A Blueprint for Implementing Microsoft Exchange Server 2007 Storage Infrastructures

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Designing a consolidated storage infrastructure is the first step toward successfully implementing Microsoft® Exchange Server 2007 to help manage ever-increasing e-mail growth. EMC has created an integrated, cost-effective storage infrastructure blueprint for Exchange Server 2007 deployments using Dell/EMC CX3 UltraScale™ series storage arrays and EMC® software that can deliver high availability and performance while scaling effectively for future growth.

Many organizations rely on Microsoft Exchange for e-mail and collaboration services, and for these organizations, Exchange can be one of their most critical communication tools—often even more critical than telephone and fax systems. This reliance can increase the number of e-mails as well as the variety and richness of attachments users send and receive, leading to explosive growth in both e-mail message volume and mailbox size. Exchange Server 2007 introduces many features designed to accommodate this growth, including a native 64-bit architecture, an increased number of message stores, local and cluster continuous replication, flexible journaling, and policy-based message records management.

Designing a consolidated storage infrastructure to support Exchange Server 2007 is the first step toward an efficient and cost-effective deployment. After extensive testing of Exchange Server 2007 workloads running on Dell/EMC CX3 UltraScale series storage arrays with an EMC software infrastructure, EMC has created a blueprint for Exchange Server 2007 deployments designed to provide an integrated, cost-effective solution that delivers high availability and performance while scaling effectively for future growth.

Although changes to the database engine in Exchange Server 2007 due to its 64-bit memory support, increased I/O size (8 KB in Exchange Server 2007, compared with 4 KB in Exchange Server 2003), and increased Extensible Storage Engine cache size have lowered I/O requirements compared with Exchange Server 2003, I/O subsystem availability and performance remain critical for Exchange Server 2007 deployments. Dell/EMC CX3 storage arrays include high-performance Fibre Channel drives to store production data as well as cost-effective, high-capacity Serial ATA (SATA) drives to store backup and archive data. These storage arrays support native Internet SCSI (iSCSI) and Fibre Channel connectivity—including a minimum of four Gigabit Ethernet ports and a minimum of four 4 Gbps Fibre Channel ports—and provide dual redundant active storage processors with battery-backed caches. They are designed to provide data-in-place upgrades to allow scaling from small- to very-large-capacity configurations.

Storage-based EMC software such as the EMC Navisphere® and SnapView™ applications (with SnapView providing snapshot and clone functionality), and host-based EMC software such as the EMC Replication Manager and RepliStor® applications, are tightly integrated with Microsoft technologies like Volume Shadow Copy Service (VSS). This integration is designed to provide rapid e-mail, mailbox, database, and entire server recovery and restore, helping maximize operations efficiency.

Related Categories:

- Dell/EMC storage
- Microsoft Exchange Server 2007
- Microsoft Windows Server 2003

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1This term does not connote an actual operating speed of 1 Gbps. For high-speed transmission, connection to a Gigabit Ethernet server and network infrastructure is required.
The global architecture of the EMC blueprint for Exchange Server 2007 storage infrastructures includes four major modules:

- **Store**: Uses a building block approach to provide a solid foundation for the infrastructure; this module is at the core of the EMC blueprint, with the other three modules being added as needed.
- **Backup**: Adds backup and rapid recovery functionality at the server, storage group, database, and mailbox levels.
- **Archiving**: Supports unrestricted mailbox quotas while keeping databases manageable, and does so transparently to end users of Microsoft Outlook® software.
- **Protection**: Adds disaster recovery functionality.

This article outlines the physical and network architectures of this blueprint and discusses the Store and Backup modules. An article addressing the Archiving and Protection modules is planned for a future issue of Dell Power Solutions.

### Physical and network architectures

Figure 1 shows the physical architecture of the Store and Backup modules in the EMC blueprint for Exchange Server 2007 deployments using a Dell/EMC CX3-20 storage array. To help simplify testing, the Exchange Server 2007 support infrastructure, including the domain controller and global catalog, is consolidated on VMware® ESX Server 3.0.1 virtual machines (VMs) running on a Dell™ PowerEdge™ 6850 server with two dual-core Intel® Xeon® processors at 3.0 GHz and 32 GB of RAM. The Exchange Server 2007 Client Access and Hub Transport roles are assigned to a separate PowerEdge 1850 server with two dual-core Intel Xeon processors at 2.8 GHz with Intel Hyper-Threading Technology and 8 GB of RAM.

In this blueprint, Exchange Server 2007 runs on a PowerEdge 2950 server with two dual-core Intel Xeon processors at 2.4 GHz, 16 GB of RAM, and the Microsoft Windows Server® 2003 Enterprise x64 Edition OS with Service Pack 1 (SP1). This server also runs EMC PowerPath® 4.6 software to help provide resiliency against a storage processor failure in the Dell/EMC CX3-20 array, as well as the EMC Replication Manager 5.0 agent with SP1 to help orchestrate rapid backup and recovery of Exchange Server 2007 data. In addition, this PowerEdge 2950 server includes Microsoft iSCSI Software Initiator 2.0.3 with Microsoft Multipath I/O (MPIO) hot fix 1.8 and version 24 of the EMC Navisphere agent and command-line interface (CLI) to allow iSCSI access to the Dell/EMC CX3-20 array. EMC PowerPath uses the MPIO framework to provide path failover functionality.

EMC Replication Manager 5.0 with SP1 is designed to simplify replication and recovery of Exchange Server 2007 data by coordinating and automating the steps required at the application, host, and array levels. It is a simple, easy-to-use application that utilizes the Microsoft VSS and Virtual Device Interface (VDI) frameworks; in addition to supporting Exchange Server 2007, it can provide rapid backup and recovery of Exchange Server 2003 and the Microsoft SQL Server™ 2000 and SQL Server 2005 database platforms. In the EMC blueprint, the EMC SnapView clone application running on Dell/EMC CX3 arrays helps create backup copies of Exchange Server 2007 data in coordination with the Replication Manager agent running on the Exchange Server 2007 production servers. Although SnapView snapshots use less
space than SnapView clones—snapshots store only changes to production data, while clones make full copies—the appropriate choice for creating backup replicas is highly dependent on the production data change rate. Because of online maintenance and online defrag (OLM/OLD) operations, many Exchange databases can change significantly. As a result, SnapView clones can provide a higher-performance configuration than SnapView snapshots in Exchange environments. In the EMC blueprint, the EMC Replication Manager mount host mounts Exchange Server 2007 instant clones for backup and recovery of e-mail, mailbox, and database data.

Following Exchange Server 2007 installation, administrators typically should run the Microsoft Exchange Server Best Practices Analyzer (ExBPA) and follow its recommendations for performance tuning and hot-fix installation.

Network architecture

The network architecture in the EMC blueprint focuses on iSCSI technology, which allows servers to connect to storage arrays using existing IP network infrastructures. iSCSI can be cost-effective and easy to implement while still providing good performance for applications like Exchange that require low bandwidth and a high number of I/Os per second (IOPS). The small I/O size in Exchange Server 2007 also allows Exchange Server 2007 implementations using iSCSI to scale to large numbers of users by utilizing Gigabit Ethernet network interface cards (NICs) and Microsoft iSCSI Software Initiator.

Figure 2 shows the iSCSI data ports for the Dell/EMC CX3-20 array. Exchange Server 2007 and the EMC Replication Manager mount host connect to the external storage through two Intel PRO/1000 network adapters using four MPIO-based iSCSI connections. As shown in Figure 3, these connections are created using Microsoft iSCSI Software Initiator 2.0.3, with NIC0 logging in using iSCSI connections a0 and b3 and NIC1 logging in using iSCSI connections a3 and b0.

Store module

The architecture of the Store module in the EMC blueprint is based on a building block design approach, which can scale well as enterprises grow and require additional space and fault tolerance. This design helps provide scalable performance while minimizing configuration and operations complexity by dividing users into groups of 500 per building block, with a maximum mailbox size of 250 MB. Each building block logical unit (LUN) is created in a four-disk RAID-10 group to help provide fault tolerance and high performance while minimizing the number of disks required.

Figure 4 shows a building block for 500 users in two storage groups utilizing backup to disk, and Figure 5 shows a building block for 500 users in two storage groups utilizing two EMC Replication Manager clones. The databases reside on the corresponding LUNs (drive or mount point) created on the RAID-10 disk group. Log files reside on the corresponding LUNs (drive or mount point) created on the RAID-10 disk group.

In February and March 2007, EMC engineers used the Microsoft Exchange Server Jetstress tool to test one building block (four database disk spindles and four log disk spindles in shelf 0_0 of a Dell/EMC CX3-20 storage array containing 146 GB, 15,000 rpm disks). Figure 6 shows the results, which indicate that one building block can
achieve up to 755 I/Os per second (IOPS) while staying within the Microsoft recommended database read latency limit of 20 milliseconds. The test team was able to create 725 mailboxes of 250 MB each with a user profile of 0.5 IOPS while maintaining a database read latency of 9 milliseconds and a database write latency of 5 milliseconds.

In the EMC blueprint, the Exchange Server 2007 message stores and logs on the Dell/EMC CX3-20 array are accessed through the assigned ports logged in to using Microsoft iSCSI Software Initiator. EMC PowerPath 4.6 provides LUN storage processor failover.

Backup module

The combination of Microsoft Windows Server 2003 Enterprise Edition and Microsoft Exchange Server 2007 supports Exchange data backup using VSS, a Microsoft service that enables administrators to create restartable copies of Exchange databases. Both the EMC NetWorker™ and EMC Replication Manager applications support VSS. Administrators can perform backups directly using the EMC NetWorker Module for Microsoft Exchange Server, which performs a VSS backup using either tape or SATA disk drives as the target location.

EMC Replication Manager 5.0 with SP1 provides local replication capabilities for Exchange Server 2007. The SnapView enabler software is required on the Dell/EMC CX3 storage arrays to support clone and snapshot capabilities. The EMC blueprint utilizes EMC SnapView clones to create instant backup copies of the Exchange Server 2007 Information Store. The Replication Manager agent resides on the production Exchange node and the mount host server. After the clones are mounted to the mount host server, administrators can run the Microsoft Eseutil utility using the esetutil /k command to validate the Exchange clone and help ensure database integrity. They can then back up the clones as flat files to another medium, such as tape, SATA disk, or a disk library using EMC NetWorker, Symantec NetBackup, CommVault Galaxy, or other industry-leading backup tools. In this blueprint, the use of a mount host helps reduce performance impact on production Exchange servers when carrying out database checksum or backup operations.

The Replication Manager agent on Exchange servers takes advantage of array replication technology to create clones of Exchange Information Stores. Administrators should create these clones during non-production hours and when the process of creating clones does not conflict with other database maintenance procedures, such as OLM/OLD.

Administrators should not mount replicas back to Exchange production servers to run Eseutil. When the Exchange Mailbox server is not using a single-copy cluster (SCC) configuration, the replicas can technically be mounted back to this server without explicitly requiring a mount host; however, doing so does not offload the Eseutil workload from the Mailbox server. Loading the Exchange administrative tools also loads Eseutil and the necessary dynamic-link library (DLL) files required for the checksum operation. Production Exchange servers must have the same service pack and hotfix revisions of the Exchange DLL files installed.

After the message stores have been checked for consistency, administrators can use EMC NetWorker to copy the clones to tape or other media. Array-based clones require clone and production LUNs to have equal block sizes, but do not require them to use the same RAID level; the EMC blueprint, for example, uses RAID-10 for the production databases and RAID-5 for clones, which helps reduce the number of disks. The number of required clone LUNs is directly proportional to the number of Exchange database LUNs: if administrators are using only one Exchange database LUN and require two clones,

\[ \text{Storage IOPS} \quad \begin{array}{|c|c|c|c|} \hline \text{Database read latency (milliseconds)} & \text{Database write latency (milliseconds)} & \text{Log write latency (milliseconds)} \\ \hline 228 & 8 & 4 & 1 \\ 368 & 9 & 5 & 1 \\ 453 & 11 & 5 & 1 \\ 507 & 12 & 5 & 1 \\ 549 & 14 & 6 & 2 \\ 575 & 16 & 6 & 2 \\ 604 & 17 & 6 & 2 \\ 628 & 18 & 6 & 2 \\ 755 & 18 & 6 & 2 \\ \hline \end{array} \]

\[ \text{Figure 6. Test results using the Microsoft Exchange Server Jetstress tool on one building block} \]

\[ \text{Figure 5. Building block for 500 users in two Microsoft Exchange Server 2007 storage groups utilizing two EMC Replication Manager clones} \]

\[ ^{1} \text{For more information about Microsoft Exchange best practices and the Eseutil utility, visit support.microsoft.com/kb/822896.} \]
they must create two clone LUNs that are the same size as the Exchange database LUN.

Basic backup
The basic backup architecture in the EMC blueprint uses Exchange-aware backup software such as EMC NetWorker and Microsoft NTBackup. With a 500 GB LUN, administrators can quickly perform a single nightly backup to disk and then present this backup copy to offline backup tape devices, helping avoid the tight backup windows Exchange administrators typically struggle with. Nightly backup-to-disk jobs are dependent on the tape backup completing successfully, so administrators must test the data integrity of each night’s backup to disk and ensure that no backup errors (such as -1018, -1019, or -1022 errors) have occurred. These processes allow administrators to maintain the last viable full backup on disk to facilitate rapid restore times.

In February and March 2007, EMC engineers tested streaming backup-to-disk performance by using the Jetstress tool to back up an Exchange Server 2007 Information Store to the backup-to-disk LUN on shelf 0_0 of a Dell/EMC CX3-20 storage array containing 146 GB, 15,000 rpm disks, as shown in Figure 4. Figure 7 shows the results, which indicate that an Exchange Server 2007 Information Store can be backed up to disk at an approximate throughput of 50 GB/hour.

The cluster continuous replication (CCR) feature in Exchange Server 2007 helps provide redundancy for Exchange Information Stores to facilitate rapid recovery without using Exchange backups. An article addressing Exchange Server 2007 backup processes using CCR is planned for a future issue of Dell Power Solutions.

Advanced backup
The advanced backup architecture in the EMC blueprint uses EMC Replication Manager 5.0 software with SP1 to create local clones (within the same array) of Exchange databases and log files. Replication Manager allows administrators to create multiple clones of Exchange Information Stores, enabling them to quickly restore e-mail, mailboxes, databases, and servers following database or log file corruption. Administrators should typically maintain two clones of each storage group, which Replication Manager can automatically rotate to keep two days of backup copies available on a local array.

EMC recommends using EMC NetWorker to back up clones to tape for off-site backup maintenance. Using two clone backup copies on a local array and tape for off-site backup enables administrators to provide additional time for Exchange OLM/OLD operations to complete. Replication Manager can also facilitate Eseutil integrity checks of Exchange databases on remote hosts, helping minimize performance impact on Exchange production servers during these checks.

EMC Assessment for Microsoft Exchange Server
Enterprises can face many challenges when upgrading to Exchange Server 2007 or implementing a new Exchange environment. EMC, which has more than a decade of experience with Exchange deployments, offers its expertise through EMC Assessment for Microsoft Exchange Server. When performing these assessments, EMC employs industry standards, best practices, and tools such as Microsoft ExBPA, Quest MessageStats, and EMC VisualSRM™ software to gather, analyze, and report on Exchange e-mail use.

EMC Assessment for Microsoft Exchange Server can help enterprises understand their existing environment before moving forward with a migration or upgrade to Exchange Server 2007 by providing an analysis of the current environment and a recommendation for the future design—with the ultimate goal of helping organizations meet their e-mail and collaboration service levels and minimize their total cost of ownership for this environment.

**Blueprint for Exchange Server 2007 storage infrastructures**
The EMC blueprint for Microsoft Exchange Server 2007 storage infrastructures is designed to help organizations plan for Exchange Server 2007 upgrades or new deployments. Built on Dell/EMC CX3 UltraScale series storage arrays and EMC software, this blueprint can help administrators cost-effectively manage and scale Exchange environments while providing robust backup and recovery functionality. Following the guidelines and best practices described in this article, and taking advantage of services such as EMC Assessment for Microsoft Exchange Server, can help enterprises significantly simplify the deployment of Exchange Server 2007 storage infrastructures in their data centers.


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