Flexible enterprise storage for high-performance Linux environments

Dell™ EqualLogic™ PS Series virtualized iSCSI SANs offer a robust storage infrastructure and tools designed to simplify storage management and improve scalability and performance for Red Hat® Enterprise Linux® platforms.

During the past decade, organizations have increasingly turned to Linux as a high-performance, feature-rich, and cost-effective operating platform for mission-critical enterprise applications. Many IT organizations are migrating from complex, proprietary RISC environments to standards-based x86 server infrastructures powered by Linux to help increase IT flexibility and business agility while reducing costs.

Enterprises need approaches to storage that complement today's Linux-based server deployments, and provide the scalability and flexibility to support next-generation agile IT environments. For many organizations, finding the right approach means moving away from rigid, proprietary storage technologies to standards-based flexible storage architectures.

In particular, large-scale Linux deployments are often implemented in a grid-based architecture in support of high-performance computing, multilayered business applications, Oracle Real Application Clusters (RAC) database environments, and virtualized server and cloud computing infrastructures. In each case, the server farm requires concurrent, high-performance access to shared storage.

Dell EqualLogic PS Series Internet SCSI (iSCSI) storage area network (SAN) arrays provide a robust platform for Red Hat Enterprise Linux environments (see Figure 1). Based on open industry standards that complement the open Linux architecture, these arrays help organizations build an agile, scalable, and cost-effective infrastructure that delivers the performance and reliability required for mission-critical applications. EqualLogic PS Series arrays also offer capabilities that can simplify storage management within Red Hat Enterprise Linux environments while helping ensure that organizations continue to attain outstanding storage performance as they scale capacity.

Figure 1. Dell EqualLogic PS6010E series array: Offering robust storage for Linux-based server environments
Capitalizing on flexible, cost-effective Linux platforms

Built on an open source model, the Red Hat Enterprise Linux platform has long offered exceptional flexibility and low cost of ownership compared with proprietary operating systems. Its subscription pricing model, ability to run efficiently on industry-standard, cost-effective hardware, and simplicity of management help minimize capital and operating expenditures.

As the platform has evolved, added capabilities for reliability and security and its UNIX®-like user experience have helped accelerate deploying Red Hat Enterprise Linux for mission-critical enterprise applications. By migrating to Red Hat Enterprise Linux, large-scale enterprises are turning to a simple, capable, and cost-effective alternative to rigid RISC platforms for building next-generation IT environments (for one example of a UNIX-to-Linux migration implementation, see the sidebar, “Setting a course for Linux”).

Responding to customer demand, technology vendors are helping to deliver hardware and business applications that are supported on Red Hat Enterprise Linux, which today offers an impressive ecosystem of certified hardware platforms and business-critical applications. As organizations continue to embrace Linux, they need a storage infrastructure that helps extend key benefits of Linux across their data centers. To complement rapidly growing grid-based, scale-out server architectures, storage should create a shared pool of capacity and provide the scalability to accommodate growth. Replacing complex, proprietary storage with open, industry-standard platforms helps increase IT agility, simplify management, and reduce costs.

SANs based on open, industry-standard iSCSI with a virtualized peer storage architecture are well suited for helping deliver the performance and availability necessary for mission-critical applications. They provide an effective platform for consolidating IT resources and supporting the high-availability capabilities of virtualization. By pooling enterprise storage into a shared environment, virtualized iSCSI SANs help organizations maximize resource utilization and management flexibility to meet changing requirements quickly.

Extending the benefits of Red Hat Enterprise Linux with Dell EqualLogic PS Series SANs

Dell EqualLogic PS Series iSCSI SANs offer a flexible, scalable, easy-to-manage, and cost-effective shared storage platform that is well suited for Red Hat Enterprise Linux server environments.

The EqualLogic PS Series peer storage architecture complements the grid-based, scale-out server architecture typically used when deploying Linux-based server infrastructures (see Figure 2). The addition of the Dell EqualLogic Host Integration Tools for Linux streamlines and automates storage management tasks, helps

Setting a course for Linux

Carnival Cruise Lines needed to move its shoreside Oracle Database 10g data warehouse environment, which the company uses to track industry changes, identify customer trends, and set pricing for cruises. Dell Consulting Services performed proof-of-concept (POC) testing during a six-week period that explored the potential benefits of migrating from a UNIX environment to a Red Hat Enterprise Linux platform on Dell PowerEdge™ servers and a Dell EqualLogic PS Series virtualized Internet SCSI (iSCSI) storage area network (SAN).

Using first a 10 Gigabit Ethernet (10GbE) EqualLogic PS6010XV series iSCSI SAN and then an EqualLogic PS6010XVS series hybrid array—which includes both solid-state drives (SSDs) and hard drives with spinning disks—the POC showed that Carnival could achieve a performance gain of 38 percent compared with the legacy system.

“What’s great about the Dell EqualLogic PS6010 series is that with 10 Gigabit Ethernet as a standard, we actually have faster transport over an iSCSI network than over our Fibre Channel,” says John Ashmore, manager of systems engineering for Carnival.

At the same time, Carnival could reduce capital and operating expenses by moving to a Linux-based environment supported with EqualLogic PS Series storage. “Over the next five years, this data warehouse migration will save us hundreds of thousands of dollars that we would otherwise be spending on storage hardware and storage management software,” says Doug Eney, vice president, information systems engineering for Carnival.
Storage optimization

achieve scalable performance, and enables high availability for mission-critical applications running on Red Hat Enterprise Linux.

Open, industry-standard protocol
EqualLogic PS Series iSCSI SANs offer a compelling alternative to Fibre Channel storage. Capitalizing on industry-standard iSCSI connectivity, EqualLogic PS Series SANs enable administrators to use a familiar, cost-effective Ethernet infrastructure. Unlike Fibre Channel SANs, the Ethernet storage network can be managed without specialized training and administrative skills. By deploying EqualLogic PS Series SANs with 10 Gigabit Ethernet (10GbE) connectivity, organizations can achieve the performance needed to support consolidated, virtualized applications and data-intensive operations that require high-speed, large-block data transfers.

Flexibility and scalability
Using a peer storage architecture, EqualLogic PS Series SANs provide a virtualized storage environment in which the storage resources in the SAN are configured as one virtualized pool of storage resources. The EqualLogic PS Group Manager tool allows administrators to easily create data volumes by automating the complex tasks involved in configuration and volume provisioning. Volumes are automatically spread across arrays within the virtualized storage pool.

The virtualized storage architecture also helps administrators to scale storage in a simplified manner. When an array is added to the EqualLogic PS Series group, volumes are automatically and nondisruptively distributed across the expanded storage pool. Because each added array includes its own processing power, cache memory, and network controller resources, organizations can scale performance and throughput along with storage capacity without downtime.

Management automation
Deploying EqualLogic PS Series arrays to support a Red Hat Enterprise Linux environment helps administrators simplify IT management. Capabilities that discover EqualLogic PS Series storage arrays in the network, build RAID sets automatically, and conduct a system health check streamline storage deployment. In many cases, administrators can deploy, configure, and start serving storage from an EqualLogic PS Series array in less than one hour.

Administrators can monitor petabytes of storage capacity across multiple SANs from a single console using EqualLogic SAN HeadQuarters (SAN HQ). Intelligent, automated management of RAID configuration, volume provisioning, disk sparing, multipath I/O configuration, and more can minimize tedious administrative tasks and avoid sources of errors, enabling even novices to manage the SAN effectively.

Data protection
EqualLogic PS Series SANs also provide the availability and data protection required to support mission-critical applications running in a Linux environment. Redundant, hot-swappable components, including power supplies, controllers, and disk drives—combined with spare drives and automated rebuilding of RAID sets—help to ensure high application availability. Comprehensive system monitoring and event notification methods enable administrators to track system health and identify problems quickly. Snapshot capabilities allow administrators to...
create and manage space-efficient, point-in-time copies of data volumes, and replication tools facilitate automated data replication to support data protection and disaster recovery strategies.

**Low total cost of ownership**
Organizations can extend the cost benefits of the Red Hat Enterprise Linux platform by deploying EqualLogic PS Series SANs using multiple storage tiers. Capabilities such as automated tiering and thin provisioning help organizations optimize storage utilization and avoid unnecessary costs. EqualLogic PS Series SANs also offer comprehensive, all-inclusive software licensing; organizations can take advantage of existing features and incorporate new capabilities without adding costs.

**Streamlining storage management with Dell EqualLogic Host Integration Tools for Linux**
Dell offers EqualLogic Host Integration Tools for Linux, enabling administrators to streamline storage management, and helping them achieve scalable performance and enhanced availability within Red Hat Enterprise Linux environments. Using the Remote Setup Wizard included in the EqualLogic Host Integration Tools for Linux, administrators can easily discover, initialize, and manage the EqualLogic PS Series SAN from a Red Hat Enterprise Linux–based system.

The EqualLogic Host Integration Tools for Linux also includes the EqualLogic multipath device configuration software that enhances Linux multipathing by helping simplify installation, automate ongoing administration, and enhance I/O bandwidth and latency. The software tool facilitates creating redundant data paths between the server and the EqualLogic storage group, offers comprehensive automatic failure detection and failover to avoid single points of failure, and helps ensure high availability in the event of hardware downtime. Host Integration Tools for Linux also enhances performance and throughput by load balancing across paths and establishing direct paths from the server to the arrays hosting data in the connected volumes (see Figure 3).

Given the virtualized storage architecture, EqualLogic PS Series data volumes can have data spread across multiple arrays to take advantage of the aggregate storage resources. The EqualLogic multipath device configuration software helps improve performance beyond standard Linux multipathing by enabling direct connectivity between the host and each array in which data resides.

The EqualLogic multipath device configuration software consists of two components—a kernel-level software module that integrates directly into the Linux device driver subsystem to route I/O to the desired path, and a user-level service that manages iSCSI connections.

- A loadable kernel module implements EqualLogic PS Series–aware multipathing at the device layer, routing each I/O request through the optimal path to the EqualLogic PS Series group.
- The EqualLogic Host Connection Manager daemon monitors the iSCSI session state and the configuration of the Linux server and EqualLogic PS Series group. Running in the background, the daemon dynamically gathers information on the topology of the EqualLogic PS Series SAN and data layout of the attached volumes. The daemon issues standard iSCSI administration commands to create and manage iSCSI sessions to maintain optimal...
Storage optimization

“Implementing Dell EqualLogic PS Series storage for these next-generation infrastructures can extend the benefits of Red Hat Enterprise Linux, helping organizations to achieve outstanding performance and scalability while reducing costs.”

iSCSI session connectivity between the host and the EqualLogic array group.

In a server grid-based implementation, leveraging the EqualLogic multipathing functionality across the Linux servers is particularly compelling, helping ensure high-performance access by every server to every array in the EqualLogic PS Series group. When expanding the EqualLogic PS Series group with additional arrays, the EqualLogic Host Connection Manager monitors changes in the SAN and automatically manages connectivity to help deliver optimal performance. The automated load-balancing capabilities of the EqualLogic PS Series group help ensure efficient access across every Linux server in the grid, which rebalances workloads across the resources in the SAN.

The EqualLogic Host Integration Tools for Linux also includes the EqualLogic Host Performance and Configuration Tuning Suite, which evaluates Linux server settings and advises administrators on proper configuration settings to help optimize performance.

Like other software capabilities offered with EqualLogic PS Series arrays, the EqualLogic Host Integration Tools for Linux is available at no additional cost. Administrators with existing EqualLogic PS Series arrays and a valid support contract can download EqualLogic Host Integration Tools for Linux and immediately start using its capabilities.

Offering scalable storage for robust Linux platforms

For many organizations, Red Hat Enterprise Linux has become the operating platform of choice for their next-generation infrastructures. Based on an open architecture that offers clear cost-of-ownership advantages, Red Hat Enterprise Linux has evolved into a reliable, flexible, feature-rich platform that supports a comprehensive ecosystem of enterprise applications.

Implementing Dell EqualLogic PS Series storage for these next-generation infrastructures can extend the benefits of Red Hat Enterprise Linux, helping organizations to achieve outstanding performance and scalability while reducing costs. EqualLogic Host Integration Tools for Linux enhances EqualLogic PS Series storage functionality for Red Hat Enterprise Linux environments. Organizations can use the EqualLogic Host Integration Tools for Linux to help further simplify storage management within Red Hat Enterprise Linux environments and sustain the performance and availability of EqualLogic PS Series storage while accommodating growth.

Vikram Belapurkar is solutions marketing manager at Dell, focused on storage virtualization and consolidation solutions. He has over 10 years of experience in technical and business roles within the IT industry.

Learn more

Dell EqualLogic: dell.com/equallogic

Linux Operating System Solutions: dell.com/linux