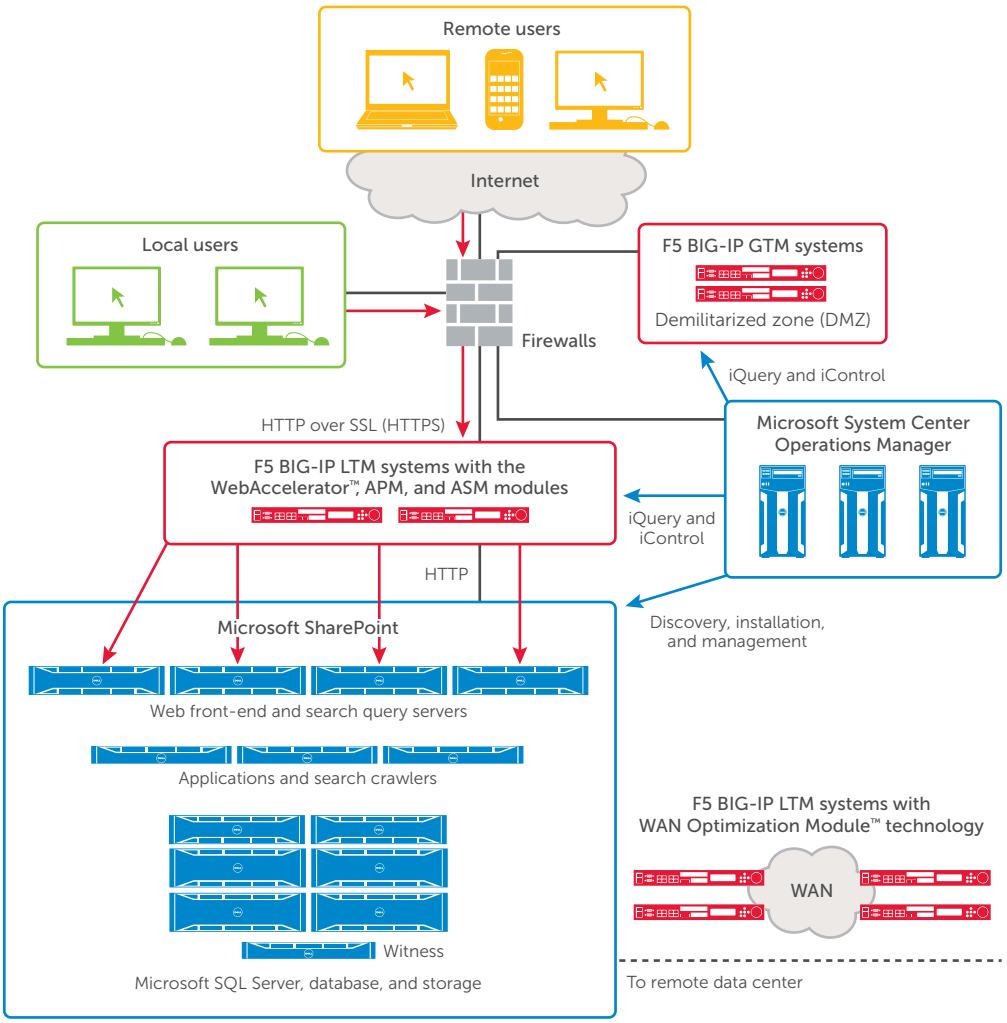

Figure 1. Example Dell reference architecture for Microsoft SharePoint 2010

experience and increase productivity. Figure 1, for example, shows one possible design based on Dell reference architectures for SharePoint, illustrating how these components can provide comprehensive application management while taking advantage of BIG-IP modules to help maximize performance, security, and availability. Dell Services can also work directly with organizations to select from a variety of architectures and deployment templates that can meet the specific needs of their environment while helping simplify deployment and ongoing management (see the "Simplifying SharePoint deployment" sidebar). Through this type of design, organizations can create SharePoint application environments that are reliable, cost-effective, and manageable. PS

James Hendergart is a business development manager at F5 Networks.

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Learn more

F5 Networks and Dell:
f5.com/dell

F5 application-ready solution for Microsoft SharePoint 2010:
f5.com/solutions/applications/microsoft/sharepoint-server

F5 Networks at the Dell TechCenter:
dell.to/g4Zfh1

Bringing world-class business software to midsize organizations

By Manohar Bhambhani, Tim Daigle, Mark Johnson, Michael (Shane) Sedate, and Joe Tolod

Oracle® Accelerate solutions help midsize organizations boost their competitive edge by blending Oracle applications, Oracle Business Accelerators, and Dell Services expertise to efficiently and cost-effectively deploy top-tier enterprise software.

In today's Web-enabled marketplace, many midsize organizations compete globally and face similar complex challenges as their larger competitors. To thrive, these organizations often must be able to source, manufacture, and sell globally. However, they commonly assume they lack the budget and resources required to implement top-tier business applications such as enterprise resource planning (ERP) software that can support global business operations.

Oracle Accelerate was developed to help midsize organizations enjoy the benefits of top-tier business software cost-effectively. Oracle Accelerate combines Oracle enterprise-class software with Oracle Business Accelerators and industry- and geography-specific deployment expertise. Oracle Business Accelerators are rapid implementation tools and templates designed to simply and quickly implement best-in-class software with minimal business disruption. Skilled solution providers can help ensure a rapid and successful implementation and rollout.

As an Oracle Accelerate solution provider, Dell offers a range of design and deployment services that help midsize organizations quickly and effectively take advantage of Oracle Accelerate application solutions. In particular, Dell Services offers rapid implementation for Oracle E-Business Suite and Oracle JD Edwards EnterpriseOne applications together with services that include project design and planning, configuration and installation using Oracle Business Accelerators, data migration, testing and rollout, and ongoing support. Oracle Accelerate, in combination with the knowledge and consultation available from Dell Services, helps midsize organizations deploy integrated, enterprise-class applications smoothly and cost-effectively.

Rapid implementation tools

Cost-effective software targeted for midsize organizations typically limits the scope of features and functionality compared with software developed for large enterprises. Although this approach may have been adequate in the past, midsize organizations in the Virtual Era can't afford to compromise on robust functionality to compete in a dynamic, Web-enabled, and globalized marketplace.

Oracle Accelerate enables midsize organizations to utilize the latest versions of Oracle enterprise-class

applications in combination with Oracle Business Accelerators and Oracle Accelerate solution provider expertise to offer rapid, cost-effective deployment in a way that minimizes business disruption. Oracle Business Accelerators are tools, wizards, and templates that help organizations quickly configure Oracle enterprise software in line with industry best practices (see Figure 1). These best practices serve as a framework for delivering targeted, custom approaches to implementation.

Oracle Business Accelerators enable application suites to be deployed in phases that can be easily expanded and scaled, allowing organizations to deploy only what they need, but also enabling them to easily extend functionality as their needs change. Oracle Accelerate solution providers, such as Dell Services, can apply industry best practices, geographical awareness, and knowledge of application capabilities to facilitate deployment.

Oracle Accelerate supports software such as ERP, product life-cycle management (PLM), supply chain management, and business intelligence applications. It is offered with a range of deployment options including both on-premise and fully hosted solutions with subscription-based pricing. Additionally, Oracle has recently extended its Business Accelerators tool sets to include Demantra for advanced demand planning, Agile for PLM, Siebel customer relationship management (CRM) for managing customer-facing operations, and Oracle Transportation Management (formerly G-Log) for transportation planning and execution capabilities. This combination of software, industry best practices, and services enables midsize organizations to rapidly deploy world-class applications designed for fast time to value, enhanced performance, and reduced total cost of ownership.

Targeted application deployment

As an Oracle Accelerate solution provider, Dell Services combines industry expertise and a tested methodology for rapid deployment to help ensure successful deployments of Oracle E-Business Suite and Oracle JD Edwards EnterpriseOne applications. Dell Services offers a comprehensive suite of services ranging from project design and planning to installation, testing, and rollout, and utilizes a variety of custom-developed templates and Oracle Business Accelerators specifically designed to ensure rapid configuration and deployment of Oracle Accelerate solutions.

Dell also brings the experience and expertise of financial back-office functions such as general ledger and sub-ledger accounting and financial reporting, and common operational functions such as inventory, order management, procurement, and distribution. This industry knowledge helps organizations adopt best practices and processes for these key business functions. As a result, combined services and expertise help reduce the time to implement Oracle ERP applications from months to as little as a few weeks in some cases (see Figure 2).

Dell Services provides the following offerings for Oracle Accelerate:

- **Project planning:** Encompasses analysis of business practices, processes, and key requirements
- **Software installation:** Leverages custom Dell templates and Oracle Business Accelerators to install and configure Oracle E-Business Suite

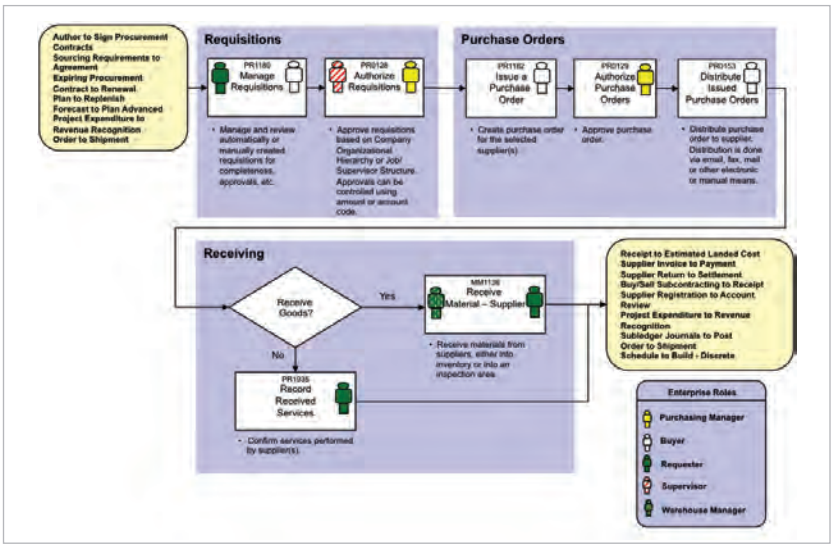

Figure 1. Assets provided by Oracle, like this Business Process Flow Model, help organizations to accelerate implementations while taking advantage of industry best practices

Oracle Accelerate podcast

In this podcast, Mark Johnson and Shane Sedate discuss how Dell and Oracle are working together on Oracle Accelerate solutions, the primary benefits this approach can bring to midsize organizations, and what's on the horizon.

oracle.com/goto/podcast

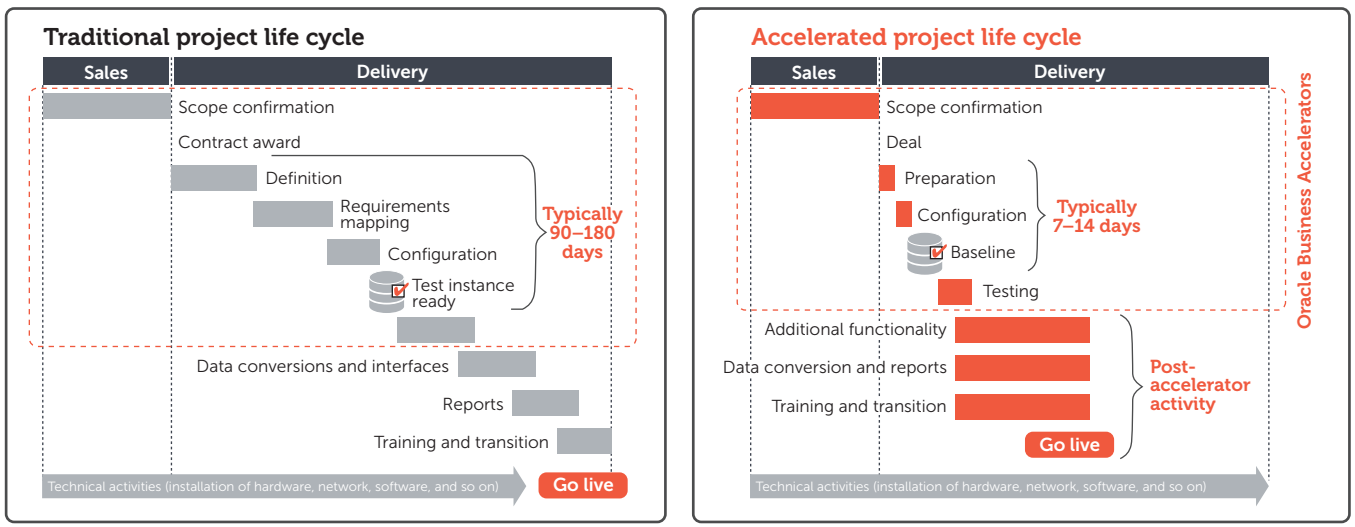

Figure 2. Dell Services offerings for Oracle Accelerate help to speed ERP implementations

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Tim Daigle is the Oracle Practice leader at Dell, and builds Oracle-specific solutions across multiple industries and geographies. He has over 20 years of experience in the IT industry.

Mark Johnson is vice president of midsize application programs at Oracle, and is responsible for the Oracle Accelerate program globally.

Michael (Shane) Sedate is a director in the Oracle Practice for Dell Services at Oracle, and is responsible for leading the Oracle Accelerate programs at Dell.

Joe Tolod is a senior business development manager at Oracle, and is responsible for the Dell Global Systems Integration Alliance.

or JD Edwards EnterpriseOne, including core application modules, database software, and supporting technology tools

- **End-user training:** Helps workers get up to speed on deployed applications, processes, and out-of-the-box reporting capabilities
- **Conversion services:** Include data migration and security design
- **Conference Room Pilot (CRP) deployment:** Incorporates real organizational data, and can then be tested and tailored to meet specific needs and usage patterns
- **Production rollout:** Includes go-live conversion support
- **Ongoing management and upgrade support:** Takes advantage of tailoring and configuration methodologies that can be upgraded and utilized with subsequent software versions

By helping ensure rapid deployment and rollout, Dell Services enables midsize organizations to minimize the time and effort required to implement large-enterprise-caliber Oracle business applications and reduce the cost of training, support, and ongoing maintenance. Dell Services also helps midsize organizations adopt industry-standard best practices and processes, enabling them to enhance productivity and competitiveness.

World-class functionality

Oracle Accelerate solutions offer midsize organizations significant advantages by combining enterprise-grade Oracle applications and Oracle Business Accelerators with industry- and geography-specific deployment expertise to efficiently and cost-effectively deploy top-tier enterprise software. These end-to-end implementations help midsize organizations to compete effectively in today's global marketplace. Dell Services augments Oracle Accelerate offerings by providing a comprehensive suite of services that help midsize organizations design, deploy, and maintain Oracle Accelerate application solutions. Dell Services can deliver both industry-specific expertise and custom templates and tools designed to ensure rapid, successful deployment. PS

Learn more

Oracle Accelerate for midsize companies:
oracle.com/accelerate

Dell Services:
dell.com/services

Deploying a storage-optimized **virtual desktop infrastructure**

By Chhandomay Mandal

To help simplify management of diverse endpoint devices and reduce costs, Dell and VMware built, tested, and validated an end-to-end virtual desktop reference architecture designed to optimize VMware® View desktop virtualization on Dell™ hardware.

Desktop virtualization is emerging as an important strategy for organizations seeking to reduce the cost and complexity of managing an expanding variety of client desktops, laptops, netbooks, and mobile handheld devices. By enabling organizations to centralize desktop deployment and management, a virtual desktop infrastructure (VDI) can help simplify administration and reduce costs while enhancing security and regulatory compliance, increasing IT flexibility and business agility, and strengthening business continuity and disaster recovery.

A VDI deployment must be carefully architected to help ensure that it delivers the performance and scalability to support an enterprise-wide client community. When moving from a distributed stand-alone desktop model, all components—storage, processors, memory, and networking—are moved to a centralized data center for all the users, making appropriate design and sizing critical to success. For example, the consolidation of desktop storage in a VDI environment can create tremendous capacity demands. And VDI access demands—including periods of heavy usage, such as hundreds of users logging in almost simultaneously at the beginning of a workday—can also require high levels of storage performance.

To help organizations simplify the design and implementation of a successful, scalable VDI deployment that includes optimized storage capabilities, Dell and VMware collaborated to create a desktop virtualization reference architecture. This architecture is based on VMware View desktop virtualization software, Dell PowerEdge™ servers, Dell EqualLogic™ PS Series Internet SCSI (iSCSI) storage area network (SAN) arrays, and Dell PowerConnect™ network switches.

In May and September 2010, Dell Labs tested this reference architecture at the server, storage, network, and application levels to help ensure that it can provide the necessary performance and scalability for a range of use cases. A VDI deployment based on this architecture helps organizations to simply, flexibly, and cost-effectively implement a desktop virtualization strategy with a storage platform designed to minimize the bottlenecks that can occur during I/O spikes and reduce storage performance. Organizations can use this architecture as a baseline for designing their own VDI deployments.

Planning a virtualization-aware storage platform for VDI

A VDI deployment can place large performance and capacity demands on the storage platform. Performance demands include I/Os per second (IOPS) generated by basic desktop client operations such as system boot, logon, and logoff, and by desktop usage operations from different users. Additionally, IOPS requirements change based on user types, because workloads from a typical task worker differ significantly from those of a knowledge worker or a power worker. Finally, "storm" events—such as morning logons and afternoon logoffs by many users at approximately the same time—can cause I/O spikes that place high performance demands on the storage infrastructure. Storage capacity demands include consolidating tremendous amounts of stand-alone desktop storage into a centralized infrastructure.

To be successful, storage designs for a VDI deployment must take these demands into account. In particular, the storage platform should have not only the high performance and elasticity required to handle large utilization spikes, but also the ability to cost-effectively handle large capacity requirements. A VDI storage infrastructure should also be virtualization aware, so that the virtualization layer can offload processor-intensive tasks (such as copying hundreds of virtual machines for desktop provisioning) to the storage layer, where it can be done more efficiently.

Dell EqualLogic PS Series iSCSI SAN arrays are well suited for supporting VDI deployments. EqualLogic storage offers scalable, high-performance virtualized iSCSI storage designed for extensive reliability, manageability, and efficiency. Features such as automated workload tiering and load balancing help optimize storage performance and efficiency. These arrays also support solid-state drives (SSDs), which are well suited for meeting the high-performance, low-latency demand typical of VDI deployments.

EqualLogic arrays come with a range of efficiency features to enhance utilization and help reduce costs. Storage virtualization (available on all EqualLogic arrays) coupled with thin provisioning can provide tremendous capacity with reduced physical storage requirements. Also, thin clone technology available in EqualLogic arrays enables administrators to create a template volume with provisioned desktops that can then be cloned to create many additional virtual desktops without needing extra space, helping to dramatically reduce capacity requirements.

EqualLogic arrays are designed to be fully VMware virtualization aware, enabling automation and optimization of key storage functions such as desktop provisioning. For example, EqualLogic arrays offer comprehensive integration with VMware vStorage Application Programming Interfaces (APIs) for Array Integration (VAAI), enabling the VMware software to offload tasks such as block zeroing and full copy directly to EqualLogic arrays, thereby helping to reduce the time required to provision and deploy new virtual machines. Other EqualLogic array features include Auto-Snapshot Manager/VMware Edition for automated virtual machine protection with VMware-based and SAN-based snapshots, and the VMware vCenter™ Site Recovery Manager Adapter for disaster recovery automation with built-in auto-replication.

EqualLogic PS6000XVS and EqualLogic PS6010XVS storage arrays further enhance the performance and efficiency of VDI deployments by combining SSD and Serial Attached SCSI (SAS) drives within a single chassis. The on-board intelligence of the EqualLogic firmware provides automatic tiering between the two drive types—SSD and SAS—and automatic load balancing across multiple drives of each type, helping deliver the appropriate balance of responsiveness and capacity needed for VDI workloads.

Designing and testing the reference architecture

To help organizations successfully implement a desktop virtualization strategy, Dell and VMware created a VDI reference architecture. A primary goal of the reference architecture is to test and validate a baseline VDI configuration composed of building blocks that organizations can easily adapt to their own requirements. The reference architecture was tested by Dell Labs by simulating the load generated by 280 desktop users with a range of typical workload profiles.

Simplifying desktop deployment and management

Discover a flexible, highly scalable building-block configuration using Dell EqualLogic storage and VMware View that can be a baseline for sizing virtual desktop deployments to help meet specific goals.

vmware.com/files/pdf/Dell-VMware-View-RA.pdf

Reference architecture configuration

The tested architecture consists of four Dell PowerEdge R710 rack servers running as VMware ESX servers (see Figure 1). Each server is configured with two quad-core Intel® Core™ i7 processors at 2.7 GHz with Intel Hyper-Threading Technology enabled; 48 GB of Double Data Rate 3 (DDR3) RAM at 1,333 MHz; two internal 73 GB, 15,000 rpm SAS drives; and VMware vSphere™ 4.0 Update 1 software. Each server also has one built-in Gigabit Ethernet (GbE) network interface card (NIC) with four ports plus an added quad-port Intel GbE NIC, for a total of eight GbE ports. In the tests, four of these ports were used for software iSCSI, two were used for internal networking and management traffic, one was used as a secondary service console, and one was unused. In the tests, two additional servers were used for infrastructure management tasks such as running the VMware vCenter Server management tool, the EqualLogic SAN HeadQuarters (SAN HQ) monitoring tool, and the VDI load generation tool.

For storage, the reference architecture utilizes one Dell EqualLogic PS6000XV iSCSI SAN array with sixteen 500 GB, 15,000 rpm SAS drives in a RAID-50 configuration, and included four 500 GB volumes. In the tests, one base Microsoft® Windows® XP image and linked clones off the base image were placed in each of the volumes configured on the EqualLogic array.

For networking, the reference architecture utilizes three Dell PowerConnect 6248 GbE Ethernet switches in full-duplex mode. In the tests, two switches were used for iSCSI access by the servers and storage array, and one switch was used for application traffic.

The reference architecture was tested using a simulated load of 280 desktop users. The VMware Desktop Reference Architecture Workload Code (RAWC) 1.1 tool was used to simulate desktop workloads. Using RAWC, each virtual desktop was configured with Microsoft Windows XP Professional with Service Pack 2 (SP2), one virtual processor, 1 GB of RAM, one 10 GB hard drive, one NIC port, the VMware View 4 agent, Microsoft Office 2003 with Microsoft Outlook® messaging software configured to use Exchange, McAfee VirusScan Enterprise 8.5i for antivirus scanning, and the 7-Zip open source Windows utility for creating and extracting .zip files.

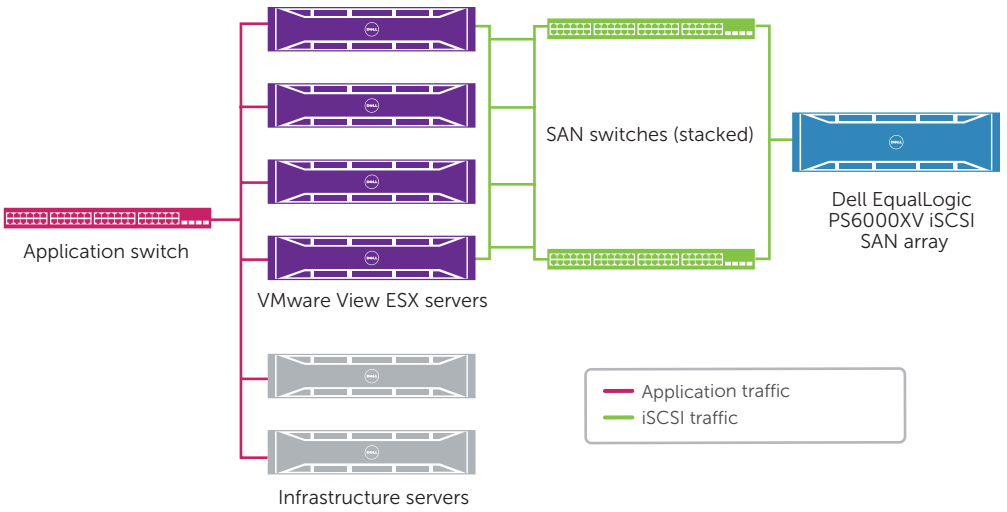

Figure 1. Test configuration for the reference architecture

	Processor utilization	Memory utilization	Network bandwidth	Disk latency
Goal	Less than 75 percent	Less than 90 percent	Less than 480 MB/sec	Less than 20 ms
Average	46 percent	74 percent	18 MB/sec	6 ms
Maximum	68 percent	86 percent	39 MB/sec	14 ms

Figure 2. Workload test results for a typical desktop worker

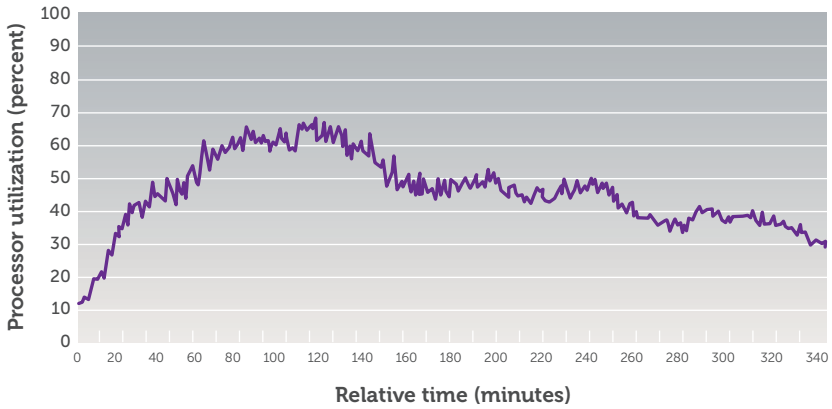

Figure 3. Processor performance results

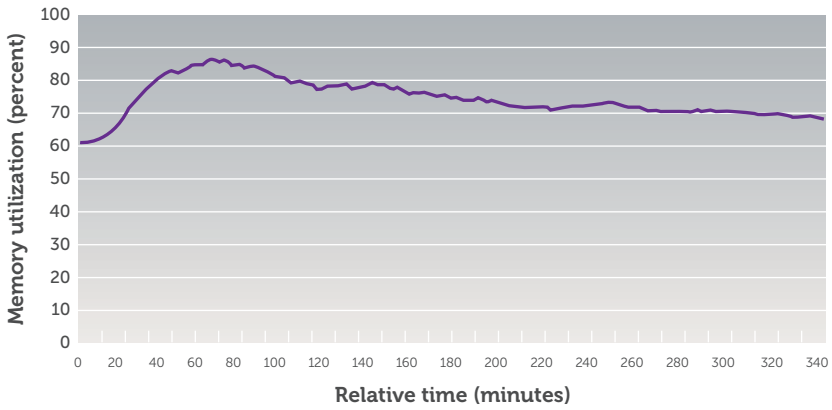

Figure 4. Memory utilization results

Each virtual desktop was then configured to run a workload that simulates typical user behavior for both task workers and knowledge workers. Task worker usage was simulated with repetitive functions using a small set of applications, and knowledge worker usage was simulated with functions from a wider array of applications. Applications in the tested workload included the Microsoft Office Outlook, Word, Excel®, and PowerPoint® applications; Adobe® Reader software; the Microsoft Internet Explorer® Web browser; McAfee VirusScan; and 7-Zip.

Performance results

The performance of the reference architecture was measured at the server, storage, network, and application layers. The test team used VMware vCenter Server to monitor virtual machine, server, and network performance; EqualLogic SAN HQ to monitor storage performance; and Liquidware Labs Stratusphere to monitor application response times.

The monitoring results show that the reference architecture configuration was able to support 280 typical desktop users well within targeted ranges of performance for processor, memory, network, and disk components (see Figure 2). Processor performance averaged 46 percent with a maximum of 68 percent (see Figure 3), and memory utilization averaged 74 percent with a maximum of 86 percent (see Figure 4).

Additionally, SAN HQ indicated that the storage array met targeted performance and latency requirements (see Figure 5). The array latency averaged 6 ms with a maximum of 14 ms—less than the 20 ms target threshold—and the array handled an average of approximately 4,000 IOPS.

Sizing considerations

The tested and validated VDI reference architecture can provide a starting point for organizations interested in deploying a desktop virtualization infrastructure. Components of the reference architecture can be scaled up or down based on an organization's specific workload requirements. Dell and VMware are also currently developing a reference architecture based on EqualLogic PS6000XVS arrays. These hybrid arrays support SSDs and SAS drives within a single chassis with automated workload tiering based on data access patterns, and hence they are well suited for VDI deployments.

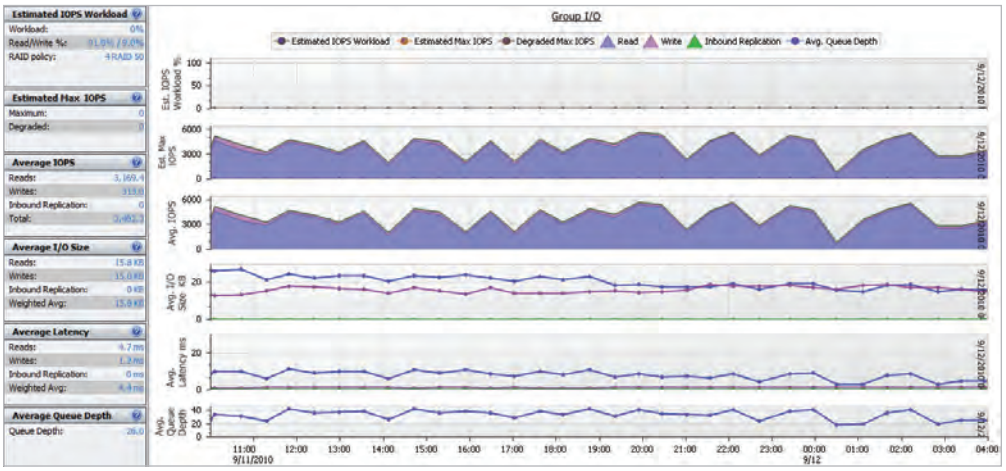

Figure 5. Dell EqualLogic SAN HQ array performance analysis

Transitioning to a desktop virtualization infrastructure

The Dell VDI reference architecture combines VMware View desktop virtualization technology with Dell PowerEdge servers, Dell EqualLogic iSCSI SAN arrays, and Dell PowerConnect switches to offer a tested and validated configuration for VDI that organizations can use as a baseline for their own virtual desktop deployments. A crucial component of the reference architecture is EqualLogic storage—a scalable, cost-effective, VMware virtualization–aware platform that is designed to optimize the performance and capacity demands of desktop virtualization infrastructure. By implementing a cost-effective VDI strategy using the EqualLogic-based reference architecture, organizations can significantly reduce management complexity, enhance security and compliance, and reduce the costs of supporting large, distributed client communities. PS

Chhandomay Mandal is a senior product marketing manager in the Dell Enterprise Storage Product Group, and has worked in the data storage industry for more than 15 years.

Learn more

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

VMware View:
vmware.com/products/view

Lowering data recovery risks in virtualized environments

By Doug Hazelman

Innovative vPower™ technology from Veeam Software enables the quick, reliable recovery of VMware® virtual machines and individual application items, helping IT administrators to maximize service levels and minimize risk.

Powerful protection

Visit Veeam online for a short video exploring how the SureBackup Recovery Verification, Instant VM Recovery, and U-AIR technologies in vPower help IT administrators ensure the recoverability of VMs and individual application items.

veeam.com/go/vpower

Many IT administrators have experienced a critical data recovery crisis. Users come online at the end of the quarter, a critical system has just gone offline, phones are ringing, and escalation has reached upper management. The longer the critical system outage, the more money it costs the organization.

Performing a full recovery in this situation can be time-consuming—and, if such a recovery hasn't been tested recently, may not even work. Many IT professionals would therefore choose to troubleshoot the problem first, but this approach carries its own risks: spending two hours troubleshooting before proceeding with a six-hour full recovery means the loss of an entire day at a critical time.

Veeam Software, an award-winning developer of innovative virtualization solutions, has introduced vPower to help administrators overcome these challenges in virtualized environments. Included in version 5 of the Veeam Backup & Replication™ solution, the Virtualization-Powered Data Protection™ capabilities in vPower help ensure data recoverability and enable the rapid recovery of both full VMware virtual machines (VMs) and individual application items—all from an image-level backup.

Automated backup verification

Backups are useful only if they can be recovered—and that means testing them. The patent-pending SureBackup™ Recovery Verification technology included in vPower is designed to automatically test and verify the recoverability not just of some backups, but of every backup of every VM in the environment.

This automated verification process goes beyond simply comparing the backup data against the production data. It takes a VM (either in production or in an isolated virtual lab environment) through an entire boot sequence directly from the compressed and deduplicated backup file. After the boot sequence has started, a series of verification tests helps ensure not only that the VM is recoverable, but also that the applications inside that VM are functioning properly. The verification runs the VM from the same location as the backup, whether that's on a Dell™ PowerEdge™ server's direct attach storage or on shared storage such as a Dell EqualLogic™ PS Series array.

Rapid recovery of virtual machines

When the need arises to actually perform a recovery, speed is essential. vPower also includes patent-pending Instant VM Recovery technology, which enables administrators to quickly start

a VM from a backup file and connect it to the production network, helping put a failed system back in production much faster than a full recovery could (see Figure 1).

This option is similar to running a VM on a spare tire—the VM continues moving forward, but perhaps not at full speed, because it's still running from the backup file. Administrators can then take advantage of VMware Storage vMotion™ technology and related VMware features to migrate the VM to a production data store without interrupting service. In environments that aren't using Storage vMotion, Veeam Backup & Replication enables the VM to be replicated from the second-tier backup data store (such as a Dell PowerVault™ MD3000i array) to a production data store (such as a Dell EqualLogic PS6000 array), all through a single product and single interface.

Flexible recovery of individual application items

A crisis requiring full recovery doesn't happen every day, of course. Much more common is the need to recover individual items, such as files that end users have accidentally deleted. In the past, recovering these items typically required licensing additional software or agents from a backup vendor, and the backups themselves needed to be application aware.

Quick file-level recovery has been a part of Veeam Backup & Replication since its initial release. Now, the patent-pending U-AIR™ (Universal Application-Item Recovery) technology in vPower extends this capability to enable administrators and end users to restore any application item from within a VM, regardless of application or OS. This feature is designed to be truly universal, and does not require purchasing or installing additional software on the VMs.

The U-AIR wizard includes several options for dedicated recovery from common applications such as the Microsoft® Active Directory®, Exchange, and SQL Server® platforms, and enables administrators to customize a recovery for other applications in their environment. A proxy appliance in the virtual lab enables end users to directly recover their own items through Web browser–based applications such as the Microsoft Office SharePoint® or Microsoft Office Outlook® Web Access interfaces.

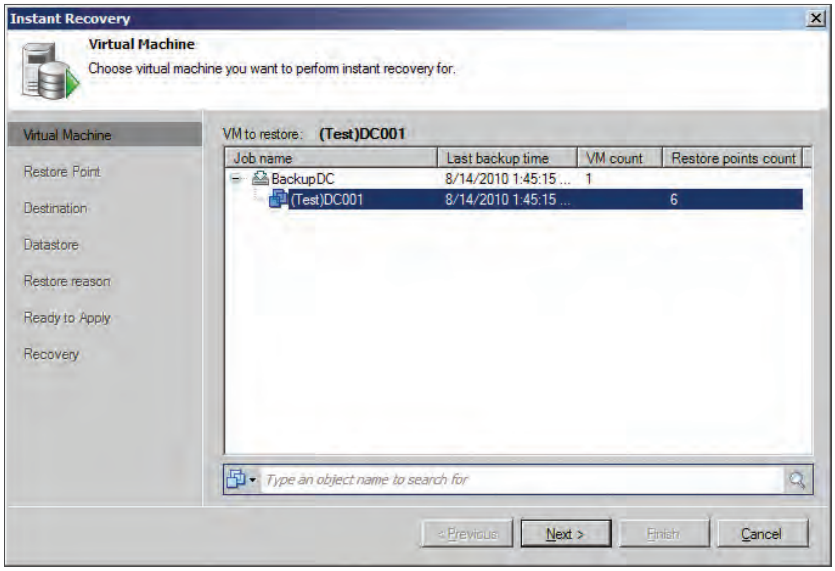

Figure 1. Veeam vPower Instant VM Recovery wizard

Secure, recoverable data to help minimize risk

vPower offers an innovative approach to backup and recovery designed to significantly reduce risk in VMware environments. The combination of SureBackup Recovery Verification and Instant VM Recovery enables fast, reliable recovery to help maximize service levels and minimize disruption during a crisis, while U-AIR provides a comprehensive and flexible way to restore individual items from within VMs. When combined with highly available storage such as Dell EqualLogic PS Series arrays, vPower helps IT administrators ensure that their data is both secure and recoverable. PS

Doug Hazelman is the senior director of product strategy for Veeam Software. You can follow him online at veeam.com/blog and twitter.com/vmdoug.

Learn more

Veeam Software:
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Automating and standardizing cross-domain IT processes

By Hal Clark

The combination of Dell™ Advanced Infrastructure Manager (AIM) and BMC Atrium® Orchestrator enables the creation of automated, standardized processes while facilitating communication and consistency across specialized IT teams.

Dell Advanced Infrastructure Manager (AIM) enables the rapid, flexible deployment of OS instances on servers, storage, and hypervisors. In IT, just as in Formula One racing, an increase in speed usually necessitates an increase in control. As Dell AIM enhances the ability to deploy operating systems to help meet the needs of the business, integration with BMC Atrium Orchestrator offers control over configuration of those operating systems as well as the applications deployed on them—helping organizations to overcome the challenges of IT silos by automating and standardizing processes across the infrastructure.

Addressing the challenges of IT silos

When IT departments reach a point where specialization becomes necessary, the resulting teams can often become siloed. Skills are concentrated, and because tasks are no longer shared, each team develops its own unique processes and procedures. The goal of a well-run IT department should be to bring these silos back together and leverage the skills that exist in other teams. IT maturity initiatives like IT Infrastructure Library (ITIL) provide guidelines that make consistent communication across silos possible, but implementing these best practices can be challenging.

One of the most significant IT trends over the past several years has been utility computing—also referred to as grid computing, on-demand computing, adaptive enterprise, and agile IT. Regardless of the specific term, the goal that characterizes these initiatives is "lights out" data center automation, in which IT resources are

dynamically linked and delivered in a real-time, as-needed fashion, with higher-priority services receiving a higher preference.

Technological innovations like Dell AIM have brought this idea closer to reality. But despite the promise of dramatic operating efficiencies, the final goal has not yet been realized. The key question is not so much why this is the case—but rather whether this is a technology problem at all.

The implementation of a data center automation technology is necessarily a new project, entering an environment replete with existing automation solutions of various scopes. IT is, by definition, the realm of tool builders and tool users. Bringing a new tool—a new automation solution—into this environment precipitates a series of scoping and integration activities. Regardless of how capable the new automation solution may be, there will always be another piece of the puzzle, another domain, that is beyond the scope of this new tool.

The challenge and opportunity of utility computing is therefore to maintain proper procedural control and operational integrity within this web of tools and the processes that link them. In other words, the real question is not whether utility computing can be implemented, but rather whether it *should* be implemented—and, if so, how and under what circumstances. Because a significant source of service failure relates to change activity, both planned and unplanned, it's no wonder that so many organizations have been reluctant to pursue the potential benefits of a dynamic computing infrastructure.

Connecting people, processes, and technology

In conjunction with Dell AIM, BMC Atrium Orchestrator can help organizations take the next step toward making these benefits a reality. It is a flexible, programmable distributed rules engine that coordinates work across different IT domains—connecting people, processes, and technology and encompassing the "paperwork process" of business workflows like change management and approval, technical processes like server and storage management, and even scripted tasks. It automates the interaction of discrete IT configuration tasks with enterprise process management frameworks like incident ticketing or change control processes.

The workflows of connected people, processes, and technology in BMC Atrium Orchestrator are called *run books*. Run books are executed and managed within the BMC Atrium Orchestrator scalable grid architecture. The grid provides load balancing and high availability for the sequencing and execution of run book processes over disparate networks, and also serves as a repository and revision tracking system for run books.

Administrators can create and manage run books through the BMC Atrium Orchestrator Development Studio application. Instead of writing code or maintaining scripts to automate IT activities, run book developers can use Development Studio to manipulate processes in a graphical paradigm that uses icons to represent external systems, tasks, or decision points (see Figure 1). They can drag and drop process elements into the appropriate order and then manipulate the process flow in detail with the simplicity of a visual flowcharting exercise.

BMC Atrium Orchestrator can also quickly import existing scripts and incorporate them into a workflow, enabling reuse, a high level of change control, and quick integration of each team's scripts into a library of actions that can then be used throughout the IT environment. IT teams

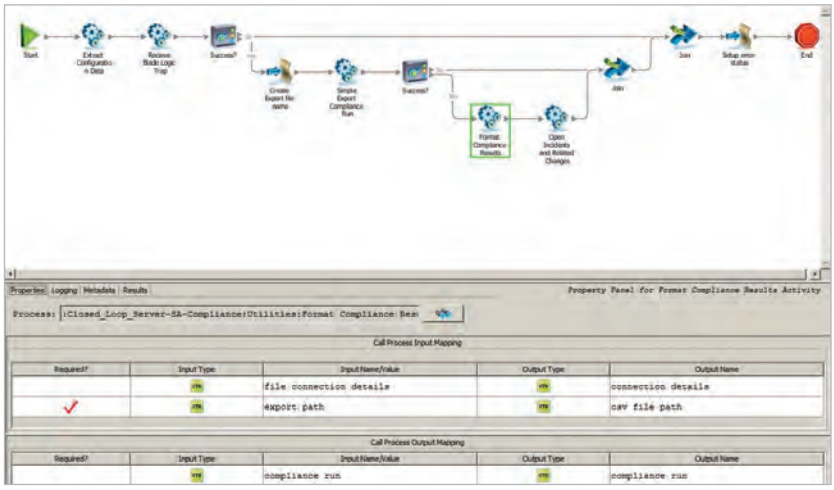

Figure 1. Example run book workflow in BMC Atrium Orchestrator Development Studio

can share their domain-specific skills in a common library of reusable components and still link their activities to incident and problem management systems, change management systems, and other service management systems. Included prebuilt adapters for leading service desk solutions like the BMC® Remedy® suite enable IT organizations to automate routine, labor-intensive, error-prone tasks by leveraging systems, applications, and tools across silos in the operations environment—from trouble ticket and fault management to performance monitoring to virtualization management and more.

Understanding the BMC Atrium Orchestrator architecture

Architecturally, BMC Atrium Orchestrator is a distributed rules engine (see Figure 2). Each peer is a node in a distributed grid, and peers can be distributed across the enterprise or around the world. Multiple types of peers are available, depending on infrastructure or process requirements:

- **Activity Peer (AP):** The AP is the workhorse of the grid, handling workflow processing load distribution. It accepts and executes workflows and hosts external application adapters, providing both the core workflow engine and a Web container. An AP joins a grid on startup to communicate with the other peers.
- **Configuration Distribution Peer (CDP):** The CDP is the overall configuration manager for the grid, housing the Grid Manager application and managing overall distribution of software components to the peers across one or multiple grids. The CDP provides the same types of services and capabilities as the AP, and provides a central point of administrative control and content distribution for the distributed grid components. The CDP also centralizes, stores, and distributes configuration information and content. When a fault affects a CDP, the grid automatically selects another AP to take over the CDP role within the grid—a form of standby failover in a multi-peer grid.
- **High-Availability Configuration Distribution Peer (HACDP):** Although it is possible to deploy multiple CDPs, the usual approach is to deploy them in a high-availability configuration in which the peers mirror each other. The HACDP is not idle and participates in workflow execution, so it provides high availability and load distribution for the grid in which it participates.
- **Lightweight Activity Peer (LAP):** The LAP is installed on a third-party system server and extends the grid communication to that system, which is useful when a third-party system requires an adapter to execute locally, or when the adapter requires libraries in a third-party application whose libraries cannot be installed outside of that application. Unlike the other peer types, the LAP does not execute workflows.
- **Access Manager:** Access Manager is an identity manager that provides single

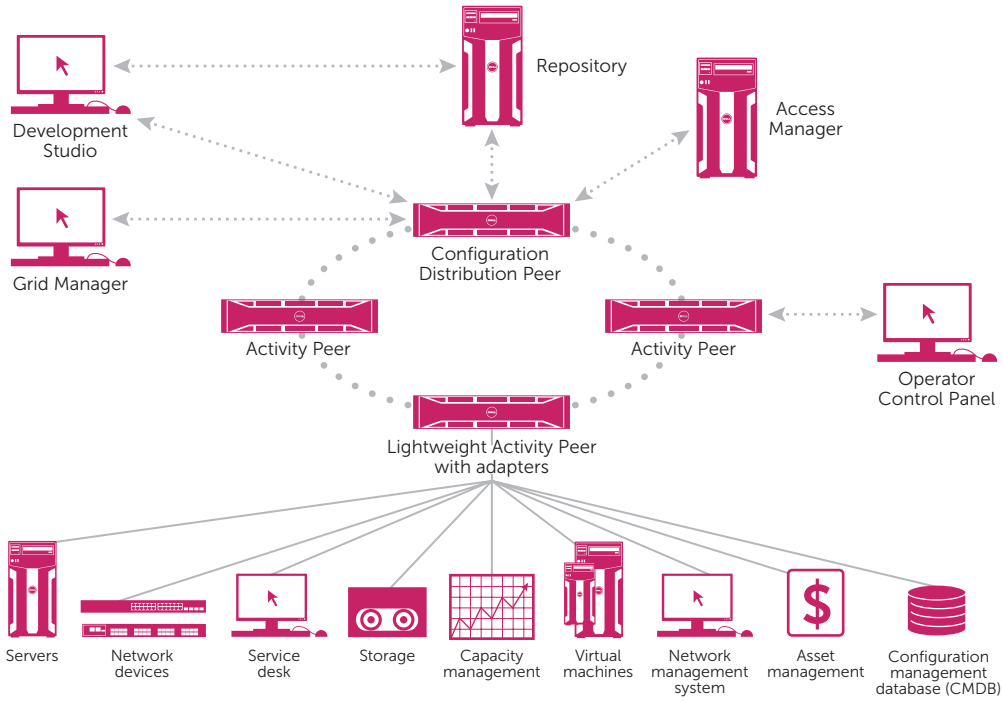

Figure 2. BMC Atrium Orchestrator architecture

sign-on services as well as authorization policy administration and enforcement. It also provides an interface to manage configurations with external Lightweight Directory Access Protocol (LDAP) directories.

- **Repository:** The repository stores content such as adapters and modules, which is then available to multiple users through either Grid Manager or Development Studio. It also maintains revisions of workflows throughout the development process.
- **Grid Manager:** Grid Manager resides on the CDP and provides a user interface to add and maintain grids, peers, adapters, and process schedules. It also enables administrators to manage module deployment and activation. Multiple databases can be configured to store audit records, grid metrics, process metrics, and business metrics.
- **Development Studio:** Development Studio is a stand-alone application supported on Microsoft® Windows® and Apple Mac OS X operating systems in which administrators can design, develop, and test workflows as well as manage workflow rules, schedules, and configuration. It can use the grid repository to access and store content. It also supports source code management systems like Subversion and Concurrent Version System (CVS), including integrated check-in, check-out, and authentication.
- **Operator Control Panel:** The Operator Control Panel provides an interface for monitoring workflow operation or manually initiating a workflow. It is often launched in context by applications initiating workflow actions to visually show the workflow execution progress. An inherent capability of workflow execution in the BMC Atrium Orchestrator architecture is the ability to operate the same workflow semiautomatically or fully automatically; administrators can use the Operator Control Panel to interact with the workflow at decision points where the workflow suspends in semiautomatic operation awaiting operator input.

Workflows in BMC Atrium Orchestrator consist of processes bound by conditional logic and connected to external systems. Processes can be complex or simple. A simple process can involve converting a date or sending an e-mail message. A complex process can contain several different types of processes:

- **Nested or called processes:** These processes reuse the functions of another process, and are used when one process is inserted as a set of functions within another process. A process within one module can call processes from other modules.
- **Processes exposed as Simple Object Access Protocol (SOAP):** These processes are used to service requests to execute processes. Web services are a core component of BMC Atrium Orchestrator, and any process can be exposed as a SOAP Web service; administrators can then use Development Studio to automatically create processes based on a Web service's Web Services Description Language (WSDL) document.
- **Operator processes:** These processes run at the Operator Control Panel and require interaction with an operator.

Because BMC Atrium Orchestrator is designed to bridge technologies, it also comes with a library of adapters—pieces of code that run on the grid and can be called by workflows to interact with external systems. *Monitor adapters* make a passive connection to an external system to receive stimulus inputs that can then automatically initiate workflows based on selective criteria. *Actor adapters* enable workflows to execute actions in external systems and retrieve responses from directed actions.

Base adapters for Simple Network Management Protocol (SNMP), Secure Shell (SSH), command-line interfaces, Web services, Simple Mail Transfer Protocol (SMTP), Java Message Service (JMS), and other connective technologies are also available to meet specific integration requirements. Application adapters are more complex components that link to higher-level systems like BMC Remedy Service Desk™,

Microsoft Active Directory®, or VMware® vCenter™ software. Application adapters are built from base adapters, but include the programmatic logic necessary to abstract the complex tasks that exist within an application platform into a common set of processes that can be called within a workflow. For example, the application adapters for VMware vCenter and Solaris Zones expose operations specific to each environment for the abstract "Create VM" actions called within a workflow. An IT team that supports a virtual infrastructure based on Solaris Zones could codify their virtual machine provisioning processes into a workflow. Then, rather than creating a new workflow to perform the same tasks in their VMware environment, they could simply connect the same workflow actions to the vCenter adapter for specific configuration items that utilize this interface.

Integrating Dell AIM with BMC Atrium Orchestrator

Dell AIM offers rapid reprovisioning and sophisticated disaster recovery capabilities on physical or virtual infrastructures. It manages pools of compute, storage, and network resources that can be assigned to operating systems and application images to create *personas*—server environments that are captured on disk, including the OS, the optional AIM agent software, the application software, and the network and other settings required to run an application on a server in the AIM environment. Personas are typically stored in a central repository and are not tied to a particular piece of infrastructure, which enables them to be easily reassigned to another server resource through *retargeting*. This process includes stopping the persona, assigning another server to run the persona, booting the reassigned server into the OS image corresponding to the persona, and reconfiguring the persona and its connectivity.

Although AIM can offer significant immediate value to server administrators, storage and network teams may have processes and procedures in place that hamper them from taking advantage of these new capabilities without significant change. The more specialized each group becomes, the more difficult it is to take advantage of tools that bridge the gaps between IT silos without integrated processes.

BMC Atrium Orchestrator workflows can be modified to incorporate calls to the AIM application programming interface (API) to perform AIM operator tasks such as creating, deleting, and retargeting personas to perform storage and network configurations when called from change management systems like BMC Remedy. Change management represents the "people-to-people" workflows that help ensure that IT operations run smoothly. Server, application, storage, network, and even business stakeholders can be made to participate in these workflows.

Moving toward holistic utility computing

Properly implemented, automation can help eliminate repetitive, manual, error-prone tasks and help ensure the consistency and repeatability of complex, cross-domain processes. As enterprises adopt IT maturity initiatives like ITIL, the processes that drive businesses become clearer and the necessity for cross-domain cooperation becomes more pressing than ever. The imagined future of a "lights out" data center may still be possible—but people will still play a big part in that future. Solutions like Dell AIM and BMC Atrium Orchestrator can help organizations make the next step toward a holistic utility computing model. PS

Hal Clark is a senior solutions marketing manager for process automation at BMC Software, and has many years of experience in defining IT processes and organizational transformation for effective use of automation.

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Proactive monitoring for dynamic virtualized environments

By David Weber and Veronique Delarue

Virtualization can significantly increase monitoring complexity. By using BMC® ProactiveNet® Performance Management, IT departments can create an intelligent, automated approach to identifying and prioritizing issues in these dynamic environments.

Enhance IT responsiveness

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Monitoring can be as simple as waiting for something to happen. Whether it's monitoring the availability, performance, or capacity of an endpoint, and whether that endpoint is a server, a storage device, or a piece of software running on both, monitoring is one of the simplest activities in IT.

Or at least that might have been true before virtualization came along. Now, not only can availability, performance, and capacity change from moment to moment, but the challenge of setting useful thresholds on those attributes has become dramatically more complex than it was in traditional physical environments.

For effective monitoring of a dynamic virtualized environment, flexibility, adaptability, and a deep understanding of that environment are critical. BMC ProactiveNet Performance Management (BPPM) is designed to address each of those facets. In BPPM, *flexibility* means the ability to collect key metrics and alerts from hardware, operating systems, and applications whether those components are instrumented for data collection or not. *Adaptability* means that BPPM gathers this critical data continually even as the environment changes. And BPPM's comprehensive and accurate data model enables administrators to make the most of the data to help them understand their environment. Through deep analytics, dynamic baseline capabilities, and—with the Hardware Monitoring component—the ability to retrieve hardware data directly from the hardware either in band or out of band, BPPM helps IT administrators to ensure the availability and performance of complex environments.

In-band and out-of-band monitoring

Hardware Monitoring is a modular element of BPPM available both as an agentless element and as a Knowledge Module® (KM) component. The KM loads rules and intelligence into the BMC PATROL® Agent to enable the collection of hardware data, including Dell™ PowerEdge™ server alerts and other performance and health status data. (For more information on KMs and agents, see the "What is a Knowledge Module?" and "Agent or agentless?" sidebars.)

In total, the Hardware Monitoring component offers three options for hardware monitoring: in band, out of band through the OS, and out of band through a server's Integrated Dell Remote Access Controller (iDRAC). *In-band* monitoring refers to the data collection from within the OS. In this approach, the PATROL Agent resides in memory and on disk within the OS running on a server, and collects OS performance metrics. The Hardware Sentry KM tells the PATROL Agent how to retrieve alerts and data from the

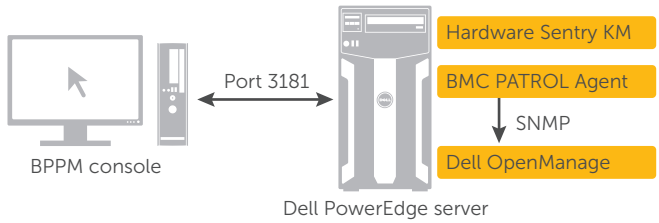

Figure 1. BMC PATROL Agent communicating locally with Dell OpenManage

Dell OpenManage™ Server Administrator agent and how to collect native Intelligent Platform Management Interface (IPMI) or RAID controller data directly from Microsoft® Windows Server®, Linux®, Solaris, or VMware® ESX and ESXi platforms (see Figure 1). The modular BPPM architecture enables administrators to choose their targets and monitor only the components of the infrastructure that need attention.

Out-of-band monitoring refers to the collection of the same data from an external vantage point. Administrators can use the PATROL Agent for either in-band or out-of-band data collection. For agentless operation, the PATROL Agent can act as a proxy (see Figure 2).

A single agent installed within a data center can handle out-of-band monitoring for many servers, enabling highly flexible monitoring architectures. In addition, BPPM administrators can choose to collect server alerts by communicating with the OS out of band or by direct communication with the hardware. The iDRAC in Dell servers presents IPMI, HTTP, and Simple Network Management Protocol (SNMP) interfaces, all of which are accessible with the Hardware Monitoring component. Administrators can therefore choose from a number of event collection options depending on the environment.

Comprehensive automation

Flexibility is critical, but with so much data coming in from servers, operating systems, and applications, what happens when virtualization enters the mix? The rapid and often unpredictable changes in configurations that can occur in virtualized environments can significantly challenge administrators' ability to keep up: when virtual machines migrate from one server to another, for example, static monitoring may leave them monitoring the wrong server. BPPM combines

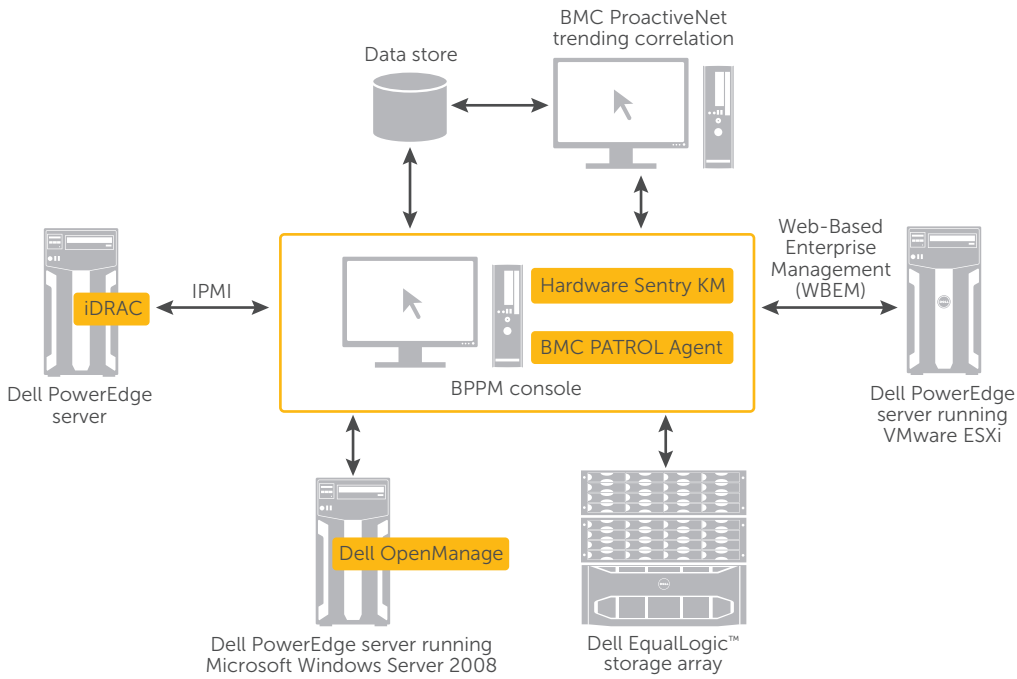

Figure 2. Example architecture using BMC ProactiveNet Performance Management for agentless monitoring

What is a Knowledge Module?

As the name implies, a Knowledge Module (KM) adds capabilities, or "knowledge," to a BMC agent and console in the form of additional routines that execute on the agent, as well as filtering and reporting insight at the console. KMs are available for hardware, operating systems, hypervisors, databases, and application platforms.

The BMC PATROL Agent was designed to accept KMs as flexible, integrated extensions. A KM may contain simple data filtering rules, or—as in the case of the Hardware Sentry KM—may contain complex code that enriches the PATROL Agent, enabling it to query hardware interfaces like Intelligent Platform Management Interface (IPMI). Other KMs available from BMC allow the PATROL Agent to execute SQL queries, or to communicate directly with application-specific interfaces like Open Database Connectivity (ODBC), Java Management Extensions (JMX), and Microsoft .NET.

a comprehensive impact model with dynamic thresholds and proactive analytics to help address the challenges of monitoring in these environments.

Impact model

A comprehensive data model is a good step toward improved modeling—if it can be maintained and trusted to always represent the current state of the environment. BPPM relies on an impact model not only to represent the configurations of the servers, storage, operating systems, hypervisors, and applications, but also to map those discrete components against their value to the enterprise (see Figure 3). In other words, this impact model describes the functional IT components as well as their relationships to business services. Services like order processing and shipping include not only IT resources like servers and applications, but also the person-to-person processes that depend on those resources to be successful.

When a fault occurs within the infrastructure, the impact model enables a BPPM operator to see the source of the fault as well as the relationships that the faulty component has to the rest of the infrastructure. Because the model also describes how the infrastructure components support business services, operators can quickly prioritize remediation. For example, imagine a scenario in which two alerts come in: one from a Web server in a hung state, and another from a database server running out of memory. Without an impact model, the operator would likely prioritize the resolution of these problems on a first-come, first-served basis. Using the impact model, however, the operator can quickly determine that the Web server supports customer-facing order entry systems, while the database is a secondary replication target for payroll—which is not due for another 10 days. In this situation, it is easy to see how critical the impact model is to the effective evaluation and resolution of IT problems.

Dynamic thresholds and proactive analytics

Although the impact model enables operators to prioritize remediation activities and target the

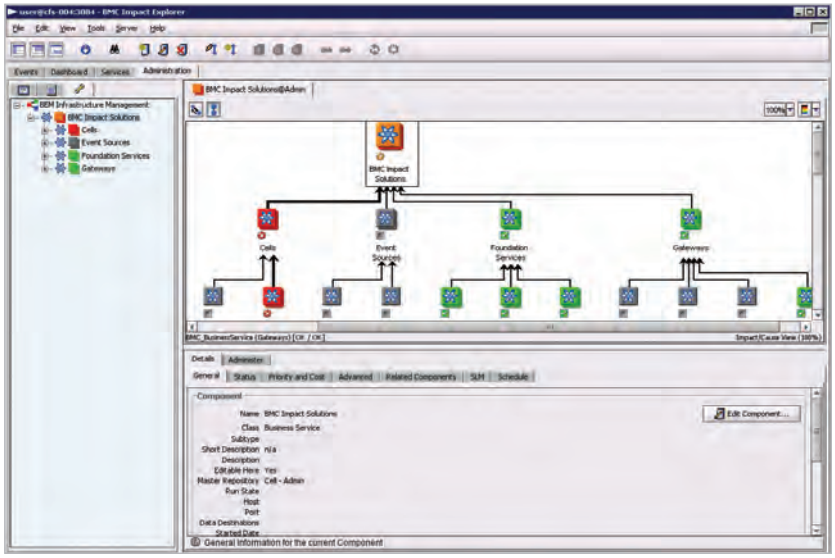

Figure 3. Infrastructure impact model in the BMC Impact Explorer® interface

infrastructure components that need immediate attention, it does not reduce the volume of alerts that come in. In a complex environment with events coming in from a multitude of sources, even basic prioritization can become challenging for console operators. To help effectively monitor applications, BPPM collects alerts from the server, storage, and network hardware; the operating systems and hypervisors (if applicable); and the services on which the applications depend, such as databases, application servers, and middleware.

In typical monitoring scenarios, operators set thresholds to determine when discrete components like servers or applications need attention. When a server's processor utilization becomes too high or an application consumes too much memory, a threshold is crossed and an alert is generated. In virtualized environments, however, the goal is generally to maximize processor utilization, and what constitutes "too much" memory for a given application may change based on the application's requirements from day to day. So although thresholds can provide guidelines, they still require constant attention and readjustment, and simply setting and adjusting monitoring thresholds can quickly become a full-time job.

Thresholds represent generalized rules for how a given application or infrastructure component is expected to perform. The problem with static thresholds is that they fail to take into account the dynamic nature of today's systems. For example, when setting performance thresholds for a database server, it is important to closely monitor the memory consumed by and available to the database application. The accepted process for determining the correct low and high ends for these metrics is to turn on logging for some period of time and then examine the logs to determine the minimum and maximum memory thresholds for the database.

The appropriate amount of time to capture these logs depends on the application, but it should at least represent a full duty cycle. A payroll application, for example, should be observed for at least one full payroll cycle. While the system is idle between payroll periods, the database is likely to use a relatively small amount of memory, and in the days leading up to payday, memory utilization would typically increase. The thresholds identified from these observations are then set within the monitoring system, and if memory utilization goes below the minimum or above the maximum, an alert is generated. An administrator must then try to determine the cause of the alert.

Static thresholds are not only time-intensive to establish; they also tend to lead to a situation in which alerts are generated only after a failure has occurred. Because static thresholds do not take into account variances in time, an operator could miss important indicators that lead up to a failure. These indicators represent an opportunity to prevent the failure rather than simply respond to it after it has occurred.

BPPM's proactive analytics feature is designed to bring automation to the task of monitoring. BPPM begins by analyzing the stream of events coming from the infrastructure. In a short time, it can determine what normal performance looks like for an application or server, and over time it generates a baseline that represents normal performance at a given time (see Figure 4). Both the baseline and the value of that baseline at a given point in time represent the work that goes into creating static thresholds. BPPM can determine rough thresholds within hours; within days, it can build a highly accurate model of expected behavior at all times. If a server reaches

Agent or agentless?

The choice between loading an agent on a managed server and collecting data from an external vantage point often comes down to a balance between the criticality of the monitored server and the performance impact of polling. Agent-based in-band monitoring runs in the OS, in parallel with critical applications. In the event of a hardware fault, the OS—and, by extension, the agent—may go down, preventing a critical alert from being sent. However, software issues like application performance problems may be detected immediately, with detailed alerts then forwarded to an administrator.

Because out-of-band agentless monitoring depends on polling, administrators using this option must decide how often to poll the monitored server. Even if the hardware or OS were to crash, agentless monitoring would alert the administrator—but only the next time the server is polled.

100 percent processor utilization or a database's memory footprint increases during a heavy traffic period, BPPM can determine whether these events represent a significant change from the expected behavior. Distinct from static thresholds, BPPM's dynamic thresholds determine an application or server's low and high ends at any given point in time, taking the manual labor and guesswork out of setting thresholds.

For example, by applying dynamic thresholds to the scenario of the payroll application, BPPM could determine whether the database server's memory usage was higher than normal during the time between paydays. Even though the memory usage might not be as high as the static maximum, BPPM would notice that the database was consuming more memory than it otherwise would at a time between paydays. Long before the database reached a point where it would have to be shut down and restarted because it exceeded a static threshold, BPPM would alert an operator to the anomalous condition and allow IT staff to address the issue without affecting a critical resource during a production time period.

Another advantage of proactive analytics is root cause identification. As noted earlier in this article, comprehensive monitoring involves the collection of data from all the components that make up the impact model, from servers and storage to operating systems and hypervisors, applications, and middleware. Because BPPM collects data from all of these sources and analyzes the entire event stream, it can automatically correlate events that come in from different sources. When an application stops responding, multiple alerts are often generated—BPPM may receive alerts from the application server, the OS, the server, the storage device, and the network, to name a few. When these alerts come in, BPPM refers to the impact model to determine the relationship between these components and identify the single event that most likely precipitated the entire stream of alerts.

This scenario provides another key example of automated monitoring. In the earlier example of the hung Web server and the database server running out of memory, the console operator would examine the impact model to determine the highest-priority fix. Proactive analytics enables that same operator to sort through multiple alerts and prioritize a fix for exactly the right problem.

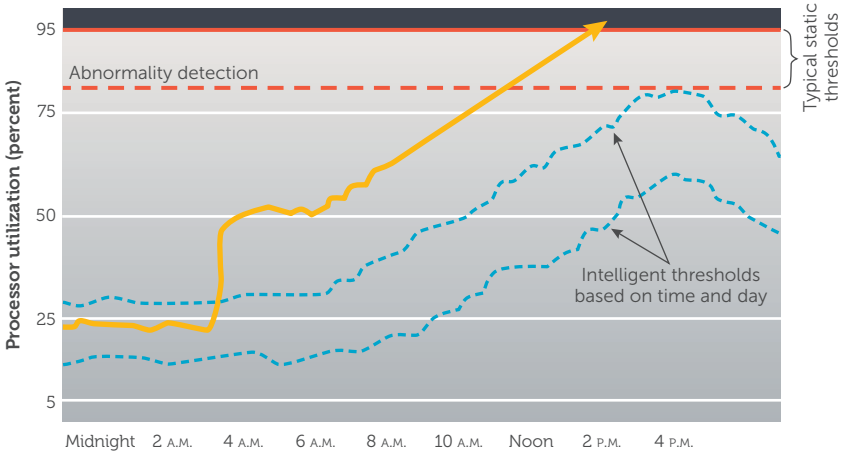

Figure 4. Example dynamic thresholds in BMC ProactiveNet Performance Management

Deep insight into complex virtualized environments

Effective monitoring in virtualized environments requires an approach designed for the dynamic nature of virtual systems. On top of a solid foundation of hardware monitoring enabled by the Hardware Monitoring component, BPPM offers deep insight into IT infrastructure—as well as advanced capabilities like the impact model and proactive analytics—to help IT administrators get the most out of these complex environments. PS

David Weber is lead integration manager at BMC Software and a 25-year veteran of the IT industry, having spent most of that time in systems and service management.

Veronique Delarue is a technical and marketing writer at Sentry Software with over 15 years of experience in the computer systems, software, and telecom industries.

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Dressed for success

By Joyce Ruff

By outfitting their data centers with Dell™ rack enclosures, basic and metered PDUs, rack-mount UPSs, digital KVM remote console switches, and other complementary accessories, organizations can design a successful and highly efficient IT environment.

Dell's Efficient Enterprise strategy focuses on making IT responsive to changing business needs while reducing operating costs through standardization, simplification, and automation. Dell PowerEdge™ servers, PowerVault™ and EqualLogic™ storage, and PowerConnect™ networking products can help organizations create an intelligent infrastructure to support those goals—a key component of the overall strategy.

But outfitting a complete data center installation requires more than just servers, storage, and switches: IT managers must also account for power, cooling, and systems management needs to help ensure that the data center is both functional and efficient. By taking advantage of Dell rack enclosures, power distribution units (PDUs), uninterruptible power supplies (UPSs), digital KVM (keyboard, video, mouse) remote console switches, and other accessories, organizations can outfit their data centers in complementary components from head to toe.

Selecting a stylish suit

No data center is complete without a suitable rack enclosure. Dell PowerEdge rack enclosures are designed to accommodate a wide range of IT equipment while supporting enhanced power management, efficient cooling, and flexible cable management. Dell server, storage, and networking systems can be easily installed into 48U PowerEdge 4820, 42U PowerEdge 4220, and 24U PowerEdge 2420 rack models using the Dell ReadyRails™ static and sliding rail kits, which are designed to quickly snap into square-hole and unthreaded round-hole racks without tools. The tallest member of this family, the PowerEdge 4820, is designed for high-density installations, enabling organizations to support additional servers while maintaining the existing footprint.

The PowerEdge 4820 and PowerEdge 4220 models are each available in three form factors: standard (600 mm wide by 1,070 mm deep), wide (750 mm by 1,070 mm), and deep (600 mm by 1,200 mm). The wide and deep versions are designed to address specific requirements for additional space to facilitate power and cable management.

The wide PowerEdge 4820W and PowerEdge 4220W racks have three inches of extra space on each side for cables and PDUs—useful for network switches, blade servers, and other installations that

require routing cables along the sides of the rack. The wide form factor also moves the PDU trays farther away from the rack-mounting posts, helping reduce contention between power cords, cables, and installed equipment.

The deep PowerEdge 4820D and PowerEdge 4220D racks offer expanded space in the back for cables and PDUs to support high-density installations. This form factor includes expanded PDU trays in the back that can hold up to four vertical-mount full-height PDUs on each side, providing extra space that can be used for additional power management or for routing cables. PDUs can also be mounted with a 90-degree rotation so that the power cords point toward the back of the rack rather than toward the middle.

All three form factors adhere to the EIA-310-E standard for rack mounting of electronics, such that the mounting posts for installing components are held in a consistent location while the exterior of the rack grows to the specified dimensions. This design helps ensure compatibility with existing equipment while providing additional options for cable and power cord routing. With removable rear doors and tailbars, a sliding top access panel, and top canopy knock-outs, these racks help significantly simplify the cabling of IT equipment.

Dell rack enclosures are also designed to maximize airflow and reduce thermal issues, enhancing efficiency and power savings for the data center. For thermally efficient hot aisle/cold aisle data center topologies, the standard rack enclosure fits within two standard floor tiles in a space two feet wide by four feet deep. Space planners can select the form factor that best meets their needs.

Choosing the right power tie

A stylish suit is enhanced with the right power tie—that extra touch that accentuates the outfit. Organizations can complement Dell rack enclosures by choosing from an extensive portfolio of Dell PDU and UPS systems, mixing and matching to create the right combination for their needs. Three-year warranties along with world-class support and reliability help ensure that the physical infrastructure can protect and support critical enterprise applications.

Powering up with Dell PDUs

Reliable power distribution is a key part of data center design. Dell PDUs help provide reliable power distribution in a rack enclosure from low-amperage single-phase circuits to higher-power three-phase solutions. The Dell family of PDUs includes basic and metered functions, input voltages ranging from 100 V to 415 V, input currents ranging from 16 A to 60 A, and varying quantities of outlet types with up to 48 receptacles. In addition to the amperage rating, Dell specifies the true measure of power consumption for each PDU in kilowatt-hours.

Dell PDUs combine worldwide standard International Electrotechnical Commission (IEC) power outlet connections with regionalized input options, allowing flexibility across a variety of global power infrastructures. Detachable inlet cords on some models allow for a wide choice of deployment options.

Dell PowerEdge racks come in a range of sizes and form factors to fit different data centers

Planning an efficient infrastructure

The online Dell Energy Smart Solution Advisor tool offers a wide range of configuration flexibility and environmental inputs to help IT professionals plan and tune their compute and infrastructure equipment for maximum efficiency.

dell.com/calc

Dell PDUs are designed to provide reliable power distribution in a rack enclosure

Dell PDUs also come in several form factors. The 1U and 0U models can be placed in a 1U rack space with other rack-mounted equipment or in the side of some racks. Vertical PDUs available in half-height length for all Dell racks, full-height length for 48U and 42U racks, and extended-height length for 48U racks provide the flexibility to select the appropriate PDU for the equipment in a specific rack. The vertical PDUs can be installed without tools, utilizing button mounting in the rear trays of the Dell racks, with the outlets facing toward the center of the rack or turned 90 degrees to direct the outlets toward the back of the rack to help with cord management.

The latest 48U and 42U high-density vertical PDUs include an increased number of highly packed outlet receptacles in both basic and metered versions, making them well suited for large deployments that maximize the amount of equipment installed in a rack. For example, one high-density PDU could handle all of the power supplies in multiple blade server systems installed in one rack.

Metered PDUs help simplify the deployment of advanced power metering and environmental monitoring. Real-time remote monitoring of connected loads helps prevent potential overloads. User-defined alarms can warn of potential circuit overloads before critical IT failures occur. Data logging can provide load metering and report power utilization trends, enabling data center managers to make informed decisions when rightsizing IT environments to help reduce total cost of ownership. And administrators can access and configure the PDU with embedded firmware through secure Web, Simple Network Management Protocol (SNMP), or Telnet interfaces, or through the Dell Management Console powered by Altiris™ from Symantec™, which provides IT administrators with a consolidated view of their infrastructure.

The receptacles, circuit breakers, ports, ground bonding point, and user interfaces are located on the front panel of each metered PDU for easy access. Color-coded outlet receptacles and circuit breakers associate the breakers with the receptacles they protect. Each PDU also includes an environmental monitoring sensor port, a dry contact sensor port, a 10/100Base-T Ethernet port, a serial communication port, and an internal network interface card. Optional cord retention kits help to manage the power cords plugged into the PDU. Other accessories include temperature, temperature/humidity, and dry contact sensors; the dry contact port can be used for user-defined sensors, such as rack door position, motion, light, and proximity sensors. Dell PDUs are specified for an operating temperature of 122°F (50°C)—especially important for the warm environment in the back of the rack—and come with a full three-year warranty.

Making it last with Dell UPSs

Also available with a three-year warranty, including batteries, Dell UPS backup systems are available in line-interactive and online models in tower and rack-mount styles. These UPS models help protect equipment from downtime, damage, and data loss due to power problems by maintaining power during an outage long enough for IT staff to save data and shut down equipment properly. As an added benefit, the systems also help protect against power surges and disruptive line noise. Each Dell UPS is rated for maximum output power expressed in watts, which describes the total load that can be managed across all receptacles. All models are built to run at a 95 percent efficiency rating or greater.[1]

Line-interactive tower and rack-mount UPSs are designed to provide reliable, vital power backup of IT equipment ranging from 500 W to 5,600 W. These models regulate voltage by boosting input utility voltage up or moderating (bucking) it down as necessary before allowing it to pass to the protected equipment or resorting to battery power.

Within the Dell UPS family, the online double-conversion rack-mount UPSs offer the best combination of high efficiency, power protection, and reliability for backup of critical IT equipment ranging from 2,700 W to 5,600 W by isolating equipment from raw utility power. These models combine power backup and power conditioning

[1] Based on product specifications; actual efficiency will vary based on configuration and usage.

to provide continuous clean power and help protect against power disturbances.

The internal batteries in Dell UPSs are designed to run protected equipment for 5–10 minutes (depending on the model) at full load during a power outage, or up to triple that time if the UPS is at half load. In that time, system administrators can gracefully shut down connected systems or transfer to generator power. In high-reliability environments where it is important to keep systems running rather than shut them down, an optional external battery module (EBM) can extend battery runtime by three or four times for all but the 500 W tower UPS and 1,000 W rack UPS models.[2]

Dell UPS systems come with installed management software, an advanced graphical LCD, and tool-less rack mounting using the Dell ReadyRails interface. The large backlit display, available in nine languages, enables IT staff to easily view system status, configure UPS parameters and options, and easily navigate among functions. Remote monitoring and Dell Management Console integration are enabled with the optional network management card, which supports secure access over a LAN or over the Internet with no additional software required. This configuration enables administrators to manage multiple UPSs, control multiple servers connected to a UPS, and conduct orderly, unattended power shutdown of connected equipment.

Managing appearances

With the basic parts of the outfit selected, the next step is to put it all together. In a data center, centralized management links the devices for efficient access. Dell KVM remote console switches, also called KVM-over-IP switches, enable administrators to use only one keyboard, mouse, and monitor to simultaneously access multiple devices, including servers, routers, switches, and storage heads. Similar to the Dell servers and UPS systems, the KVM switches can be easily mounted into a 1U space in the front or back of a Dell rack using the tool-less Dell ReadyRails kit.

The Dell KVM 1082DS, 2162DS, and 4322DS models perform management in a heterogeneous environment for Dell and third-party servers, serial devices, and PDUs. In addition, they help simplify server management with integrated firmware and provide access both locally in the data center and remotely, with enhanced features including Common Access Card (CAC) capability, true serial support, and multiple USB ports.

Managing servers in multiple locations or in remote data centers can be challenging, especially if resources are limited. Administrators can manage Dell KVM switches and perform KVM functions over a local area network (LAN) or wide area network (WAN) with the easy-to-use client software and the local and remote on-board Web interface. In addition, administrators can easily update and install firmware, applications, and operating systems either locally or remotely by using virtual media or a local USB drive.

Dell KVM remote console switches also include multiple features and enhancements across several key areas:

- **Security:** Administrators can use the CAC-over-USB capability to support multifactor authentication schemes required by governments and other high-security environments that cannot rely on simple authentication based on usernames and passwords. They can set passwords for local

Dell UPSs help protect equipment from downtime, damage, and data loss

[2] Based on tests performed by Eaton Corporation in May and June 2009 on Dell UPS models under 100 percent and 50 percent loads; actual runtime will vary based on configuration and usage.

Selecting the right UPS

The online Dell UPS Selector tool makes it easy to select the appropriate model from the Dell UPS family to help meet the needs of a specific IT environment.

dellups.com

The 10-second challenge

The Dell UPS ReadyRails mounting interface is designed for easy installation—with no tools required. In this video, see just how quickly this design can be fitted onto a Dell rack.

youtube.com/watch?v=7GCPOKSNuC4

Dell KVM remote console switches enable centralized management of heterogeneous environments

and remote access as well as the management port, and can encrypt keyboard, mouse, video, and virtual media data using Advanced Encryption Standard (AES), 128-bit Secure Sockets Layer (SSL), Data Encryption Standard (DES), or 3DES. Using local security, they can also set access rights and permissions for users and administrators.

- **Availability:** With dual Gigabit Ethernet ports and dual power supplies, Dell KVM remote console switches offer failover redundancy for high-availability environments that need to ensure that data centers aren't adversely affected by partial network or power outages. An external modem port provides another means of accessing the switch if the network is compromised.
- **Performance:** Enhanced video compression and configuration flexibility enable the switches to provide excellent remote video performance, even over long distances between console switches and Server Interface Pods (SIPs).
- **Options:** The USB 2.0 SIP provides support for full-speed virtual media and CAC data transfer. A serial SIP connects serial devices to the switch without emulation, using the same console. KVM functions are designed to work with all existing Dell Category 5 (Cat5)–based PS/2, USB 1.1 and 2.0, and serial SIPs.

The switches also offer a high level of monitoring and preventive maintenance, providing the benefits of remote server and heterogeneous data center management.

Adding accessories

The right accessories can complete the outfit. While rack enclosures provide the necessary capacity for holding key data center components, and KVM remote console switches offer the ability to manage those components, a range of complementary Dell accessories are available to enhance airflow and usability.

Dell PowerEdge racks are designed to offer near-zero resistance to airflow, with 80 percent perforation on the front and rear doors. In addition, the flexible air dams in the rack provide solid segregation between the front and rear of the cabinet, helping minimize internal recirculation of hot air. A rack fan can be installed in the top of the 48U and 42U racks to facilitate air movement through the upper canopy.

Blanking panels can be placed in unused U-spaces to help ensure proper airflow through the installed devices and enhance cooling efficiency. Plastic panels snap in place while steel panels are attached with screws for added security.

Components that do not come with rails for rack installation can be placed on the 1U fixed equipment shelf, which is designed for tool-less installation into Dell racks. The steel shelf can hold up to 200 pounds (90.7 kg) of weight, and comes with a pair of hook-and-loop straps for securing cables.

The Dell KMM (keyboard, monitor, mouse) console can connect to the KVM console switch to provide at-the-rack visibility to the attached devices. This console, with a flat panel screen and an integrated touchpad keyboard, can be installed without tools into a 1U space in a Dell rack.

Suiting up

A complete data center requires more than just the basics of servers, storage, and switches. Adding complementary components such as Dell racks, PDUs, UPSs, KVM remote console switches, and other accessories can help organizations fully outfit their data centers and create a successful and efficient enterprise environment. PS

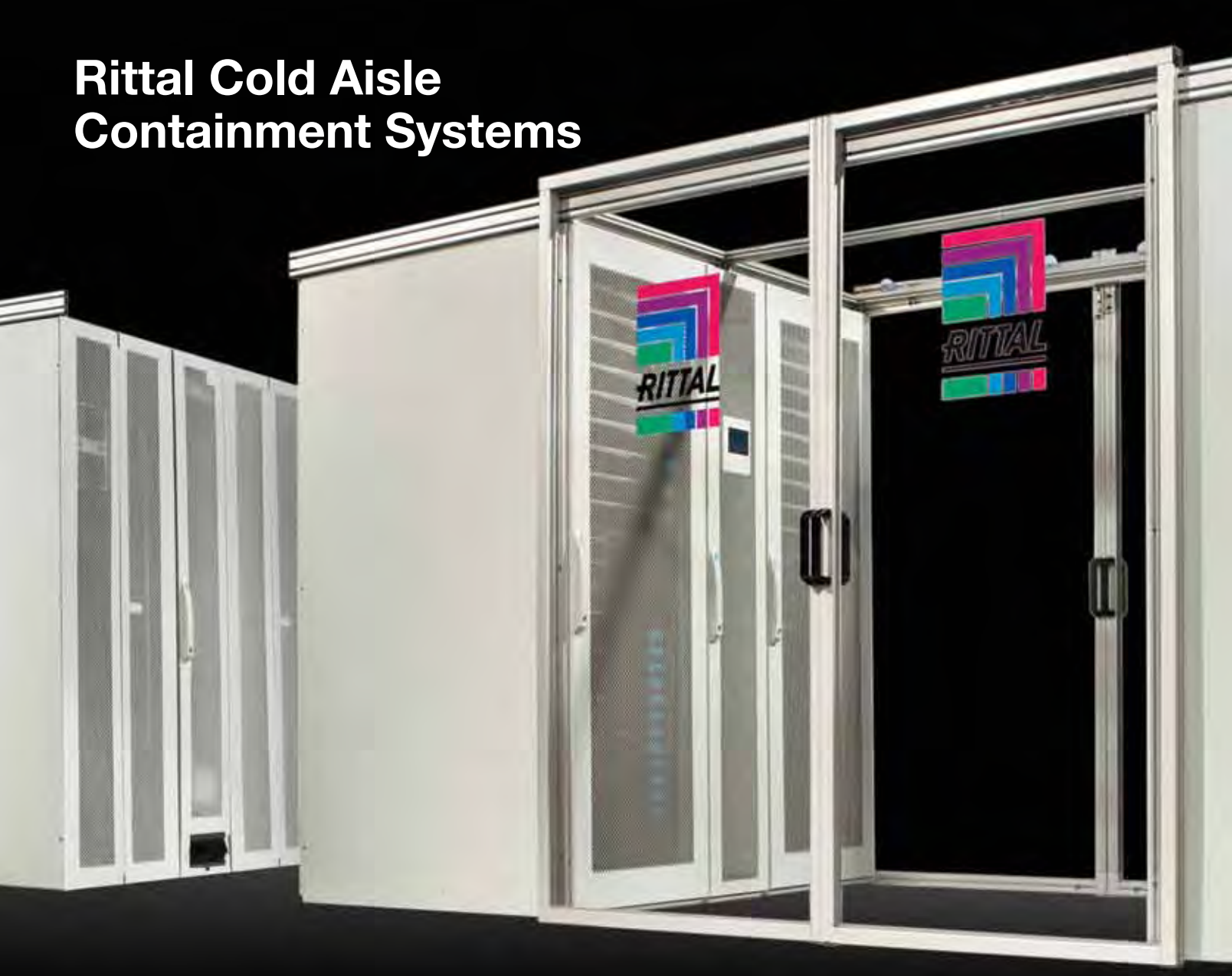
Joyce Ruff is a product marketing manager for the Data Center Infrastructure team within the Dell Enterprise Product Group, and is responsible for the rack enclosures and accessories that complement Dell server solutions.

Learn more

Dell racks and accessories:
dell.com/poweredge/rack

The Efficient Enterprise:
dell.com/efficiententerprise

Rittal Cold Aisle Containment Systems



Energy Saved Is Money Earned

Cooling can represent a significant portion of a data center's overall energy usage. As an industry leader in IT infrastructure solutions, Rittal supplies thousands of data centers worldwide with advanced cooling systems that include cold aisle containment and liquid cooling technologies designed to reduce overall energy consumption.

Whether you're designing a new data center or updating an existing installation, Rittal can show you how easily energy savings translate to your bottom line. Find out why the world's leading companies depend on Rittal's money-saving solutions by downloading our free overview white papers at **www.rittal-corp.com/moneyearned**.

Implementing a unified networking fabric in virtualized data centers

By Sunil Ahluwalia and Pankaj Gupta

IT organizations can now simplify data center connectivity and reduce costs by consolidating LAN, NAS, iSCSI SAN, and Fibre Channel SAN traffic onto a single 10 Gigabit Ethernet wire.

Efficient IT

This Webcast series explores specific steps organizations can take to maximize server and storage efficiency in the data center.

dell.com/efficientIT

For many organizations, the benefits of virtualization have been limited by the complexities of networking virtualized servers. I/O demands increase as virtual machines are added to each physical server, which requires adding more ports than were necessary for traditional networking connectivity. A typical virtualized server may use 8–10 Gigabit Ethernet (GbE) LAN ports and two dedicated storage area network (SAN) ports.

As server virtualization continues to take root, 10 Gigabit Ethernet (10GbE) and unified networking are helping organizations overcome connectivity challenges and simplify the data center infrastructure. Unified networking enables consolidation of multiple GbE connections onto a single 10GbE adapter to help reduce cable and infrastructure complexity and overall total cost of ownership. Enhancements to the Ethernet standard and ratification of the Fibre Channel over Ethernet (FCoE) specification enable IT departments to realize increased benefits by cost-effectively converging data and storage infrastructures.

Accelerating the transition to unified networking

Ethernet has served as a familiar, cost-effective data center fabric for years, supporting LAN, network attached storage (NAS), and Internet SCSI (iSCSI) SAN traffic. Now, with Open-FCoE, a standard 10GbE server adapter can also connect servers to Fibre Channel SANs. Open-FCoE uses the Fibre Channel network, service, and protocol layers and carries data packets over the Ethernet physical and data link layers. The Data Center Bridging (DCB) standard enhances 10GbE connectivity by providing quality-of-service features needed to create a lossless, unified Ethernet fabric for storage.

These technologies, together with Intel® Ethernet X520 server adapters on Dell™ PowerEdge™ servers, now enable LAN, NAS, iSCSI SAN, and Fibre Channel SAN traffic over one 10GbE wire. Combined, Dell servers and Intel Ethernet server adapters can deliver a cost-effective and high-performing connection to the storage network and help accelerate the move to 10GbE-based I/O consolidation.

Extending consolidation with Open-FCoE

The Open-FCoE architecture uses a combination of FCoE initiators in Microsoft® Windows® and Linux® operating systems and in the VMware® ESX hypervisor to deliver high-performance FCoE solutions over standard 10GbE Ethernet adapters (see Figure 1). This approach allows IT managers to simplify the data center and standardize on a single adapter for LAN and SAN connectivity.

Intel 10GbE server adapters are designed to fully offload the FCoE data path to deliver full-featured converged network adapter (CNA) functionality without compromising on power efficiency and interoperability. Key advantages of the Intel Open-FCoE solution include the following:

- **Scalable performance:** Because there are no proprietary hardware offloads, Intel Open-FCoE performance scales naturally with the server processor. For real-life applications, Open-FCoE can deliver the performance that IT managers expect.[1]
- **Ease of use:** The Open-FCoE approach uses standard 10GbE adapters so that IT staff can leverage existing knowledge to configure and manage adapters for FCoE deployments, and standardize on Intel 10GbE server adapters for LAN, NAS, iSCSI, and FCoE traffic.
- **Cost-effectiveness:** The intelligent combination of hardware data plane offloads and software initiators enables comprehensive CNA functionality in a cost-effective way.
- **Reliability:** Intel's extensive Ethernet experience combined with certified FCoE initiators enable a reliable Open-FCoE solution.

Announcing Dell/EMC certification of Dell servers and Intel adapters

Dell PowerEdge servers and Intel Ethernet X520 server adapters with 10GbE technology are designed to provide the processing and I/O performance required for unified data centers. PowerEdge servers are built with multi-core processors and memory controllers to power multiple virtual machines and demanding applications. Intel Ethernet X520 server adapters use hardware-based offloads to enhance FCoE throughput and help ensure processor cycles are available for application processing. PowerEdge server models 1950, 2900, 2950, 2970, R410, R510, R610, R710, R715, R805, R810, R815, R900, R905, R910, T610, and T710 with Intel Ethernet X520 server adapters are now certified for use with Dell/EMC storage.

I/O unification requires storage that supports both application-level file protocols and disk-level block protocols while leveraging storage virtualization. Dell/EMC storage works as an enabler of unification, supporting NAS, iSCSI, and FCoE in the same storage system plus existing Fibre Channel deployments.

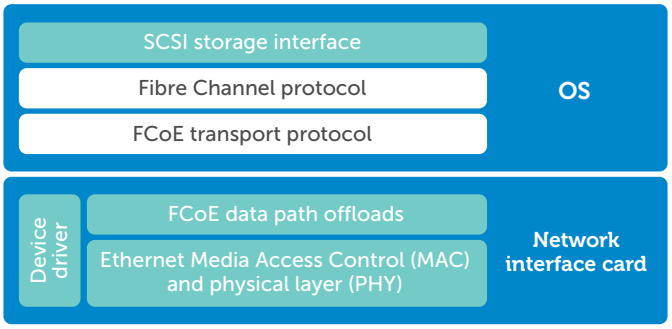


Figure 1. Open-FCoE architecture

Reducing the cost and complexity of networking

Server virtualization in data centers continues to grow, creating connectivity and networking challenges. The combination of 10GbE and unified networking helps organizations overcome connectivity challenges and simplify the data center infrastructure. 10GbE provides a simple, well-understood fabric for virtualized data centers, one that helps reduce cost and complexity as the number of virtual machines continues to grow. 10GbE unified networking can also lay the groundwork for new computing models, such as cloud computing, designed to deliver enhanced business agility and data center efficiency.

FCoE helps extend and simplify infrastructure consolidation. Open-FCoE, the architecture available in Intel Ethernet server adapters with 10GbE technology, also helps ease the transition to a unified data center. And the certification of Dell PowerEdge servers with Intel Ethernet X520 server adapters offering 10GbE technology for Dell/EMC storage provides an optimized, end-to-end unified data center solution that is available to IT organizations today. PS

Learn more

Intel Ethernet server adapters:
intelethernet-dell.com

Dell PowerEdge servers:
dell.com/poweredge

Dell/EMC storage:
dell.com/emc

Sunil Ahluwalia is a senior manager of product marketing at Intel responsible for GbE and 10GbE products for the data center.

Pankaj Gupta is a senior product marketing manager for Dell enterprise networking products.

[1] For more information, see "Intel 10GbE adapter performance evaluation for FCoE and iSCSI," by Demartek, September 2010, demartek.com/reports_free/demartek_intel_10gbe_fcoe_iscsi_adapter_performance_evaluation_2010-09.pdf.

Utilizing 10GBase-T for broad 10 Gigabit Ethernet deployment

By Robert Hartman and Carl Hansen

Virtualized data centers deploying Dell™ PowerEdge™ servers, Dell PowerConnect™ switches, and Intel® Ethernet server adapters can use 10GBase-T to broadly deploy 10 Gigabit Ethernet and help avoid I/O networking bottlenecks.

Efficient IT

This Webcast series explores specific steps organizations can take to maximize server and storage efficiency in the data center. Register for Dell and Intel's presentation on optimized storage to learn more about intelligent storage, data management, and unified storage over Ethernet.

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Virtualization, increasingly powerful server platforms, and rising numbers of hosted applications and virtual machines have combined to dramatically increase the demand for additional I/O in the data center. Capitalizing on performance increases in the latest four-socket Dell server platforms, for example, enables organizations to host more virtual machines per server and more applications per virtual machine than ever before. As a result, the bottleneck in many data centers has now shifted to network I/O.

Organizations have addressed this challenge by adding Gigabit Ethernet (GbE) ports. But although this approach helps to increase I/O, it has also increased networking complexity. IT organizations can help reduce this complexity and provide the scalability to meet growing data demand by consolidating traffic from GbE ports onto fewer 10 Gigabit Ethernet (10GbE) ports, and leveraging technology advances that have helped dramatically improve the implementations of this consolidation.

Until now, either fiber optic or small form-factor pluggable + (SFP+) direct attach copper connections were available for deploying 10GbE connectivity. Both have limitations. The high cost of optical cabling and switches makes the optical connections appropriate for a limited number of usage models, while the 7 m (23 foot) reach of SFP+ direct attach copper cabling limits its use to short-distance connections.

IT managers need a different approach to enable broad 10GbE deployment—and 10GBase-T is well suited for the task. This article presents a best-practices deployment using the 10GBase-T standard in networks optimized with Dell servers and switches and Intel Ethernet server adapters using 10GbE technology.

Driving the need for 10 Gigabit Ethernet

A number of recent advances in information and data center technologies are helping drive the need for a 10GbE fabric, including virtualization and server clustering, network convergence, and advanced storage architecture. The Internet is also a major factor, with new forms of Internet-based information delivery and an explosion of digital and social media content.

Organizations are consolidating applications onto high-performing virtualized servers, helping drive increased demand for high-bandwidth networking infrastructures. At the same time, sophisticated management tools, powerful applications, and the advent of cloud computing can require increasing the number of servers deployed in today's data centers. And as server processors move from dual to quad and octal cores, they are performing additional processing and producing increased data communications over the network.

Unified storage is also helping to increase the demand for high bandwidth. Organizations

"IT managers can use the Dell and Intel recipe to provide 10GbE performance for both top-of-rack switch and end-of-row usage models."

moving to unified networking are simplifying network storage by merging multiple traffic types onto low-cost Internet SCSI (iSCSI) transport and Ethernet technology. This convergence significantly loads network ports because of the dynamic and random nature of the data, and IT planning for data over Ethernet places increased emphasis on bandwidth availability and utilization. Simply put, GbE cannot scale up to meet these demands—resulting in an environment that is ready for the benefits of 10GbE connectivity.

10GbE has emerged as a flexible, unified data center fabric for several reasons. It provides the bandwidth required for virtualization, today's powerful servers, and demanding applications. And 10GbE is expected to deliver the simplified network infrastructure needed to support cloud computing. 10GbE has also emerged as a cost-effective choice because it enables IT staff to consolidate multiple GbE ports onto fewer, more powerful 10GbE ports to help reduce cabling and costs for interconnection.

Exploring usage models for the 10GBase-T standard

Today, IT managers can select from the following 10GbE interconnect and switch options based on specific intended uses:

- **SFP+ direct attach copper:** These connections are a good choice for deploying 10GbE within blade server enclosures or racks over short distances.
- **Optical cabling:** Fiber optic connections are well suited for areas of heavy traffic aggregation such as the network backbone.
- **10GBase-T:** Now, IT managers have 10GBase-T as a third option for either top-of-rack switch or end-of-row usage models.

This mix of interconnect and switch options provides the flexibility to choose the appropriate option for each situation. The 10GBase-T standard defines 10GbE over Category 6 (Cat 6) or Cat 6a copper wire with RJ-45 connectors. This continuation of the Ethernet standard helps ensure a smooth transition from GbE networks, and backward compatibility to GbE allows flexibility in upgrading the infrastructure. For example, an organization can upgrade its servers and its switch infrastructure at different times and know they will remain compatible during the transition.

Benefits offered by 10GBase-T include a mix of simplicity and low cost. Many networks today already have Cat 6 or Cat 6a cabling in place, so they are 10GBase-T ready. Any fiber already in place can be repurposed for 10GbE. And new Cat 6 or Cat 6a cabling can be added at a lower cost than either direct attach twinaxial copper or fiber multimode connections. Finally, training and knowledge transfer costs can be reduced, because IT staff are already familiar with Ethernet technology and RJ-45 connectors.

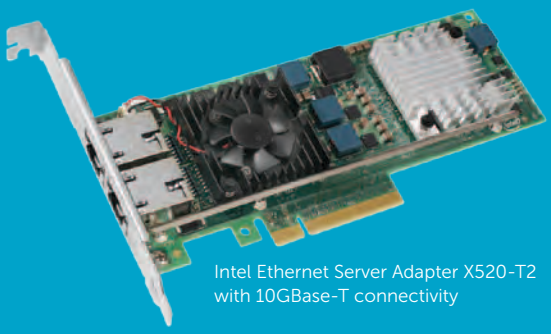
Along with cabling, today's 10GBase-T network adapters are also cost-effective. Intel dual 10GBase-T adapters are the third generation of Intel Ethernet server adapters with 10GbE technology, and third-generation technology advancements help deliver significantly lower cost per port and power draw compared with previous generations.

Deploying 10GBase-T using Dell and Intel technologies

The Dell and Intel 10GBase-T deployment recipe brings together a combination of Dell server and switch technologies and Intel

Blending a networking recipe for virtualized data centers

A mix of Intel and Dell technologies offers a recipe well suited for deployments using the 10GBase-T standard to deliver cost-effective 10 Gigabit Ethernet (10GbE) performance in virtualized data centers.



Intel Ethernet Server Adapter X520-T2 with 10GBase-T connectivity

Intel Ethernet Server Adapter X520-T2

- Dual 10GBase-T connectivity is offered in a low-profile PCI Express (PCIe) 2.0 form factor.
- Included Intel Virtualization Technology for Connectivity (Intel VT-c) helps deliver high performance in virtualized server environments.
- Supported technologies under the Intel VT-c umbrella include Virtual Machine Device Queues (VMDq) technology and PCI-SIG Single Root I/O Virtualization (SR-IOV) standards.
- VMDq helps improve data processing by offloading functionality for sorting and queuing to the I/O controller from the hypervisor.
- Using the SR-IOV standard, the Intel Ethernet Server Adapter X520-T2 helps deliver direct assignment of a virtual function to a virtual machine, with mobility-enabling data isolation among virtual machines and migration of virtual machines.
- Internet SCSI (iSCSI) acceleration and iSCSI remote boot support storage over Ethernet by allowing storage and LAN traffic to share the existing Ethernet infrastructure using native iSCSI initiators in the OS.

Intel Chip Chat

Intel Chip Chat is a series of podcast interviews ranging across a wide variety of technology topics. Episode 103 covers the advancements of 10GbE, including how integrating Media Access Control (MAC) and the physical layer (PHY) into a single processor helps reduce power and costs.

intel.com/design/chipchat.htm

adapters (see the "Blending a networking recipe for virtualized data centers" sidebar). Ingredients include Dell PowerEdge rack and tower servers, Dell PowerConnect 8024 switches, and the Intel Ethernet Server Adapter X520-T2 with iSCSI support and Intel Virtualization Technology for Connectivity (Intel VT-c).

IT managers can use the Dell and Intel recipe to provide 10GbE performance for both top-of-rack switch and end-of-row usage models and data links from 1 m to 100 m:

- **Top-of-rack switch model:** This usage model is primarily used for aggregating all 10GbE connections—up to 24—in each individual rack. With dual 10GbE adapter ports, IT administrators can deploy a second PowerConnect 8024 switch per rack for redundancy.
- **End-of-row model:** Server network connections in the rack can connect all the way to the end of the row because of the 100 m reach of 10GBase-T. With the end-of-row model, organizations can use cost-effective patch panels in place of top-of-rack switches, helping reduce costs by avoiding an additional layer of switching.

Large enterprises can deploy 10GbE links across the backbone to the data center edge. The switch can be located at the edge or in a wiring closet and link to a PowerEdge T710 tower server using Intel Ethernet X520-T2 10GBase-T adapters.

Addressing advanced high-bandwidth networking needs

Today's data centers demand flexible and scalable approaches to network I/O

Dell PowerEdge R910 rack server
with the Intel Xeon processor architecture

Dell PowerConnect 8024, a 24-port 10GbE Layer 3 switch
for mixed cabling environments

Dell PowerEdge rack and tower servers

- Today's PowerEdge servers are based on powerful processors, such as the Intel Xeon® processor 5600 series and Intel Xeon processor 7500 series.
- These four-, six-, and eight-core processors support more virtual machines and applications per host than previous-generation processors.
- The innovative processor technologies in these PowerEdge servers offer enhanced efficiency and security options.

Dell PowerConnect 8024 switch

- High-density 10GbE switching capability is available with 24 ports for high throughput and availability.
- Ready for converged Ethernet environments, the switch supports virtualization and iSCSI storage.
- Enterprise-class high-availability features include redundant hot-swappable power supplies and dual firmware image support for incremental image updates.

throughput to help meet the rigorous requirements of running mission-critical applications with increased performance and availability in virtualized and unified storage environments. The 10GBase-T standard enables cost-effective, streamlined 10GbE connectivity, and it can be well suited for volume 10GbE deployments in organizations continuing to enhance efficiency in their data centers through network consolidation, convergence, storage over Ethernet, and virtualization. Together with Dell PowerEdge servers and PowerConnect switches, the third generation of Intel adapters deploying 10GBase-T technology is designed to provide cost-effective, virtualization-optimized 10GbE network performance for top-of-rack switch and end-of-row model configurations. PS

Robert Hartman is an outbound marketing manager for networking solutions at Dell, where he helps drive PowerConnect communications, go-to-market planning, and product launch messaging.

Carl Hansen is a product marketing engineer for the GbE and 10GbE Intel Ethernet server adapters for OEMs. He has been with Intel for 14 years, and has over 20 years of experience in the software and computer industry.

Learn more

Dell PowerEdge servers:
dell.com/poweredge

Dell PowerConnect switches:
dell.com/powerconnect

Intel Ethernet server adapters:
intelethernet-dell.com

Bringing converged iSCSI storage to virtualized environments

By Dhiraj Sehgal, Abhijit Aswath, and Srinivas Thodati

Key technologies from Dell, Broadcom, and VMware enable IT organizations to create converged iSCSI storage networks that help them control costs, boost performance, and keep up with the growing storage demands of virtualized environments.

Demands on enterprise data storage have been growing for years, and this trend has been accelerated by the advent of cloud computing. But two evolving technologies have the potential to help organizations keep up with these growing workloads.

The first of these is 10 Gigabit Ethernet (10GbE), which allows IT departments to avoid investing in separate Fibre Channel technology just to accommodate storage requirements. Instead, they can use Ethernet with the Internet SCSI (iSCSI) protocol to create a cost-effective converged data center fabric that leverages existing IT infrastructure and expertise while providing high performance, enterprise-class functionality, and reduced total cost of ownership (TCO).

The second key technology is virtualization. The benefits of consolidation through virtualization, such as increased efficiency and flexibility, are well known in the data center. As a result, IT departments are deploying virtualized architectures at a rapid pace.

These two technologies can work well in concert. A converged 10GbE-based iSCSI storage infrastructure can enhance virtualized environments by enabling data center consolidation and performance increases using Ethernet. In addition, 10GbE-based iSCSI complements other virtualization deployment features, such as migration, clustering, and disaster recovery. However, IT departments have typically had to piece together various technologies to use iSCSI in virtualized environments, which often results in less-than-optimal performance and efficiency.

Now, however, that is changing. As Dell, Broadcom, and VMware have pursued various virtualization- and iSCSI-related initiatives, they have coordinated their efforts. As a result, organizations can now take advantage of Dell™ PowerEdge™ servers, Dell EqualLogic™ PS Series storage, Broadcom® NetXtreme II® converged network interface controllers (C-NICs), and VMware® vSphere™ 4.1 virtualization to create a comprehensive, end-to-end solution that helps them cost-effectively keep up with growing data center demands.

Creating a converged storage platform

In recent years, Broadcom and Dell have worked together on many fronts to bring their technologies together. Today, the combination of Dell PowerEdge servers, Dell EqualLogic PS Series storage, and Broadcom NetXtreme II iSCSI host bus adapters (HBAs) and iSCSI boot solutions offers a comprehensive approach to using iSCSI in the data center.

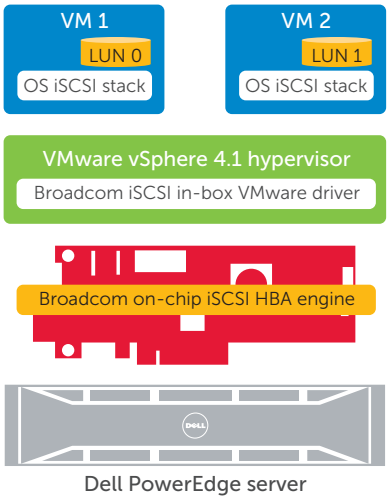


Figure 1. iSCSI-based configuration using a Dell PowerEdge server, a Broadcom NetXtreme II C-NIC, and VMware vSphere 4.1

In environments based on EqualLogic storage and Broadcom C-NICs, each port can connect to multiple cluster elements. The EqualLogic Session Manager handles both session management and path selection. It builds paths on demand, and the system adapts as the configuration changes—enabling optimal use of the host ports and storage ports.

This platform is enhanced by the collaboration of Broadcom and VMware, which has brought key Gigabit Ethernet (GbE) and 10GbE storage area network (SAN) technologies into VMware vSphere. VMware announced the introduction of vSphere 4.1 in July 2010 as a release that "advances the foundation for cloud computing." Among other features, this version enables integration with devices such as Broadcom GbE and 10GbE iSCSI HBAs and iSCSI boot solutions—an enhancement that VMware classified as supporting "increased performance through open integration with storage environments."[1]

Before VMware support for 10GbE-based iSCSI was in place, IT managers had to connect their ESX servers to these SANs using a combination of disparate network interface cards (NICs) or converged network adapter (CNA) hardware along with fat iSCSI device drivers. In these configurations, the majority of the iSCSI protocol processing is performed by the ESX server. vSphere 4.1, in contrast, supports the latest Broadcom C-NICs, which have thin iSCSI drivers and a suite of advanced hardware-based engines. Using these hardware-based engines to handle the majority of the iSCSI protocol processing can dramatically increase platform efficiency and performance. The advanced on-chip iSCSI processing in Broadcom C-NICs supports comprehensive integration with the vSphere 4.1 stack, providing a tightly integrated and optimized iSCSI data path (see Figure 1).

This approach helps avoid compromising networking facilities, and makes those facilities available within a single framework (see Figure 2). Broadcom C-NICs also provide multiple on-chip networking performance enhancements such as Transparent Packet Aggregation (TPA) for coalescing TCP/IP packets in the hardware and achieving line-rate performance and reduced processor utilization for networking traffic. At the same time, the VMware NetQueue feature helps eliminate single-queue bottlenecks.

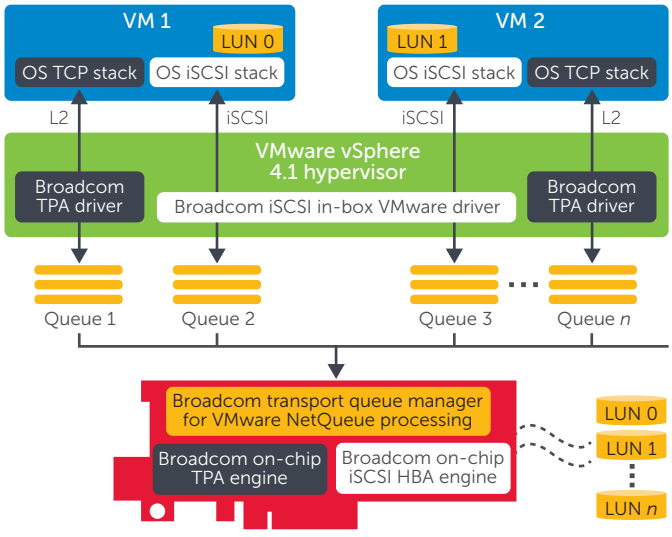


Figure 2. iSCSI-based converged storage architecture using a Broadcom NetXtreme II C-NIC and VMware vSphere 4.1

[1] "VMware advances foundation for cloud computing with VMware vSphere 4.1 and expanded virtualization management portfolio," VMware press release, July 13, 2010, vmware.com/company/news/releases/vsphere-4-1.html.

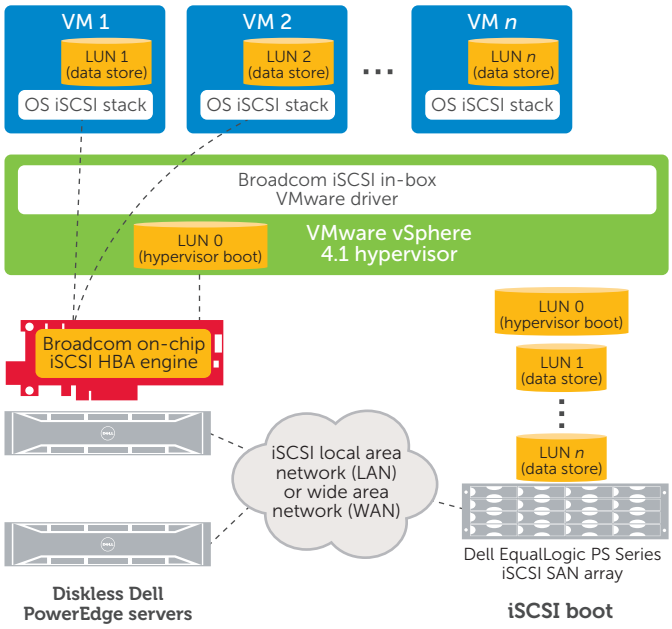


Figure 3. iSCSI boot using a Broadcom NetXtreme II C-NIC and VMware vSphere 4.1

Integrating Broadcom C-NICs and VMware vSphere 4.1

VMware vSphere 4.1 implements iSCSI Boot Firmware Table (iBFT), a component of the Advanced Configuration and Power Interface (ACPI) 3.0b standard. ACPI 3.0b gives operating systems a standard way to boot the iSCSI protocol on devices such as Broadcom NetXtreme II GbE and 10GbE C-NICs.

The iBFT capability for Broadcom C-NICs was introduced in vSphere 4.1. Its value is that in addition to supporting the booting of virtual machines, it allows the vmkernel to boot without local storage and enables use of diskless servers in virtualized environments: administrators can use Broadcom C-NICs to boot VMware ESXi and other operating systems over an iSCSI SAN (see Figure 3). This approach helps to eliminate the need for local disk storage as well as a primary source of failures in computer systems—hard drives. In addition to enhancing system reliability, the use of diskless servers helps simplify IT administration by centralizing the creation, distribution, and maintenance of server images; reducing the overall need for storage capacity through increased disk capacity utilization; and increasing data redundancy through the use of data mirroring and replication.

vSphere 4.1 also provides native support for Broadcom iSCSI HBA functionality with both GbE and 10GbE, and for TPA with 10GbE. In environments using these technologies, each Broadcom port is a separate vmhba, and there is one vmknic per NIC for iSCSI use.

Together, Broadcom C-NICs and vSphere 4.1 provide standard, unified management through the built-in VMware vCenter™ Server systems management tool, which helps to simplify tasks associated with configuring and managing virtualized servers. vCenter recognizes Broadcom C-NICs along with other types of hardware and displays them in a graphical user interface. Administrators can then set up and configure iSCSI connections to specified targets. Logical units (LUNs) that have been mapped to an iSCSI device can then be used to boot vSphere images over the network.

The driver for Broadcom GbE and 10GbE iSCSI HBAs as well as Broadcom iSCSI boot solutions is packaged "in-box" with vSphere 4.1, and both the driver and the environment have been tested through VMware's world-class quality and qualification processes. Administrators do not need to search individual server driver pages or engage directly with the device manufacturer—facilitating a seamless installation over the network and a support model for homogeneous or heterogeneous server environments, with no separate driver upgrades required. This approach also avoids the need to copy separate original equipment manufacturer (OEM) driver images for each OEM server when administrators want to enable iSCSI.

Increasing data center performance and efficiency

Converged iSCSI storage can help increase data center performance and efficiency in several ways. For example, Broadcom NetXtreme II C-NICs can

help improve the Power Usage Effectiveness (PUE) metric through leading performance-per-watt profiles. In today's cost-conscious environment, power costs are no longer being overlooked—they are, instead, one of the most commonly tracked data center TCO metrics.

Four factors can help lower PUE through the deployment of Broadcom C-NICs:

- Compared with a third-party NIC, the hardware-based iSCSI engine within the Broadcom C-NIC architecture can provide power savings of approximately 60 W per port or 120 W per server in other environments.[2]
- iSCSI boot enables the removal of per-server hard drives, which can save approximately 10 W per drive while helping further lower per-server power consumption because of reduced airflow requirements.
- Reduced processor utilization (high processor effectiveness) enables virtual machine occupancy rates to increase, providing a further opportunity to consolidate physical servers and their associated power demands across the data center.
- Broadcom C-NICs support the IEEE 802.3az Energy Efficient Ethernet (EEE) standard, which can provide power savings during periods of low link utilization.

In medium-to-large deployments of iSCSI converged storage, these factors can help organizations to significantly improve PUE—and offer permanent cloud computing and data center power savings—by enabling them to rightsize non-IT infrastructure components such as heating, ventilation, and air-conditioning (HVAC) systems and generators.

Enhancing virtualized environments

As the move toward cloud computing continues, demands on storage and networking are growing at an accelerating pace. Without the flexibility and low TCO offered by converged storage, IT departments will likely find it difficult to optimize resource utilization.

The combination of Dell PowerEdge servers, Dell EqualLogic PS Series storage, Broadcom NetXtreme II C-NICs, and VMware vSphere 4.1 enables IT departments to take advantage of converged storage using GbE- and 10GbE-based iSCSI SANs with relative ease. This type of infrastructure enhances virtualized environments and can provide dramatic data center consolidation and performance improvement using standard Ethernet technology, with unified management and simplified administrative installation. For network architects and administrators interested in cloud computing and virtualization, deploying these Dell, Broadcom, and VMware technologies facilitates high-performance virtualization through a comprehensive, end-to-end solution. PS

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Learn more

- **Broadcom Ethernet controllers:** broadcom.com/products/Ethernet-Controllers
- **Dell PowerEdge servers:** dell.com/poweredge
- **Dell EqualLogic PS Series:** dell.com/psseries dell.com/equallogic
- **Dell and VMware:** dell.com/vmware

[2] For more information, see "A unified networking approach to iSCSI storage with Broadcom controllers," by Dhiraj Sehgal, Abhijit Aswath, and Srinivas Thodati, in *Dell Power Solutions*, 2010 Issue 2, dell.com/content/topics/global.aspx/power/en/unified_networking.

Resilient, high-performance networking for virtual infrastructures

By Saleem Muhammad, Monte Barton, and Craig Phelps

Virtualization is changing expectations for enterprise networks. The virtual top-of-rack solution available in Dell™ PowerConnect™ B-MLXe routers can provide an infrastructure designed for high performance, resiliency, scalability, and simplicity.

Reducing complexity

Dell PowerConnect B-MLXe routers help to simplify networking in dense virtualized environments—freeing resources to drive business innovation.

- **Increased operational efficiency** with a single chassis and single point of management
- **Optimized application performance** with line-rate communication, minimum hops, and near-instant link or node failover
- **Infrastructure flexibility** with collapsed layers, massive scalability, and reduced cabling

Data centers continue to grow as business reliance on the network increases and organizations deploy a rising number of cloud-based applications. The traditional model of separately provisioning servers, storage, and networks is too rigid, and in many cases leads to underutilized, static resources. Organizations expect agile application deployment—in minutes, not months—to maintain their competitive edge as markets and competitors become global in scale. At the same time, data center resources such as rack space, power, and cooling are becoming increasingly scarce and costly. Server virtualization is being aggressively implemented to help meet these challenges, but it is also changing expectations for current networks.

Now, imagine a virtualized data center where workloads migrate anywhere within the data center without performance degradation, where all links from the servers to the network core are active to help maximize bandwidth utilization, and where the network is highly resilient and flexible enough to allow server connectivity to scale up or down in response to the demand. The virtual top-of-rack solution available in Dell PowerConnect B-MLXe series routers enables organizations to move toward these goals by helping to simplify virtualized data center networks and deliver agile IT.

Identifying key networking challenges

IT departments face a variety of challenges in complex data center infrastructures, including scalability in virtualized environments, application mobility, and network management complexity.

Scalability in virtualized environments

When scaling a virtualized server environment, the network presents several challenges and limitations, including the limitations of Spanning Tree Protocol (STP), the growing number of server connections, low utilization, link failure recovery, and management complexity. For example, enabling capabilities such as virtual machine (VM) mobility requires VMs to migrate within a single Layer 2 network. To create a highly available network with traditional Layer 2 Ethernet, paths through the network are designed as active or standby using STP. Although this approach provides an alternate path, only one path can be used to forward traffic in a steady state. As a result,

half of the top-of-rack ports remain idle until a failure occurs—an inefficient use of available bandwidth.

Another challenge with STP is network behavior when links fail. When failures occur, the spanning tree must be redefined. This process can take anywhere from a few seconds with Rapid STP (RSTP) to several minutes with STP—and this convergence can vary unpredictably even with small topology changes. The demands for nonstop traffic flow increase with server virtualization, and consequently network convergence times must shrink. In addition, when a spanning tree is re-converging, broadcast storms can occur and result in network slowdown. Other drawbacks include limited buffer memory to handle high workloads and bursty traffic, oversubscription ratios for server-to-server or server-to-network communications, and latency when traffic must traverse the aggregation layer (multiple hops).

Using traditional access-layer architectures in virtualized environments can also require many switches, making it difficult to perform software upgrades and increasing potential points of failure. When a node or link does fail, slow control-plane failover can result in lost traffic and application availability.

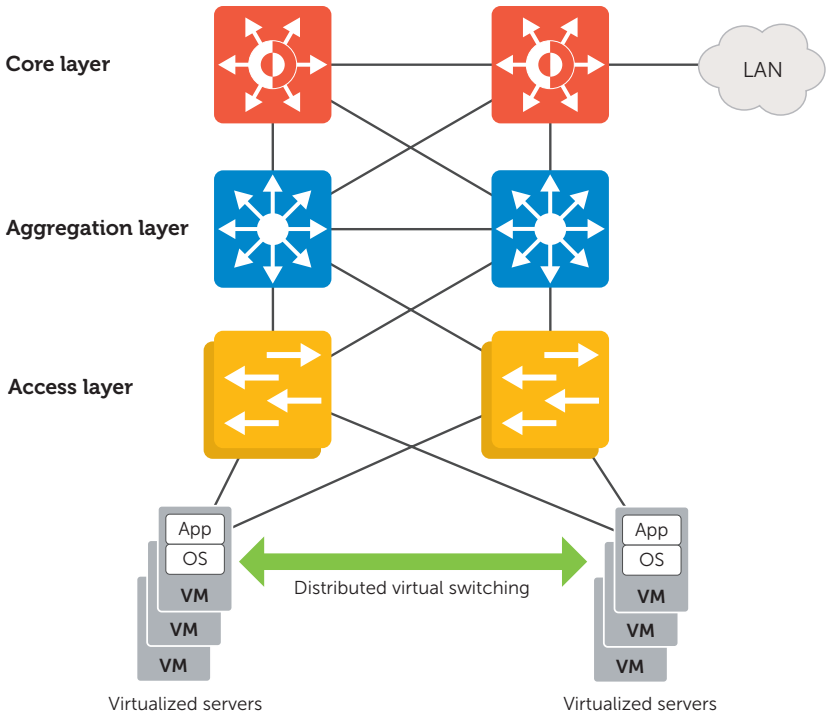

Figure 1. Network layers in a virtualized environment

Application mobility

When an application is running in a VM rather than on a physical server, it is not tied to a specific physical host. In such environments, application mobility, or VM mobility, can take place between hosts when application demands change, when servers need to be maintained, or when a quick disaster recovery from a site failure is necessary. VMs can migrate within a cluster of physical servers that are in the same IP subnet and Ethernet virtual LAN (VLAN), which is required for the migration to be nondisruptive to client traffic. The solution for flexible VM mobility is a more scalable and available Layer 2 network with higher network bandwidth utilization than is typically available in traditional physical environments.

For a VM to migrate from one server to another, many server attributes must be the same on the origination and destination servers, and this requirement extends to the network as well—requiring VLAN, access control list, quality-of-service, and security profiles to be the same on both the source and destination access switch ports. If switch port configurations differ, either the migration preflight fails, or network access for the VM breaks or may cause a security hole. In addition, automated VM migration leaves network administrators with only limited visibility into the location of applications, making it challenging to track issues to a specific VM for troubleshooting.

Network management complexity

Multitiered architectures involve considerable complexity, and server virtualization and blade servers have only increased this complexity. The access layer is no longer managed through a single switch, but now includes multiple stages of switching extending from the software switch in the hypervisor to the top-of-rack or end-of-row access switch (see Figure 1). Each time IT staff deploy a new rack of servers to host VMs, they must also configure each switching layer, driving up cost and complexity. Contributing to management complexities are the separate tools used to manage the LAN, storage area network (SAN), blade server connectivity, network interface cards (NICs), and host bus adapters (HBAs).

Delivering a highly efficient network architecture

Dell's turnkey virtual top-of-rack solution combines Dell PowerEdge™ servers and Dell PowerConnect B-MLXe series routers to deliver a highly efficient virtualized data center. It extends the reach of the

PowerConnect B-MLXe routers to the top of the rack through passive patch panels—offering highly reliable server connectivity at line rate and helping administrators overcome network challenges through high performance, high availability, massive scalability, and simplicity. The resulting environment enables IT organizations to reduce the cost of growth and enhance their responsiveness to business needs.

PowerConnect B-MLXe routers provide line-rate performance that enables servers to fully utilize the available bandwidth on each link irrespective of the features configured on the routers. The routers are designed with very deep buffers per module, which helps ensure optimal congestion management to handle high workloads and bursty traffic. Additionally, these routes can significantly enhance network utilization by avoiding the performance reductions associated with STP: unlike STP, which disables some links to eliminate network loops, PowerConnect B-MLXe routers with Multi-Chassis Trunking (MCT) technology help ensure that all links are active from server to core. The resulting network offers increased capacity by utilizing all links for data transport without requiring special configuration changes to the server.

One of the key foundations of the virtual top-of-rack solution is its ability to collapse access and aggregation layers by allowing all interconnects to take place within the PowerConnect B-MLXe routers. This architecture helps increase network availability, benefiting from the very low failure rate and high mean time between failures offered by the modular PowerConnect B-MLXe routers. In the unlikely event of a link or node failure from server to core, data traffic can deterministically fail over almost instantly, helping ensure that applications remain available to users. Additionally, the modular PowerConnect B-MLXe routers allow IT staff to replace a failed module in the chassis without resetting the system, simply by disconnecting eight cables from the module, replacing the module, and reconnecting the cables to the new module. A collapsed architecture also helps increase application mobility, because the applications move within a single chassis as opposed to a number of separately managed top-of-rack switches.

The virtual top-of-rack solution also offers massive scalability to handle dense virtualized server deployments by supporting up to 768 Gigabit Ethernet (GbE) server connections per switch. It further allows the creation of an MCT cluster, which combines two PowerConnect B-MLXe routers and presents them as a single router to the servers, pushing the maximum number of server connections even higher. As VMs are created on the servers, the network sees multiple Media Access Control (MAC) addresses on each server port. With up to 1 million MAC entries supported per router, the network can forward data traffic without negative performance impact in dense VM deployments. These routers also offer a choice of interconnects, including GbE, 10 Gigabit Ethernet (10GbE), and 100 Gigabit Ethernet (100GbE) port speeds to help ensure that they can continue to meet future needs.

PowerConnect B-MLXe routers help to simplify IT through their ease of deployment, configuration, management, and operation. With up to 768 GbE ports on a single router, these routers deliver massive consolidation, helping reduce the number of network elements that must be deployed to support virtualized server environments. This approach helps simplify network configuration and maintenance by avoiding the need for a spanning tree from the servers to the core of the network. The main component that provides connectivity to servers is a passive top-of-rack patch panel. Because it does not have any electromechanical components, it does not require power, cooling, or out-of-band management network access at the server rack. Administrators can manage the complete solution using the Network Advisor tool, a single application for managing Fibre Channel and IP data center products and IP LAN products from HBAs and converged network adapters (CNAs) in the server to the core of the network.

Simplifying IT through high-performance virtualization

Virtualization has become a critical method for consolidating server sprawl, accelerating server deployment, improving compliance with service-level agreements, and reducing the cost and complexity of IT management. As part of an overall virtualization strategy, organizations can take advantage of the virtual top-of-rack solution available in Dell PowerConnect B-MLXe series routers to help them identify and remove unnecessary complexity from their infrastructure, thus freeing resources to focus on the core value of IT to drive business innovation. PS

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Monte Barton is a business development executive with Brocade dedicated to Dell. He has over 20 years of storage industry experience and is responsible for the OEM product portfolio.

Craig Phelps is a product strategist in the Dell Networking Product Group. His 18 years in enterprise technology also includes work at TippingPoint/3Com, Surgient, Cisco Systems, and Mead Data Central.

Learn more

Dell PowerConnect B-MLXe routers: dell.to/PowerConnect_B-MLXe

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Simplified data center networking with two-tier architectures

By Robert Lesieur and Charles Goldberg

Building an Efficient Data Center with Dell™ PowerConnect™ J-Series switches enables IT departments to consolidate traditional three-tier network architectures to only two tiers—helping to simplify management, increase performance, and reduce costs.

Efficiency gains

Dell PowerConnect J-Series switches running Juniper Networks® Junos® OS enable streamlined, high-performance networking in virtualized data center environments.

- **Up to 41 percent reduction** in overall network operations costs
- **Easy expansion** with Virtual Chassis technology
- **Simplified management** through a consolidated network design

The Dell Efficient Data Center approach is designed around open, capable, and affordable solutions that enable organizations to choose the most appropriate technologies for their needs while helping protect their technology investments. A key component of this strategy is a network that enables high-performance communication in a virtualized environment.

Dell PowerConnect J-Series Ethernet switches are powerful enough to deliver standards-based networking solutions that consolidate the traditional three-tier network architecture to only two tiers. Running Junos from Juniper Networks—a single-source network OS that runs on an integrated security, routing, and switching infrastructure—these switches offer high performance, streamlined scalability, and simplified management. This uniform approach can help IT departments meet the needs of environments ranging from the smallest to the largest networks while controlling costs and tackling the ongoing challenges of a constantly changing business landscape.

Efficient network OS

Junos software helps PowerConnect J-Series switches deliver a range of efficiencies across small to large enterprise networks. For example, a February 2009 study conducted by Forrester Consulting demonstrated that using Junos across switches and routers can help organizations reduce operational costs for a range of specific network tasks, including planning and provisioning, deployment, and planned and unplanned network events.[1] This study reported a 41 percent reduction in overall network operations costs, reflecting combined total savings across specific task categories such as planned maintenance and support, resolution of unplanned network events, and infrastructure deployment, including the following:

- 54 percent savings on costs for planned maintenance and support
- 27 percent savings on costs for network downtime (based on reduction in frequency and duration of unplanned network events)
- 41 percent savings associated with increased network stability and reliability (based on reduced

[1] "The Total Economic Impact of Juniper Networks' JUNOS network operating system," by Forrester Consulting, February 19, 2009, juniper.net/us/en/reports/junos_tei.pdf.

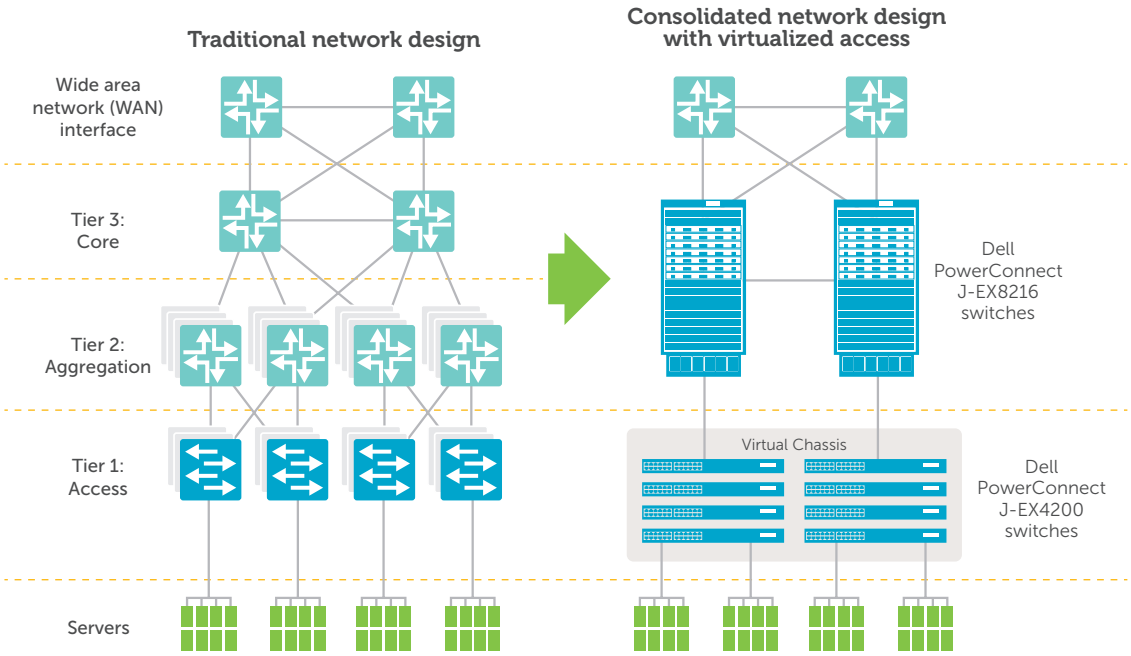


Figure 1. Dell PowerConnect J-Series switches help to simplify networks and reduce power, cooling, and space requirements

effort needed to handle both planned and unplanned events)

- 40 percent savings associated with decreased time to resolve unplanned network events
- 25 percent savings on infrastructure deployment

Cost-effective, high-performance networking

The PowerConnect J-Series enables organizations to deploy cost-effective switches that deliver the high availability, integrated security, and operational excellence they need today while providing a platform for supporting future requirements. The family comprises two product lines: the PowerConnect J-EX4200 line of Ethernet switches and the PowerConnect J-EX8200 line of modular Ethernet chassis switches. Optimized for high performance, these switches are well suited for highly virtualized data center environments and offer a comprehensive suite of Layer 2 and Layer 3 switching capabilities as part of the base software.

The PowerConnect J-EX4200 line is designed to meet the requirements of a variety of high-performance applications, including branch, campus, and data center access deployments as well as Gigabit Ethernet (GbE) and 10 Gigabit Ethernet (10GbE) aggregation deployments. Organizations can start with a single 24- or 48-port switch. As requirements grow, they can then take advantage of Juniper Networks Virtual Chassis technology to interconnect up to 10 PowerConnect J-EX4200 switches over a 128 Gbps backplane and manage this grouping as a single logical device—delivering a scalable, pay-as-you-grow solution for expanding network environments. (For more information, see the "Simplifying scalability" sidebar.) Flexible GbE and 10GbE uplink options enable high-speed connectivity to aggregation- or core-layer switches that connect multiple data center racks, floors, or buildings. All PowerConnect J-EX4200 switches include high-availability features such as redundant, hot-swappable internal power supplies and field-replaceable, multi-blower fan trays to help ensure maximum uptime.

Using the PowerConnect J-EX4200 GbE access switch in a top-of-rack setting enables administrators to jointly configure up to 10 server racks as a single Virtual Chassis. Each server rack hosts a pair of switches, each one of which is a member of a separate Virtual Chassis configuration. Effectively, each server is connected to both Virtual Chassis, with a redundant interface setting for high availability.

The PowerConnect J-EX8200 line delivers a high-performance, highly available platform for high-density 10GbE-based data center, campus aggregation, and core networks. It comprises two chassis options:

- **PowerConnect J-EX8208:** This model offers 8 dedicated slots in a 14U chassis to support line cards with a variety of 10/100/1000Base-T, 100Base-FX/1000Base-X, and 10GbE interfaces. The switch fabric delivers up to 320 Gbps per slot, enabling wire-rate forwarding performance of 960 million packets per second for packets of any size. A passive backplane is designed to support future

Simplifying scalability

By using Juniper Networks Virtual Chassis technology, IT departments can connect up to 10 PowerConnect J-EX4200 switches to create a single logical device supporting up to 480 10/100/1000Base-T ports or up to 240 100/1000Base-X ports, plus an additional 40 Gigabit Ethernet (GbE) or 20 10 Gigabit Ethernet (10GbE) uplink ports. Different models can be mixed to provide a variety of port and density options. The switches are monitored and managed as a single device, allowing administrators to separate physical topology from logical endpoint groupings and enabling efficient resource utilization. Administrators can also create highly resilient topologies by using the GbE or 10GbE uplink ports to extend the Virtual Chassis configuration across long distances spanning multiple wiring closets, floors, or even buildings.

Robert Lesieur is a product marketing strategist at Dell currently responsible for the PowerConnect J-Series product line. He has 23 years of experience in the IT industry.

Charles Goldberg is the director of alliances marketing at Juniper Networks. He has over 20 years of experience with network technologies.

Learn more

Dell networking: dell.com/networking

Dell PowerConnect J-Series: dell.com/powerconnect-j-series

scalability up to 6.2 Tbps, providing a built-in migration path for future 100 Gigabit Ethernet (100GbE) deployments.

- **PowerConnect J-EX8216:** This model offers 16 dedicated line-card slots in a 21U chassis and features a switch fabric with forwarding performance of 1.92 billion packets per second, plus the same built-in migration path as the PowerConnect J-EX8208 for future 100GbE deployments.

The PowerConnect J-EX8200 line also offers some of the highest wire-speed 10GbE port densities currently available. Up to three PowerConnect J-EX8208 switches or two PowerConnect J-EX8216 switches can fit in a single 42U rack, for a total of up to 256 wire-speed 10GbE ports per rack.

In the data center, the PowerConnect J-EX8208 switch delivers a high-performance, high-density platform that helps to reduce cost and complexity, enhance overall scalability, and provide carrier-class reliability. Populated with eight-port PowerConnect J-EX8200-8XS 10GbE line cards, this switch can accommodate large numbers of high-speed, line-rate uplinks at any packet size from access layer devices such as PowerConnect J-EX4200 switches deployed in Virtual Chassis top-of-rack configurations—offering a highly scalable way to support additional servers with a reduced number of switches.

Consolidated network tiers

Traditionally, data center networks have had a three-tier design based on access, aggregation, and core layers. Because of scalability requirements, performance limitations, and key feature deficiencies in traditional switches and routers, each tier would typically include a large number of products to be deployed, configured, and managed—increasing the cost and complexity of the data center network.

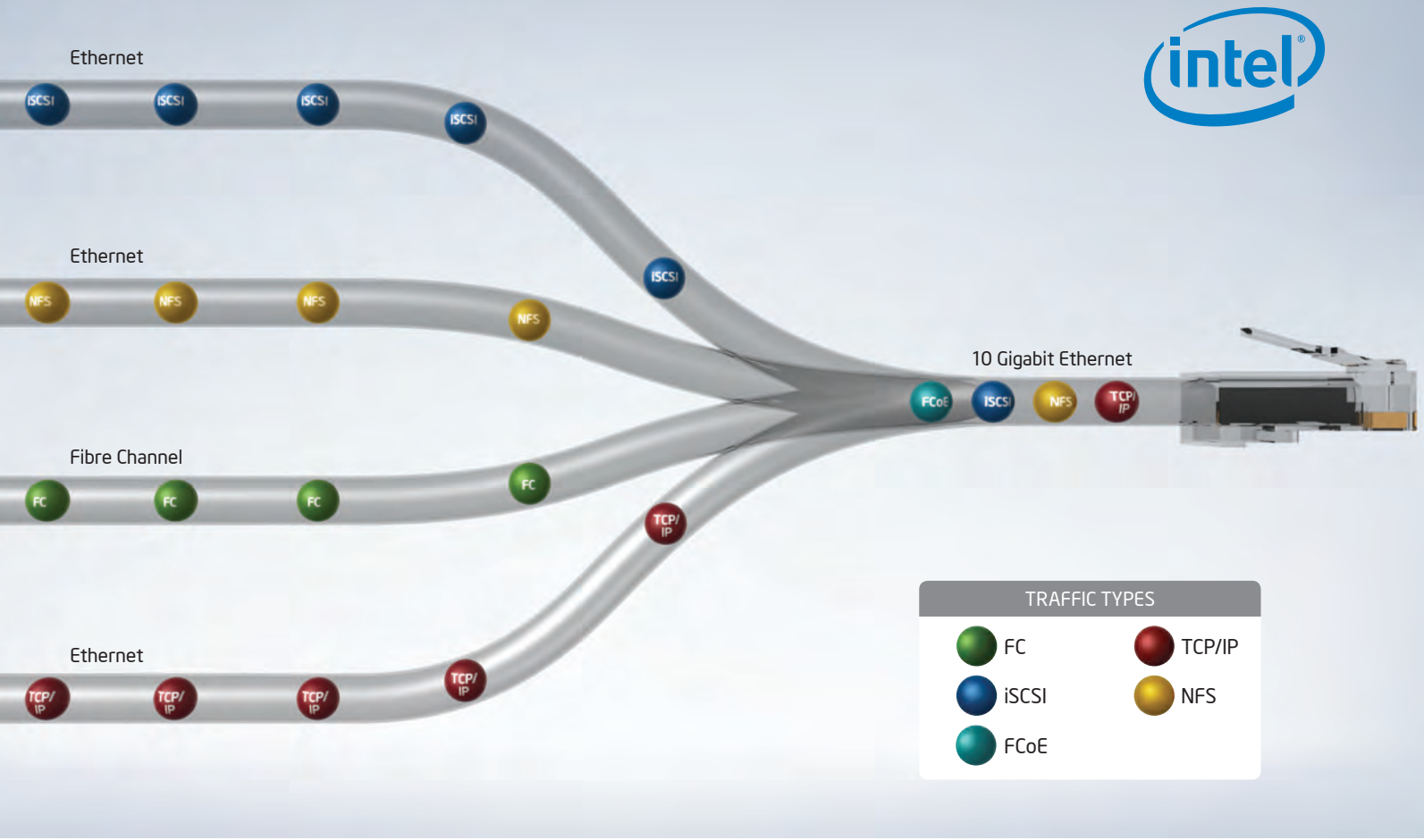
PowerConnect J-Series switches enable a network design that requires fewer devices, interconnections, and tiers than the traditional approach (see Figure 1). Beyond the obvious cost advantages, this design can offer a range of benefits—including lower latency because of the reduced number of device hops; simplified device management; significant savings on power, cooling, and space; and a reduced number of system failure points.

With its high GbE and 10GbE port densities, the PowerConnect J-EX8208 model can also serve as an end-of-row server access switch—enabling the consolidation of aggregation and core layers and helping to simplify the data center architecture; reduce power, cooling, and space requirements; and reduce total cost of ownership. In environments that require even higher port densities, the PowerConnect J-EX8216 can be used to host over 55,000 servers with a 1:25 uplink oversubscription ratio, with the option to reduce the oversubscription ratio by increasing the number of 10GbE uplinks from the PowerConnect J-EX4200 Virtual Chassis.

Foundation for the Efficient Data Center

Dell PowerConnect J-Series switches form the communication foundation of the Efficient Data Center. These high-performance Ethernet switches enable an architecture that helps simplify complex data centers, increase performance, and significantly reduce costs. By using this architecture, organizations can focus on improving the business—whether this requires deploying new applications, entering new markets, or expanding product portfolios—with a data center infrastructure that can support growth and unexpected demands without adding significant complexity and expense. PS

Open FCoE Delivers Data Center Efficiency
Read More on Page 84



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Solutions for Midsize Companies

"Live in two countries on Oracle Financials in 33 days"

Active Network, 1800 employees
Online Registration, Marketing & Event Management Software

"Monthly financial closing time shortened by 64%"

Falken Tire Corporation, 110 employees
High Performance Tires & Wheels

"Warehouse processing time reduced by 50%"

JR286 Inc., 120 employees
Branded Sportswear & Accessories

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or call 1.800.633.0737

Oracle Accelerate solutions are application bundles developed and implemented by qualified partners.
Individual results are dependent on a number of factors and may vary significantly.