

By Stanley L. Stevens  
Darren W. Miller  
Jim Schwartz

## HIGH-AVAILABILITY VIRTUALIZATION WITH DELL EQUALLOGIC ARRAYS AND MICROSOFT WINDOWS SERVER 2008 R2 HYPER-V

The Microsoft® Windows Server® 2008 Release 2 (R2) Hyper-V™ platform introduces capabilities designed to deliver high availability for virtualized data centers. Integrating a Dell™ EqualLogic™ PS Series storage area network into Hyper-V virtualized environments helps organizations capitalize on new Hyper-V capabilities, including live migration, hot-add storage, and storage platform features that enhance usability and performance.

**F**or enterprises in a broad range of fields, virtualization has become a popular IT strategy for increasing hardware utilization, enhancing flexibility, and decreasing power, cooling, and data center footprint costs. But while virtualization can offer these and other benefits, running multiple applications on each physical server can place application availability at risk: if a physical server fails, virtualized applications running on that server could become unavailable. In many situations, even temporary downtime for applications can impair worker productivity and jeopardize revenue. At a university, for example, a network outage could prevent administrators from viewing student records or researchers from working with data sets. At a hospital, the inability to access patient records or medical imaging could delay treatment.

Microsoft Windows Server 2008 Release 2 (R2) with Hyper-V virtualization technology introduces capabilities designed to increase application availability and avoid downtime in virtualized environments. Windows Server 2008 natively supports Internet SCSI (iSCSI) and Fibre Channel storage area networks (SANs). Of the two, iSCSI has a natural affinity for virtualization, and the Microsoft iSCSI Software Initiator available in Windows Server 2008 and

Windows Server 2008 R2 is designed to provide ubiquitous SAN connectivity for organizations using existing Ethernet infrastructure and leveraging existing networking skills and tools.

Organizations can design an infrastructure supporting high availability and a robust, reliable shared-storage solution with built-in redundancy and tight integration of virtualization management capabilities. The Microsoft Multipath I/O (MPIO) framework helps provide high availability and dynamic load balancing for SAN devices through redundant network or fabric connections. MPIO is designed to dynamically route I/O to the best path and helps protect against connection-point failures between a Hyper-V host and shared storage, including network interface cards and adapters, switches, and array ports.

The Dell EqualLogic Multipath I/O device-specific module works with MPIO to provide automated management and enhanced end-to-end load balancing for EqualLogic SAN volumes. EqualLogic PS Series iSCSI SAN arrays offer a highly automated shared-storage foundation for virtualized data centers that enables organizations to take full advantage of the high-availability features incorporated into Windows Server 2008 R2 Hyper-V.

## BUILDING A VIRTUALIZED ENVIRONMENT

Microsoft helped bring virtualization to a wide audience when it introduced Windows Server 2008 Hyper-V. This platform offers virtualization capabilities within a cost-effective and familiar Windows® OS-based environment that can extend from the desktop to the data center. In addition, the Microsoft System Center management suite enables organizations to access a comprehensive array of management tools to help simplify administration of virtualized environments. Windows Server 2008 R2 extends the capabilities provided in Windows Server 2008, and Dell servers and storage arrays are designed to take advantage of these new features.

For environments virtualized with Hyper-V technology, 11th-generation Dell PowerEdge™ servers can provide a particularly robust and reliable hardware foundation. Featuring the Intel® Xeon® processor 5500 series architecture and designed to provide more integrated I/O than previous-generation PowerEdge servers, 11th-generation PowerEdge servers enable the processing performance, memory bandwidth, and I/O capabilities required to host numerous virtualized applications on each physical server. Because PowerEdge servers incorporate multiple redundant components, they help to deliver high availability for virtualized environments by avoiding unplanned outages.

PowerEdge servers also help simplify the deployment of virtualized server environments. This latest generation of servers includes a Hyper-V hypervisor so administrators do not have to download and install additional virtualization software. In addition, the Intel Virtualization Technology (Intel VT) FlexMigration capabilities built into the processors allow organizations to integrate 11th-generation PowerEdge servers featuring the latest processing architecture into an environment with previous generations of Intel Xeon processor-based PowerEdge servers. In this way, FlexMigration helps simplify new deployments and protect existing investments.

Windows Server 2008 Hyper-V technology and PowerEdge servers help ensure high availability while also providing high performance, outstanding scalability, and simplified management. Additionally, failover clustering can help provide redundancy in the event of a server outage. Hyper-V technology allows clustering to operate from the parent partition of the OS and from within individual virtual machines (VMs) (with iSCSI direct). Connecting to iSCSI disks from the Hyper-V parent partition is designed to work just as it does from a physical host, including leveraging all existing tools and features. On the parent partition, MPIO provides high availability to shared storage. In this configuration, the Hyper-V host can create Microsoft virtual

hard disk (VHD) files for each VM on iSCSI-connected disks or create pass-through disks that are individually owned by the VM. Administrators can use the quick migration and live migration features to move VMs from one physical server to another in the event of a planned or unplanned outage.

In addition, iSCSI storage disks can be connected from within the VM itself. Support for guest clustering requires running the Microsoft iSCSI Software Initiator within the VM to allow services and features to run in the application context within the virtual environment as they do in a physical server environment with full visibility by the VM—helping provide for the transparent operation of all functions because applications can instantiate common workflows and data movement from within the VM. These services and features include the cluster service, MPIO, Microsoft Volume Shadow Copy Service (VSS), hardware providers, and Microsoft Virtual Disk Service (VDS) hardware providers.

To take advantage of clustering and the new high-availability capabilities available with Windows Server 2008 R2 Hyper-V, organizations must use shared common storage with high-performance disks. In many cases, an iSCSI SAN can be a suitable and cost-effective approach, because iSCSI connectivity helps simplify management compared with Fibre Channel systems.

## INCORPORATING DELL EQUALLOGIC ARRAYS INTO THE VIRTUAL DATA CENTER

Designed as high-availability virtualized storage solutions, Dell EqualLogic PS Series iSCSI SAN arrays can be an excellent fit for data centers virtualized with Hyper-V technology. Storage is virtualized in EqualLogic PS Series arrays, and data volumes are provisioned automatically from a single scalable storage pool. The EqualLogic peer storage architecture enables the arrays to share resources, evenly distribute workloads, and provide data protection for the VMs in virtualized environments. Resources are applied automatically even as VMs and their workloads change.



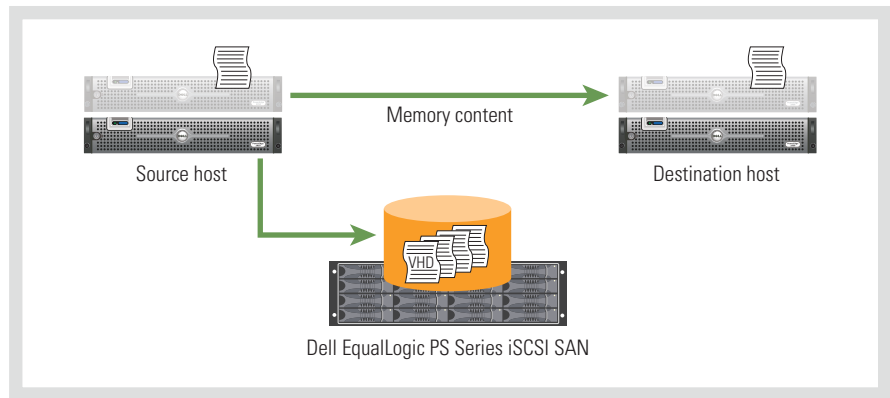
*Dell EqualLogic PS Series SAN arrays offer robust storage in Microsoft Windows Server 2008 R2 Hyper-V environments*

EqualLogic PS Series SANs also enhance application availability and help protect data. They feature redundant, hot-swappable components, including power supplies, controllers, enclosures, and disk drives, plus disk failover capabilities to help ensure high availability. Cloning and replication capabilities are also included in the firmware of EqualLogic PS Series SANs, offering advanced data protection for virtualized environments.

EqualLogic and Microsoft began working together in 2002 during the early stages of iSCSI implementation, and the 2003 releases of the Microsoft iSCSI Software Initiator and the first EqualLogic PS Series array helped a broad range of organizations to begin deploying SANs in their data centers. Additionally, Windows storage frameworks such as MPIO, VSS, and VDS offered tight integration and scalability, automated backups, and ease of management for organizations deploying Microsoft Windows Server and EqualLogic SANs.

The EqualLogic PS Series is particularly well suited for supporting Microsoft Windows Server 2008 environments. In fact, Microsoft has certified the EqualLogic PS Series for Windows Server 2008 x64 Editions, indicating that it meets Microsoft standards for compatibility and best practices. The EqualLogic PS Series has also earned the Microsoft Simple SAN designation, which means that it meets a range of ease-of-use, ease-of-installation, and ease-of-management criteria.

Joint Dell and Microsoft efforts to increase IT efficiency and ensure high availability have streamlined the process of administering the entire environment using Microsoft System Center together with the Dell OpenManage™ systems management suite. This collaboration has yielded several capabilities that help simplify IT when using EqualLogic PS Series SANs with Windows Server 2008 Hyper-V. Dell offers the EqualLogic Auto-Snapshot Manager/Microsoft Edition tool to help simplify management and deliver high availability by providing fast online backups and rapid restores for Hyper-V VMs



**Figure 1.** Live migration helps accommodate planned outages without downtime

as well as NT File System (NTFS), Microsoft SQL Server®, and Microsoft Exchange data. For Hyper-V, Auto-Snapshot Manager/Microsoft Edition provides SmartCopy snapshots of VMs and VHDs. Those snapshots can be restored to an EqualLogic SAN on a different remote or local server for new application usage or test and development when the application supports it.

### INNOVATING SHARED STORAGE PLATFORMS

Several new features in Microsoft Windows Server 2008 R2 are designed to enhance user experience and performance with shared storage to benefit virtualized environments. The Quick Connect feature allows a single-click connection from a system using the Microsoft iSCSI Software Initiator to iSCSI storage. The iSCSI user interface is also now included in Windows Server 2008 Server Core installations, which provides the option of configuring through a lightweight graphical user interface or a command line. Microsoft iSCSI Software Initiator performance has been optimized for 10 Gigabit Ethernet networks to help deliver wire-speed performance with reduced processor utilization. Additionally, Hyper-V includes support for jumbo frames and VM queues (VMQs), which helps increase iSCSI direct throughput performance in Hyper-V for demanding VM workloads. In addition, as diskless servers continue to emerge, a growing number of organizations are booting virtualized servers remotely—and

Windows Server 2008 R2 includes enhanced support for iSCSI boot that provides up to 32 redundant paths and integrated support with Windows setup.

Storage resource monitoring features in Windows Server 2008 R2 enable IT administrators to efficiently diagnose and gather information on storage I/O performance and storage path health, and to take action to move workloads or VMs to other Hyper-V hosts to help optimize performance and avoid downtime. Storage configuration reporting gathers and exports SAN component information, including the number of disks connected and multipath parameters. MPIO data center automation allows administrators to preconfigure multipath settings before connecting storage to help automate storage deployment.

The Cluster Shared Volumes (CSV) capability—part of the failover cluster feature in Windows Server 2008 R2—enables access to the same logical unit (LUN) on a SAN for Windows Server 2008 R2 Hyper-V-based systems. CSV enables administrators to map multiple VMs to a single volume or LUN, supporting live migration of VMs from one Hyper-V host to another.

### MANAGING VMs WITH LIVE MIGRATION

The live migration capability of Microsoft Windows Server 2008 R2 Hyper-V enables IT administrators to move running VMs from one physical host to another without disrupting service or causing downtime. Live migration helps administrators ensure

high availability while performing maintenance on physical servers. Administrators can also create an increasingly dynamic data center by using live migration to help with load balancing.

Live migration complements quick migration—an existing capability of Windows Server 2008 Hyper-V. Quick migration was designed to save, move, and restore VMs to help minimize the impact of downtime during unplanned outages; live migration provides an easy way to avoid disruptions during planned maintenance.

To optimize the agility gained from live migration, organizations need to use shared storage such as a Dell EqualLogic PS Series SAN. Live migration allows VM memory pages to be transferred from the source Hyper-V physical host to the destination physical host while the source VM draws from the shared storage of the SAN (see Figure 1). Modifications to the VM memory pages during this process are tracked and transferred to the destination server. Hyper-V then transfers control of the storage for the VHD files of the VM to the destination physical server and brings the destination VM online on the destination physical server. Windows Server 2008 R2 Hyper-V allows administrators to queue multiple live migrations without having to keep track of other migrations within the cluster.

### **SCALING STORAGE DYNAMICALLY WITH HOT-ADD STORAGE**


Working together, Microsoft Windows Server 2008 R2 Hyper-V and Dell

EqualLogic PS Series arrays can also provide seamless scalability for virtualized environments. Traditionally, administrators needed to take host servers offline to upgrade storage. Windows Server 2008 R2 Hyper-V is designed to allow administrators to add and remove VHDs and pass-through disks in the existing SCSI controller for a running VM without requiring downtime. As a result, administrators can respond quickly to the changing storage requirements of VMs without causing interruptions. They can also deploy mission-critical applications that might call for fast storage growth and require high availability.

EqualLogic PS Series SANs offer an exceptional fit for this scalable environment. The modular design of the EqualLogic PS Series helps make adding or removing disk capacity simple. Arrays can be added without disrupting operations. By combining the Hyper-V hot-add storage capabilities with the EqualLogic PS Series SAN, administrators can create a dynamic environment in which they can quickly scale their storage infrastructure or reconfigure VMs to meet changing requirements.

### **BRINGING HIGH AVAILABILITY TO THE VIRTUAL DATA CENTER**

To help avoid the risk of running multiple applications on a reduced number of physical servers, IT administrators must implement multiple high-availability strategies into their virtual data center environments. Microsoft Windows Server 2008 R2

Hyper-V introduces several new features that help ensure high availability in virtualized environments. Designed to provide virtualized storage and to protect data with a wealth of redundant components, Dell EqualLogic PS Series iSCSI SAN arrays can help organizations capitalize on the new capabilities of Hyper-V to help maximize availability. 

**Stanley L. Stevens** is a virtualization solutions marketing manager at Dell and a 16-year veteran of the IT industry.

**Darren W. Miller** is a product consultant at Dell and has worked in the storage industry for over 12 years.

**Jim Schwartz** is director of virtualization solutions for Microsoft.

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