



# Deploying Microsoft Exchange Server 2010 With Dell EqualLogic PS Series Arrays

## ABSTRACT

This Technical Report describes how to deploy Exchange Server 2010 in an iSCSI SAN using PS Series storage arrays. It provides configuration and management recommendations and best practices for Exchange 2010 and the PS Series SAN.



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## Preface

Thank you for your interest in Dell™ EqualLogic™ PS Series storage products. We hope you will find the PS Series products intuitive and simple to configure and manage.

PS Series arrays optimize resources by automating volume and network load balancing. Additionally, PS Series arrays offer all-inclusive array management software, host software, and free firmware updates. The following value-add features and products integrate with PS Series arrays and are available at no additional cost:

- **PS Series Array Software**

- **Firmware** – Installed on each array, this software allows you to manage your storage environment and provides capabilities such as volume snapshots, clones, and replicas to ensure data hosted on the arrays can be protected in the event of an error or disaster.
  - **Group Manager GUI:** Provides a graphical user interface for managing your array
  - **Group Manager CLI:** Provides a command line interface for managing your array.
- **Manual Transfer Utility (MTU):** Runs on Windows and Linux host systems and enables secure transfer of large amounts of data to a replication partner site when configuring disaster tolerance. You use portable media to eliminate network congestion, minimize downtime, and quick-start replication.

- **Host Software for Windows**

- **Host Integration Tools**

- **Remote Setup Wizard (RSW):** Initializes new PS Series arrays, configures host connections to PS Series SANs, and configures and manages multipathing.
- **Multipath I/O Device Specific Module (MPIO DSM):** Includes a connection awareness-module that understands PS Series network load balancing and facilitates host connections to PS Series volumes.
- **VSS and VDS Provider Services:** Allows 3<sup>rd</sup> party backup software vendors to perform off-host backups.
- **Auto-Snapshot Manager/Microsoft Edition (ASM/ME):** Provides point-in-time SAN protection of critical application data using PS Series snapshots, clones, and replicas of supported applications such as SQL Server, Exchange Server, Hyper-V, and NTFS file shares.

- **SAN HeadQuarters (SANHQ):** Provides centralized monitoring, historical performance trending, and event reporting for multiple PS Series groups.

- **Host Software for VMware**

- **Storage Adapter for Site Recovery Manager (SRM):** Allows SRM to understand and recognize PS Series replication for full SRM integration.
- **Auto-Snapshot Manager/VMware Edition (ASM/VE):** Integrates with VMware Virtual Center and PS Series snapshots to allow administrators to enable Smart Copy protection of Virtual Center folders, datastores, and virtual machines.
- **MPIO Plug-In for VMware ESX:** Provides enhancements to existing VMware multipathing functionality.

Current Customers Please Note: You may not be running the latest versions of the tools and software listed above. If you are under valid warranty or support agreements for your PS Series array, you are entitled to obtain the latest updates and new releases as they become available.

To learn more about any of these products, contact your local sales representative or visit the Dell EqualLogic™ site at <http://www.equallogic.com>. To set up a Dell EqualLogic support account to download the latest available PS Series firmware and software kits visit:  
<https://www.equallogic.com/secure/login.aspx?ReturnUrl=%2fsupport%2fDefault.aspx>

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## INTRODUCTION TO EXCHANGE SERVER 2010 AND PS SERIES STORAGE

Microsoft® Exchange Server 2010 is a messaging and collaboration server with many new features that may impact your storage needs. Exchange Server 2010 offers a range of enhancements including performance improvements, large mailbox sizes, and built-in high-availability features that are designed to advance user productivity and simplify manageability. These enhancements include:

- **Increased mailbox sizes:** Traditionally, end users have had to spend significant amounts of time managing e-mail because of mailbox size limits. Exchange Server 2010 supports mailboxes up to 10GB, which can enhance user productivity by reducing the time spent to manage and search e-mail. Also, increased mailbox sizes combined with performance enhancements such as reduced disk I/O enable mailboxes to be stored on high capacity, cost-effective storage arrays.
- **Built-in high-availability and disaster recovery (DR) features:** Exchange Server 2010 offers several high-availability (HA) and DR features including built-in storage replication. **DAG (Database Availability Group):** Provides native HA and DR features that increase Exchange uptime without complex or expensive on-premise third party solutions. The DAG allows up to 16 replicas (including the original) to exist for each mail database. A separate server node owns each copy in the DAG for a 1:1 ratio of database replicas to servers. Of the potential 16 replicas, they may be used as HA or DR copies. HA copies assume automatic failover, up to date copies that are typically local to users. DR copies assume off-site and/or time-lagged copies desired to become active only in a disaster scenario. These built-in features offer organizations a simple option for helping ensure application uptime.
- **Native archiving:** The proliferation of Personal Storage Table (PST) files has emerged as a huge challenge to meeting data protection and compliance demands. Exchange Server 2010 offers advanced archiving and compliance capabilities that, when combined with large mailbox sizes, allow organizations to help ensure data protection and compliance without the use of PST files.

By deploying Exchange Server 2010 with a PS Series SAN, businesses can combine an industry-leading messaging and collaboration application with reliable, scalable, and high-performance disk storage to meet the ever-expanding needs of e-mail users.

With any SAN, you can consolidate storage resources and provide a more scalable configuration than DAS, while also improving performance and simplifying management. In addition, a SAN can deliver high-end functionality like snapshots and data replication that not only improve data protection and recovery capabilities, but also enhance Exchange operations. To provide storage consolidation for any enterprise, EqualLogic PS Series storage arrays from Dell enable you to set up an IP-based (iSCSI) SAN that delivers performance, scalability, recoverability, and resilience beyond that delivered by other SANs. To work with a PS Series SAN, all a server needs is a standard iSCSI initiator. Once connected to a PS Series SAN over an IP network, volumes on the SAN appear as regular disks, which can be formatted and managed as usual—it's that simple.

Integrated virtualization software makes a PS Series SAN easy to manage, providing automatic RAID configuration, disk sparing, data provisioning, replication, and load balancing. For reliability, PS Series storage arrays include redundant, hot-swappable hardware, including disks, control modules, fans, and power supplies. Increasing volume size, like most SAN management tasks, is a point-and-click operation.

To expand SAN capacity and performance, you can group together multiple arrays—storage and performance scale linearly. With multiple arrays in the SAN you gain the ability to create a tiered storage solution along with pools, in effect SANs within the SAN. Storage has never been this easy to use.

To get the maximum benefits from Exchange Server 2010 and PS Series storage, you should adhere to the best practices for Exchange Server 2010, as outlined by Microsoft® and industry experts. In addition, this Technical Report contains requirements and recommendations for deploying Exchange Server 2010 with PS Series storage, including best practices for performance, reliability, scalability, flexibility, and recoverability. The best practices described in this report are applicable to all versions of Microsoft® Exchange. The examples in this Technical Report were created using Microsoft® Exchange Server 2010 running on Microsoft® Windows Server 2008 SP2 64-bit. Key issues addressed by this report are:

- Design considerations, including availability, performance, scalability, and management.
- How to set up a PS Series group and volumes.
- Benefits of booting servers from a SAN.
- How to set up an Exchange Server 2010, including optimizing the server and connecting to volumes.
- Configuring Exchange Server 2010 to use PS Series volumes.
- Expanding SAN capacity and file systems without affecting availability.
- Backing up Exchange Server 2010 data.

## **BENEFITS OF DEPLOYING EXCHANGE WITH PS SERIES STORAGE**

The benefits of deploying Exchange Server 2010 with a PS Series SAN are as follows:

- **Rapid deployment and configuration of storage** – A PS Series SAN can quickly be operating and providing storage for Exchange Server 2010. A simple setup utility lets you quickly configure an array on the network and create a PS Series group. Automation of complex operations such as RAID configuration, disk sparing, data provisioning, and load balancing means that even users new to SAN technologies can effectively manage the SAN.
- **Redundant hardware and hot serviceable configuration** – PS Series storage arrays are fully redundant with dual controllers, power supplies, and fans—all of which can be serviced online and without disrupting applications.

- **Data protection.** All data is protected with RAID and spare disks. Combined with “hot” service capabilities, online operation is assured. Volume snapshot, clone, and replication protection capabilities are available and included at no extra cost.
- **Simple and immediate storage expansion** – Using modular PS Series storage arrays as the Exchange Server 2010 storage solution, you can increase SAN storage capacity and performance online, without server or application disruption.
- **SAN boot capability** – iSCSI host bus adapters (HBAs) along with certain Intel® and Broadcom® NICs provide the ability to install and boot the Windows® operating system from a PS Series volume, increasing disaster tolerance. When server hardware fails, the unit can be quickly removed and replaced with a similarly-configured spare hardware platform. It may take a few moments to setup the IP addresses on the new NICs before this new platform can be directed to the SAN boot volume and resume providing application services. Other benefits of SAN boot include centralized storage management and reliable and highly available storage resources that eliminate the need for mirrored boot volumes.
- **Network path protection and load balancing** – Using multiple NICs or iSCSI HBAs with the Microsoft iSCSI Initiator service, you can configure multipath I/O and increase the reliability and performance of Exchange Server 2010. Also known as MPIO, multipath I/O enables the dynamic load balancing of iSCSI SAN traffic across redundant paths between the Exchange Server 2010 and the PS Series SAN.
- **Excellent Performance** – PS Series arrays provide excellent performance and scaling automatically, as demonstrated by Exchange Solution Reviewed Program results. The Microsoft Exchange Solution Reviewed Program (ESRP) – Storage website <http://technet.microsoft.com/en-us/exchange/bb412164.aspx> contains detailed information on specific Exchange solutions operations.
- **Advanced Management features.** PS Series storage comes standard with a comprehensive set of features including:
  - Automatic load balancing
  - Virtual volume management
  - Thin Provisioning
  - Space-efficient snapshots for instant backup and restore
  - Volume cloning for rapid server provisioning
  - Thin Clones
  - Multipath I/O (MPIO) support
  - Microsoft Cluster support
  - Volume Mount Point support
  - Auto-replication for a comprehensive disaster recovery solution

- Storage pools creating a “SAN within a SAN”
  - Member-by-member RAID level control
  - Volume Collections (consistency groups) tying volumes together across arrays and pools
- **VSS-based backups** – The EqualLogic Host Integration Tools for Windows® is a tool kit for Windows® systems that installs host tools and utilities including a VSS provider and a VSS requestor data protection application called Auto-Snapshot Manager / Microsoft Edition, (ASM/ME). ASM/ME interacts with the PS Series storage volume snapshot function to dramatically improve data protection operations by creating flexible, space-efficient, application consistent point-in-time-copies of data called Smart Copies.
  - **Thin provisioning database and Log volumes** – With PS Series thin provisioning capability, administrators have the option to provision storage resources for Exchange servers without actually allocating physical storage before it is required. This type of storage allocation eliminates the pains of expanding available storage when the application requires it. Repeated data growth operations can be avoided and the result is improved utilization of physical storage resources.
  - Remote site volume replication – With the PS Series auto-replication capability, Exchange Server data can be automatically transferred to a remote data center, protecting the data from serious failures, ranging from the corruption of the volume to a complete site disaster—with no impact on local data availability or performance.
  - Planning and Design Considerations

When designing an Exchange Server 2010 environment, you should understand these often conflicting requirements:

- Reliability, Availability, and Serviceability
- Performance
- Scalability
- Recoverability
- Ease of management
- Service level commitments

It is critical to focus on these requirements *before* you begin the initial Exchange installation, or they may become serious challenges to future growth and stability of the Exchange environment. The EqualLogic Technical Report, [Deploying Windows Server 2008 with PS Series](#), describes how to design a robust server and network environment that uses PS Series storage to overcome the storage challenges IT manager’s face today. Next consider downloading [Exchange Server Pre-Deployment Analyzer](#) (<http://go.microsoft.com/fwlink/?LinkID=184599>) that Performs an overall topology

readiness scan of your environment and provides a list of decisions that need to be made before you deploy Exchange Server 2010.

The Microsoft Exchange Server Best Practices Analyzer Tool (ExBPA) includes an Exchange 2010 Readiness Check scan that can be used to assess an organization's readiness for Exchange 2010. The Exchange 2010 Best Practices Analyzer is located in the **Toolbox** node in the Exchange Management Console.

### **Reliability, Availability, and Serviceability**

The environment must be robust, resilient, and easily repaired without impacting your SLA to the users. One way that this is accomplished is by using hardware that provides for hot swapping components while the system remains available. In a SAN configuration, the server, network, and storage arrays should all have a robust level of fault tolerance to avoid costly unplanned downtime and allow scheduled maintenance to take place without unacceptable amounts of service disruption. Special attention should be placed on fault isolation and overall operations while system components are being serviced.

You can easily build fault tolerance into your Exchange Server 2010 storage environment by using PS Series storage arrays, which provide high availability and scalability, in addition to hot-swappable hardware and MPIO support.

### **Performance**

The Exchange environment must provide optimal performance and response time. Access to Exchange data is crucial to the day-to-day operations of most companies, and under-performing storage can have a devastating effect on the overall performance of Exchange and on your company's productivity.

A SAN built with PS Series storage automatically optimizes its own performance and improves that performance as you add additional arrays to the SAN. If you are planning a large deployment, you may choose to isolate the Exchange workload from other application workloads. You can do this by creating separate storage pools for Exchange-related volumes within the PS Series group. The past ESRP results from EqualLogic demonstrate the performance offered by PS Series arrays.

<http://technet.microsoft.com/en-us/exchange/bb412164.aspx>

### **Scalability**

As your workload grows and storage capacity needs increase, the environment must accommodate changes without affecting users. Storage used in an Exchange Server environment must be highly scalable to accommodate not only growing numbers of users, but also the ever-growing amount of data each user needs to store in Exchange.

Modular PS Series storage arrays provide easy, online scalability.

### **Recoverability**

Recovery from situations that cause data loss, ranging in scale from a corrupted volume or virus infected file to the loss of an entire data center due to an act of nature or other cause is an important part of many organizations business continuity

planning. Since Exchange is often a critical component of user productivity, it is important to have a multi-layer plan to protect this important information asset.

PS Series storage arrays deliver snapshots and auto-replication technology as standard features. Combined with the VSS support of the Host Integration Toolkit for Microsoft and the application consistent Smart Copies provided by ASM/ME, enabling automatic data protection, including restore from snapshot, backup using VSS integrated backup applications and disaster recovery for your critical data is easily configured and administered.

### **Ease of Management**

Setup and configuration, data protection and recovery, and day-to-day administration of the storage environment should be handled easily and have minimal impact on operations and users.

PS Series storage automates complex tasks like RAID configuration and provides both graphical and command line user interfaces for easy and intuitive storage management. The EqualLogic SAN can also be proactively monitored using the included SAN HeadQuarters (SANHQ) software to provide a comprehensive view of your PS Series storage use and performance.

### **Service Level Commitments**

Organizations often have varying service level requirements across applications. One application might be critical to business results, while another might require segregation of storage resources to meet application best practices or organizational needs.

PS Series storage allows for differing performance and availability levels through the choice of SAS, SATA, or SSD disks and RAID levels including RAID 10, 5, 50, and 6, while the ability to store data on physically discrete pools allows a PS Series storage to meet data segregation commitments.

## **DEPLOYING EXCHANGE SERVER 2010 WITH PS SERIES STORAGE**

The following sections describe Exchange Server 2010 requirements and recommendations and the basic tasks for deploying Exchange Server 2010 with a PS Series SAN.

### **Background Information**

Before you begin the deployment, Dell recommends that you review the following documents:

- Microsoft TechNet article: [Deploying Exchange 2010](#)
- Technical Report [Deploying Microsoft Windows Server 2008 in an iSCSI SAN](#), located on the EqualLogic Customer Support website.

### **Microsoft's Exchange 2010 Prerequisites Includes:**

- Make sure that the functional level of your forest is at least Windows Server 2003, and that the Schema Master is running Windows Server 2003 with Service Pack 1 or later.

- The full installation option of Windows Server 2008 with Service Pack 2 or later or Windows Server 2008 R2 must be used for all servers running Exchange 2010 server roles or management tools.
- For all Exchange Server 2010 roles other than the Edge Transport server role, you must first join the computer to the appropriate internal Active Directory forest and domain.
- If you're installing the Mailbox server role and you intend the server to be a member of a database availability group (DAG), you must be running at a minimum the Enterprise Edition of Windows Server 2008 SP2 or Windows Server 2008 R2. The Standard Edition doesn't support the features needed for DAGs.

## High Availability

Microsoft® Exchange Server 2010 uses the concept known as “incremental deployment” for both high availability and site resilience. Unlike previous versions, Exchange Server 2010 no longer uses the cluster resource model for high availability, and it isn't a MSCS cluster-aware (or clustered) application. As a result of this architectural change, there is no longer a cluster-aware version of Setup, and you no longer configure high availability during Setup. Instead, you simply install all Exchange 2010 servers as stand-alone servers, and then incrementally deploy high availability and site resilience as needed.

## Basic Steps

Follow these steps to deploy Exchange Server 2010 with a PS Series SAN:

1. **Set up a PS Series group and create the volumes required for the Exchange environment.** Be sure to create access control records for each volume to allow the appropriate servers access to the volume. Also, reserve snapshot space for each volume if you will be creating snapshots or using Auto-Snapshot Manager for Smart Copies.

See the PS Series *Installation and Setup* and *Group Administration* manuals and the EqualLogic Technical Report, [Deploying Microsoft Windows Server 2008 in an iSCSI SAN](#) for more information.

2. **Properly configure the SAN network for best performance.** See the EqualLogic Technical Report [Storage Array Network Performance Guidelines](#) for more information.
3. **Install Exchange on the server and configure it to use the PS Series storage.** Exchange Server 2010 installation and deployment requirements are well documented in [Deploying Exchange 2010](#). (<http://technet.microsoft.com/en-us/library/dd351084.aspx>)

After deployment, you can expand iSCSI disks online, expand PS Series group capacity, and protect data, as described in the EqualLogic Technical Report [Deploying Microsoft Windows Server 2008 in an iSCSI SAN](#).

## Server Requirements and Recommendations

Additional Exchange server requirements and recommendations for a configuration that uses a PS Series SAN are as follows:

- One or more industry-standard iSCSI initiators. This can be a NIC and Microsoft iSCSI Software Initiator combination or an iSCSI HBA. Consult the vendor's initiator documentation for installation instructions. Always check the Knowledge Base on the EqualLogic Customer Support website for the latest initiator information.

If you plan to use multipath I/O, do *one* of the following:

- Install two or more iSCSI HBAs and the latest Microsoft iSCSI Software Initiator. MPIO can be enabled and configured by using the iSCSI Software Initiator control panel to connect each initiator to each iSCSI target (PS Series volume). For more information on Multipath I/O DSM, See the EqualLogic Technical Report [Deploying Microsoft Multipath I/O in an iSCSI SAN](#)
- Install two or more Gigabit Ethernet NIC's and use the MPIO capability that is integrated in the Microsoft iSCSI Software Initiator.
- Persistently connect the server to the PS Series volumes created for the Exchange configuration.
- Initialize the connected PS Series volumes as basic disks.
- Format the disks.

In addition, consult the [Storage Array Network Performance Guidelines](#) Technical Report for information about improving network performance between PS Series storage arrays and Exchange servers.

## Configuring Exchange to Use PS Series Storage

There are two basic types of volume architectures that can be leveraged within Exchange 2010:

- 1 volume / Database
- 2 volumes / Database

### 1 Volume / Database

A single volume per Database architecture means that both the database and its corresponding log files are placed on the same volume. In order to deploy one volume architecture that only utilizes a single volume per database, you must have a Database Availability Group that has 2 or more copies.

Some of the benefits of this strategy include:

- Simplified storage administration.
- Fewer volumes to manage.

## 2 Volumes / Database

A 2 volume per Database architecture will place the transaction logs on its own volume and each Database on its own volume. With Exchange Server 2010, in the maximum case of 100 Databases, the number of volumes you provision may exceed the number of available drive letters, requiring the use of volume mount points.

Some of the benefits of this strategy include:

- Flexibility to isolate the performance between database and logs.
- Increased reliability. A capacity or corruption problem on a single volume will only impact one database. This is an important consideration when you are not leveraging the built-in mailbox resiliency features.

The following steps cover the procedures for using Exchange Server 2010 with PS Series storage.

The steps assume the group and volume have already been created, the server is persistently connected to the volumes, the new disks associated with the volumes have been initialized, the disks have been formatted, and the drive letters or mount points have been assigned.

**Note:** If deploying a DAG, all copy paths must match. As an example, if the path of the active database is H:\db01\ then all copies on mailbox servers in the DAG (up to 16 total including active) must be H:\db01\.

The examples in the following sections assume that the Exchange server is connected to two volumes, one for the database and one for the logs. Drive letters are assigned as follows:

- H: – Database
- L: – Transaction logs

## SPECIFYING EXCHANGE LOG AND DATABASE LOCATIONS

When using a PS Series group for Exchange storage, follow the installation guidelines. After the roles wizard has completed, confirm that the Finalize installation using the Exchange Management Console is checked and click Finish. After the Finalize installation wizard has completed the default log and database path in this example for the First Database is: "C:\Program Files\Microsoft\Exchange Server\V14\Mailbox\Mailbox Database 0442864034\ Mailbox Database 0442864034.edb".

The example in this report uses the following data locations for the first Mailbox Database:

Transaction log location:	L:\Exch14\mbx1
Exchange database:	H:\Exch14\mbx1

At this point you can easily move the log and database path to the "L" and "H" volumes as outlined below in *Migrating Exchange Information Stores to PS Series Storage*.

### **MIGRATING EXCHANGE INFORMATION STORES TO PS SERIES STORAGE**

If you are currently using direct attached storage (DAS) or a local system drive for storage in your Exchange implementation, you can easily migrate mail stores and logs to a PS Series group and gain the performance and scalability, high availability and data protection benefits of an iSCSI SAN. You will want to do this during a planned maintenance period, as the mailboxes must be offline and you must have exclusive access to the mail stores being moved during the migration.

**Note:** As with any critical application whose configuration you are modifying, it is strongly recommended that you perform a full backup of all information stores and logs before performing the migration.

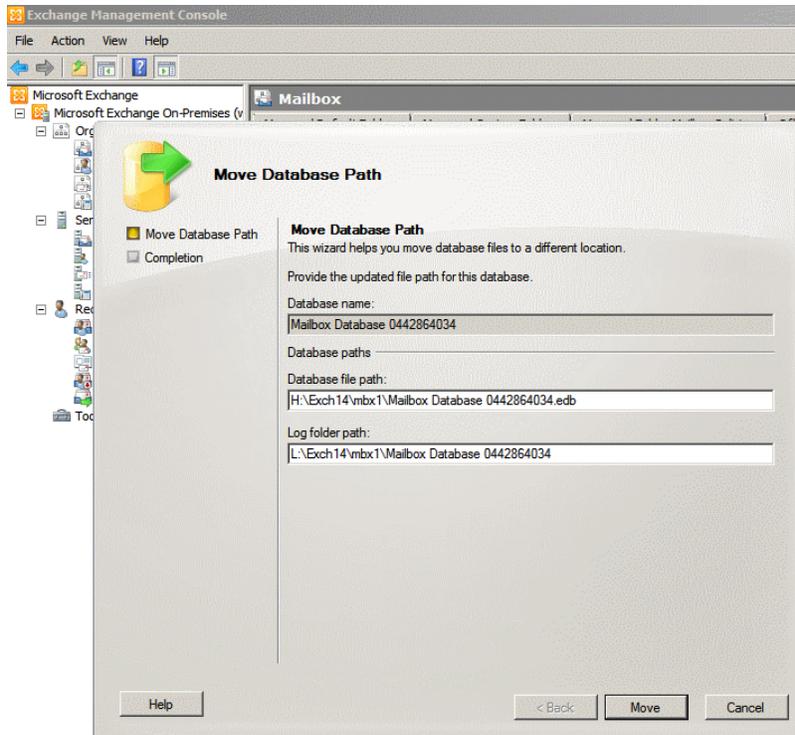
In this example, an Exchange store and logs will move from a local drive (C :) to two PS Series volumes associated with the H: and L: drives.

Moving an Exchange information store requires moving two components:

- Transaction log path.
- Exchange mailbox store (Database) that contains the mailboxes.

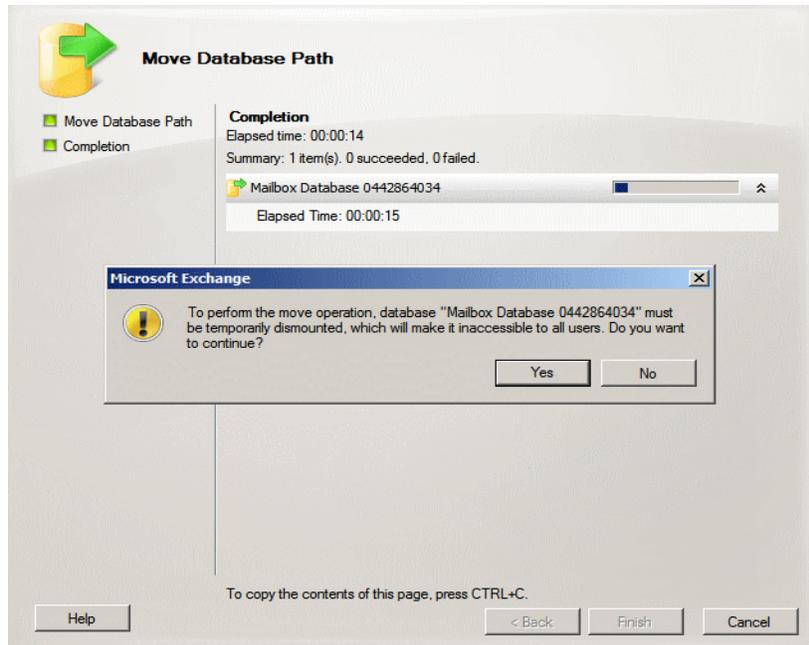
Follow these steps:

1. Configure two volumes to hold the Exchange Database and logs, as described in this technical report.
2. To move/change Transaction log and Database path: Open Exchange Management Console, expand **Organization Configuration** in the leftmost panel and then click **Mailbox**. In the center pane, under the **Database Management** tab select the Mailbox Database you want to configure. In the action pane, click **Move Database Path**. The Move Database Path wizard appears. See Figure 1.



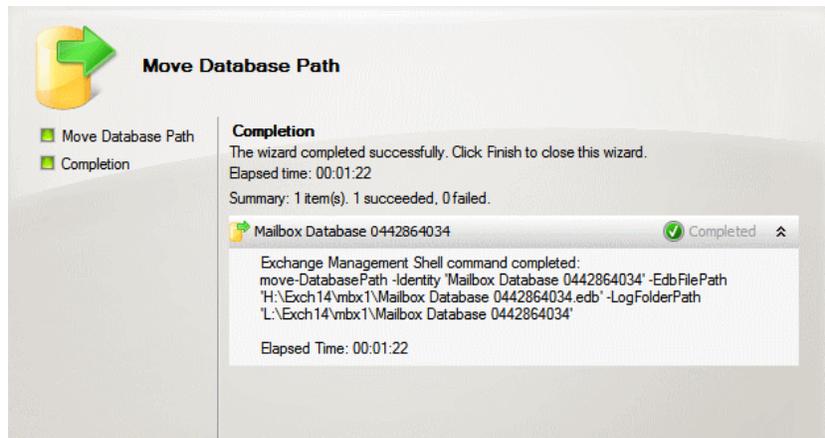
**Figure 1: Move Database and Log Path.**

3. In the Move Database Path Wizard, you can change the **Database files path** and **Log folder path** by editing their path text field, Click **Move**. A warning appears, alerting that you are about to move Exchange data files, which will cause the database to be temporarily dismounted, which will make it inaccessible to all users. Click **Yes**. See Figure 2.



**Figure 2: Dismount warning.**

4. After successful completion of the move, you will be notified. See Figure 3. Click **Finish** to close wizard.



**Figure 3: Move Path Completion.**

## **BACKING UP DATA USING VSS**

You can back up Exchange data residing on a PS Series storage array using any backup application that supports backing up Exchange. However, to leverage the capabilities of Volume Shadow Copy Service (VSS) available in Windows Server 2008, Exchange Server 2010, and EqualLogic Auto-Snapshot Manager for Windows, you must choose a backup application that supports VSS, in addition to the backup features you desire.

Backup applications that support VSS and can be used as a VSS requestor include the following:

- Symantec™ Backup Exec™ and NetBackup™.
- CommVault® Simpana™ Backup & Recovery
- CA BrightStor® ARCserve® Backup
- MS System Center DPM™

See the backup application documentation for information about using the application as a VSS requestor. See the Auto-Snapshot Manager for Windows Installation and Administration manual for information about using that VSS provider.

For more detailed backup and recovery procedures for specific backup and recovery vendors, see the Technical Reports on the EqualLogic Customer Support website.

## **SUMMARY**

As Exchange Server 2010 adds complex new features from HA and DR to Archiving, EqualLogic PS series from Dell simplifies your storage deployment and management with built-in automation, Storage virtualization with non-disruptive load balancing and scale-out, as well as tight management integration with Virtual Machines and Operating Systems, and Application level data protection provides a superior solution for Exchange deployment in both large and small environments.

## **TECHNICAL SUPPORT AND CUSTOMER SERVICE**

Dell's support service is available to answer your questions about PS Series SAN arrays. If you have an Express Service Code, have it ready when you call. The code helps Dell's automated-support telephone system direct your call more efficiently.

## **CONTACTING DELL**

Dell provides several online and telephone-based support and service options. Availability varies by country and product, and some services might not be available in your area.

For customers in the United States, call 800-945-3355.

**Note:** If you do not have access to an Internet connection, contact information is printed on your invoice, packing slip, bill, or Dell product catalog.

Use the following procedure to contact Dell for sales, technical support, or customer service issues:

1. Visit [support.dell.com](http://support.dell.com) or the Dell support URL specified in information provided with the Dell product.
2. Select your locale. Use the locale menu or click on the link that specifies your country or region.
3. Select the required service. Click the "Contact Us" link, or select the Dell support service from the list of services provided.
4. Choose your preferred method of contacting Dell support, such as e-mail or telephone.

## **ONLINE SERVICES**

You can learn about Dell products and services using the following procedure:

1. Visit [www.dell.com](http://www.dell.com) (or the URL specified in any Dell product information).
2. Use the locale menu or click on the link that specifies your country or region