

# Virtual Solution for Microsoft® Exchange Server 2007

## Using VMware® Infrastructure 3 Software, Dell™ PowerEdge™ Servers and EMC CLARiiON® CX3-20 iSCSI Storage



Building a flexible and resilient infrastructure with reduced complexity is essential to successful implementation of Microsoft Exchange Server 2007. VMware in conjunction with Dell and EMC has tested and validated a virtualization solution for Exchange Server 2007 – using VMware Infrastructure 3 software, Dell PowerEdge servers, and EMC CLARiiON CX3-20 storage arrays – that makes systems highly available, reduces costs, and scales as an organization grows. Results from Jetstress and LoadGen tests of a 1,000 user design demonstrated minimal impact of virtualizing the Exchange environment and significant increases in flexibility using VMware® tools such as VMotion™, Distributed Resource Scheduler (DRS), and High Availability (HA).



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## Business Challenge

For many organizations, e-mail systems form a critical part of their communications. IT departments know that any outage, regardless of length or cause, can impair the organization's ability to communicate and conduct business effectively. Additionally, the expense and complexity of implementing and supporting a highly available and disaster-tolerant Exchange Server 2007 infrastructure can be a constant challenge.

In addition to managing these increasing demands on the e-mail system, IT departments are also challenged to find new ways to reduce costs associated with their current IT infrastructure.

## Technology Solution

The VMware/Dell/EMC virtual solution for Microsoft® Exchange Server 2007 has been designed for small and mid-size enterprises and provides a flexible and robust platform for a wide variety of application and workload environments. For customers who have both a high proficiency with VMware® technology and an understanding of Microsoft's current support policies, they may now also consider running Exchange Server 2007 in a virtual environment. The solution can address common challenges facing today's IT departments in new ways using VMware's virtualization technology, EMC CLARiiON® CX3-20 iSCSI storage and Dell™ PowerEdge™ servers.

By virtualizing the Exchange 2007 environment on the VMware® Infrastructure 3 (VI3) platform, the solution enables Exchange 2007 environments to capitalize on the benefits of virtualization such as server consolidation, increased server utilization, simplified disaster recovery and increased flexibility using VMware® technology such as VMotion™, Distributed Resource Scheduler (DRS) and High Availability (HA).

### 1.0 Benefits of Running Exchange 2007 on a VMware Platform

#### • Less I/O Intensive than Exchange 2003

Exchange 2003 was an extremely disk I/O-intensive workload. Proper storage design often involved dedicating a very large number of high-performance disk spindles exclusively to Exchange. With Exchange 2007 Microsoft has gone to great lengths to reduce disk I/O demands. Most notably is the fact that Exchange 2007 now runs on a 64-bit platform. These changes in architecture allow more memory for

Database Buffer Cache requiring less access to the disk for reads, and greater write buffering. Exchange 2007 has also increased the number of databases to 50 with 50 storage groups. The larger number of storage groups allows for more checkpoint depth per user which also aides in reducing the necessity to read from disk by utilizing the dirty pages in memory. I/O specific changes from 2003 to 2007 have write sizes increased from 4kb to 8kb, and I/O coalescing increasing from 64kb to 1MB resulting in larger but fewer writes.

As a result of these and other architectural changes, the performance of Exchange 2007 inside a VMware virtual machine has improved substantially over Exchange 2003 performance in a virtual machine.

**VMware Infrastructure 3 supports the use of 64-bit Windows 2003 guests. When running inside a VMware virtual machine, performance improvements of Exchange 2007 over Exchange 2003 have been observed. Performance testing of the 1,000 mailbox design in this solution with Jetstress and LoadGen has demonstrated performance that is comparable with running Exchange 2007 natively on similar hardware<sup>i</sup>.**

#### • Reduce deployment costs through server consolidation

Microsoft Exchange Server 2007 runs exclusively on 64-bit hardware and can require up to five distinct server roles depending on required functionality including Edge Transport, Hub Transport, Client Access, Mailbox, and Unified Messaging servers. New 64-bit servers can contain powerful dual-core and quad-core CPUs and handle up to 64GB of RAM. In the small and mid-size organization's Exchange environment, these powerful servers will often only utilize a small portion of their full compute resources. Running multiple VMware virtual machines on these 64-bit systems can unlock the full value and provide a quicker ROI on this server hardware investment.

VMware can also virtualize 32-bit and 64-bit Windows servers such as Domain Controllers, Global Catalogue, DNS, DHCP and other infrastructure servers to further leverage server hardware investments. Server consolidation can reduce costs for deployment, maintenance, support, power, cooling, and floor space.

**VMware Infrastructure 3 enables administrators to run more workloads on a single server and can increase server utilization from what is commonly less than 15% to upwards of 65% or more.<sup>ii</sup>**

### • Reduce OS deployment times using virtual machine templates

VMware virtualization enables enterprises to build a set of common server images that can be easily updated and quickly provisioned, reducing the time required to deploy new virtual machines. The traditional method of deploying a new physical server can consist of ordering new server hardware, installing the operating system and patches, installing other required software applications and testing. This process can often range from days to weeks in many organizations. When using templates with VMware virtual machines in the Exchange environment, new virtual machines can be deployed in minutes from stored VM images. Being able to rapidly and consistently deploy new virtual machines can help streamline testing and development cycles, accelerate production deployments, assist in trouble shooting and allow for easy adjustments to changing workloads in the environment.

**Organizations using VMware templates report being able to reduce server OS deployment times by 50-70% and can reduce the time required to deploy new server images from days or weeks to minutes .<sup>iii</sup> This frees up valuable IT resources to work on other important tasks. These same benefits can be realized in a virtualized Exchange 2007 environment.**

### • Take advantage of affordable iSCSI connectivity options

Deploying Fiber Channel Storage Area Networks (SANs) can be an expensive proposition for small and mid-size organizations. VMware Infrastructure 3 supports iSCSI connectivity using a number of different storage initiator choices. Combined with the performance and reliability of EMC CLARiiON CX3-20 iSCSI storage arrays, the solution delivers affordable and reliable storage for Exchange 2007.

**VMware Infrastructure 3 supports affordable iSCSI storage options using the EMC CLARiiON CX3-20 iSCSI storage array. The disk storage for Exchange 2007 in this solution has been designed to scale in 500 user increments and has been validated for performance with Jetstress and LoadGen testing.<sup>iv</sup>**

### • Leverage VMware VMotion, DRS and HA in the Exchange environment

For many mid-size enterprises, the cost and complexity of clustering solutions such as Microsoft® Cluster Server (MSCS) is not always a suitable approach. As a result, essential systems in the environment are left without a high-availability solution. In an Exchange 2007

environment deployed on VMware, an alternative solution for high availability is introduced using the VMware Infrastructure 3 feature set:

#### • VMware VMotion:

Migrates live, running virtual machines from one physical server to another with no loss of service.

#### • VMware Distributed Resource Scheduler (DRS):

Dynamically load balances all of the VMware virtual machines in the environment across the entire pool of server resources. New functional server role decomposition in Exchange 2007 takes full advantage of the DRS feature because DRS functions most efficiently when distributing multiple small virtual machines.

#### • VMware High Availability (HA):

In the event of server hardware failure, automatically restart all virtual machines on another ESX server.

**VMware Infrastructure 3 can dynamically load balance and protect every virtual machine workload in an operating system in an application-independent manner. VMware VMotion and DRS were tested in this solution under a LoadGen workload and were shown to be completely transparent to the Outlook Clients. VMware HA was used to test behavior on ESX Server failure and was shown to rapidly restart the failed Exchange 2007 Mailbox Server role on the other ESX Server in the VMware cluster. LoadGen testing was able to successfully recover from the HA failover. The result is a server hardware redundant and flexible virtualized Exchange environment without complicated clustering software.**

#### • Simplify disaster recovery

Many disaster recovery (DR) solutions require similar server hardware at the DR site to prevent issues with driver and software compatibility when systems are brought online in the event of a disaster. Systems deployed on VMware virtual machines can eliminate this hardware requirement and can be brought online on any supported VMware ESX Server running anywhere in the world. Consolidating servers at a DR site by running multiple virtual machines on the same system can reduce the number of servers required. Additionally, since each virtual machine is encapsulated in a small set of files, replication of the VM to a DR site can be simplified.

**VMware Infrastructure 3 can simplify Exchange DR by reducing hardware compatibility constraints**

and reducing the number of servers required at the DR site through consolidation. Replication is also simplified using virtual machine encapsulation.

## 2.0 Solution Overview – Four Layers

The VMware/Dell/EMC virtual solution for Exchange Server 2007 has been designed and optimized for small and mid-size organizations looking to deploy Exchange Server 2007. Performance testing was done with user counts up to 1,000 mailboxes running at 0.5 IOPS per user and 250MB mailboxes, and has been designed for easy scalability to accommodate higher user counts. The solution can be broken down into four core layers:

- Layer 1: VMware Infrastructure 3 software
- Layer 2: EMC CLARiiON CX3-20 iSCSI storage
- Layer 3: Dell PowerEdge servers
- Layer 4: Microsoft Exchange Server 2007

### 2.1 Layer 1: VMware Infrastructure 3 Software

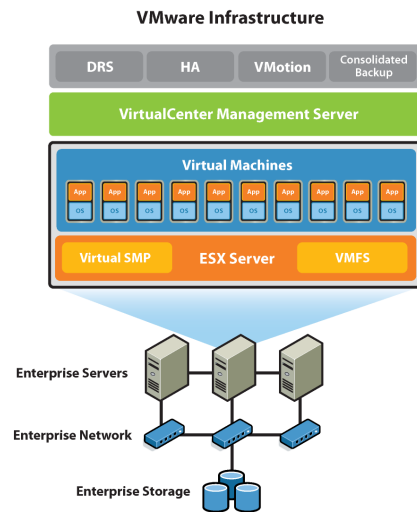
The underlying platform for building a dynamic, self-optimizing data center is built on VMware Infrastructure 3 (Figure 1). VMware Infrastructure 3 abstracts processor, memory, storage and networking resources into multiple virtual machines, providing greater hardware utilization and flexibility. Production-proven at thousands of customers of all sizes, ESX Server delivers enterprise-class performance, scalability, and flexibility.

VMware Infrastructure 3 simplifies IT so companies leverage their storage, network, and computing resources to control costs and respond faster. The VMware Infrastructure 3 approach to IT management creates virtual services out of the physical IT infrastructure, enabling administrators to allocate these virtual resources quickly to the business units that need them the most.

Hardware management can be separated from software management, and hardware equipment can be treated as a single pool of processing, storage and networking power to be allocated and de-allocated in real time to various software services. In a virtual infrastructure, users see resources as if they were dedicated to them while the administrator can manage and optimize resources across the enterprise.

Virtualization is a first step towards a responsive data center that makes efficient use of resources and responds rapidly to changing business needs. Virtualized IT data centers can provide a sustainable competitive advantage by reducing costs, improving operational efficiencies and increasing application availability.

Figure 1: VMware Infrastructure 3



### 2.2 Layer 2: EMC CLARiiON CX3-20 iSCSI Storage

On top of the virtualization layer is the core storage, the EMC CLARiiON CX3-20 iSCSI storage array (Figure 2). The CX3-20 is a dual-protocol system supporting both Fiber Channel and iSCSI connectivity and dual redundant storage processors with battery-backed cache. Designed for data in-place upgrades allow the storage array to scale easily as the environment grows. Using iSCSI can provide a cost-effective solution and further extend the economic benefits of using VMware for virtualization. The storage in this solution has been tested and validated on CLARiiON CX3 iSCSI storage using Microsoft’s Jetstress tool for benchmarking disk I/O performance.<sup>v</sup>

Figure 2: EMC CLARiiON CX3-20 iSCSI Storage Array

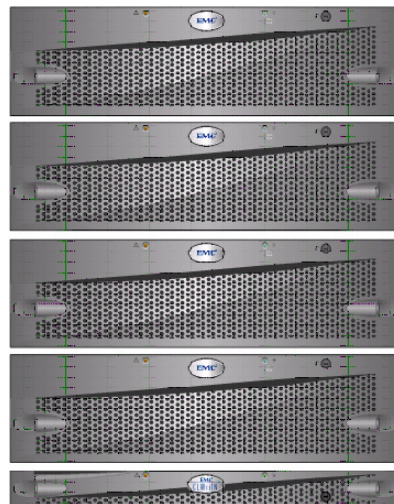
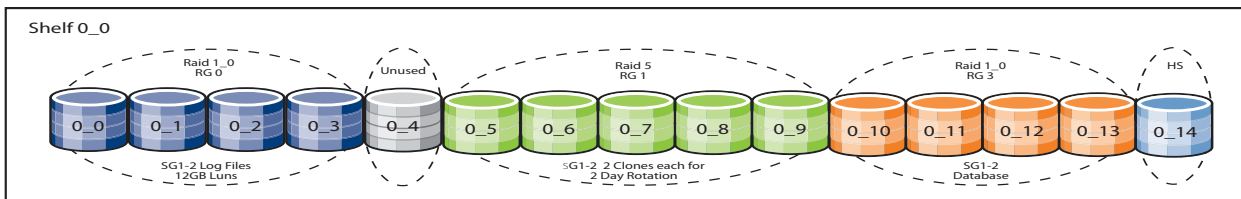


Figure 3: Building blocks for 500 users using two Exchange storage groups with two Replication Manager clone copies



The storage architecture is based on a new design utilizing building blocks (Figure 3). This design builds upon itself as environments grow and require additional space and fault tolerance. The building blocks, while addressing performance, minimize design and operations complexity in increments of four disk RAID 1/0 building blocks, with a 0.5 user I/O profile and maximum mailbox size of 250 MB. As the user workload grows, adding performance, scale, and capacity are simple and predictable.

Integrating with the EMC CLARiiON CX3-20 iSCSI storage for rapid VSS-based clone backups is EMC Replication Manager software which automates and manages the entire backup and recovery process. The solution uses EMC Replication Manager 5.0 software to easily automate the process of creating disk-based replica copies of Exchange databases. Replication Manager utilizes the Microsoft VSS framework to create point-in-time replicas of Exchange data. The replicas are mounted to a separate mount host where they are checked for consistency using the "eseutil /k" command to validate database integrity. From the mount host, Exchange data can then be backed up as flat files to other media such as tape or disk, or replicated to a disaster recovery site using EMC SAN Copy.

### 2.3 Layer 3: Dell PowerEdge Servers

Dell PowerEdge servers have set the industry standard for simplifying operations, driving leading-edge price performance and delivering business-relevant IT solutions. Dell continually delivers server technology designed for high performance, ease of use and overall efficiency. Commonality is built into the PowerEdge server family with the specific goal of simplifying management and maintenance, while reducing cost and complexity. PowerEdge servers are quick to deploy and easily integrate with VMware Infrastructure 3 and EMC CLARiiON CX3-20 iSCSI storage. Dell is leading the next wave of innovation by offering PowerEdge servers with multi-core processing.

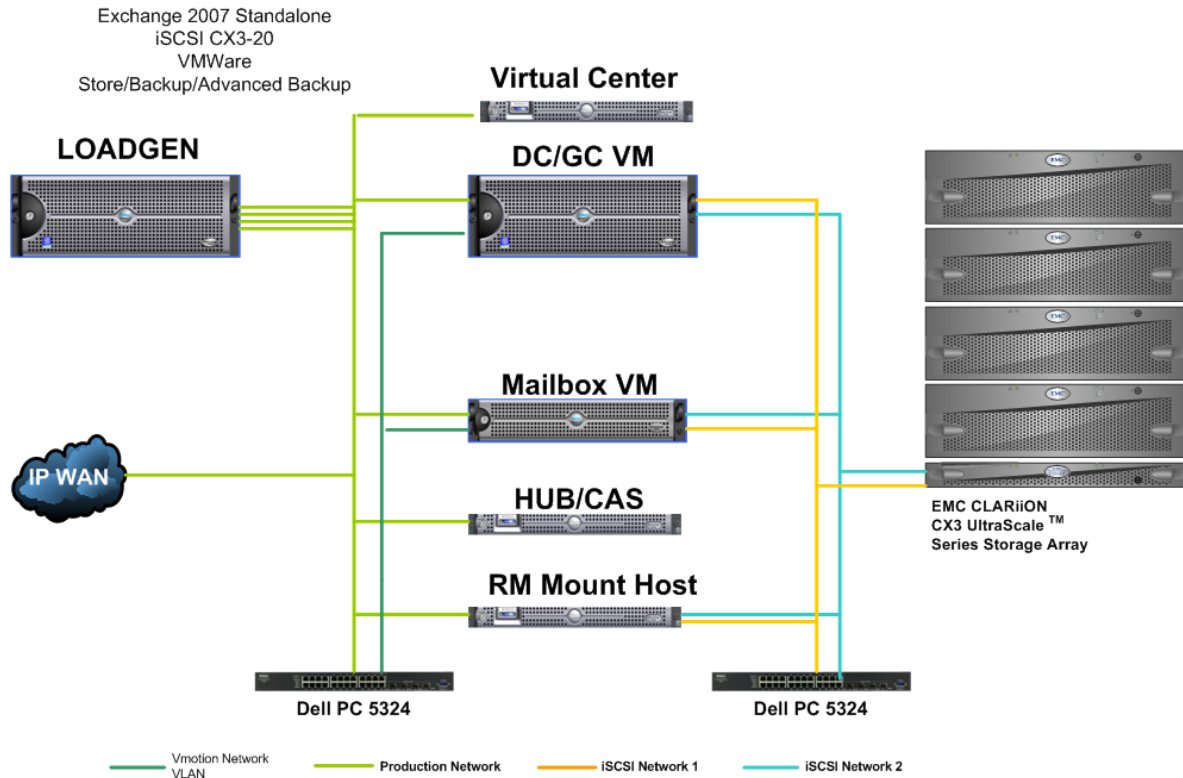
The core mailbox virtual machine in this solution was tested on the Dell PowerEdge 2950 server. Other Dell servers were used as the VMware Virtual Center system as well as the EMC Replication Manager mount host. For benchmarking, Microsoft's LoadGen tool was run from the Dell 6950. Domain controllers, Global Catalog and other required infrastructure servers required for testing were run in VMware virtual machines on Dell servers as well. Figure 4 shows all the Dell servers that were used in the testing architecture. All testing was conducted by EMC in conjunction with VMware and Dell at the EMC Commercial Solutions Validation labs in Raleigh, NC.

Organizations that are already running a VMware infrastructure and have Microsoft Active Directory in place will likely have most of the infrastructure shown in Figure 4 already in place. In particular, Virtual Center, Domain Controllers and Global Catalog servers are likely already deployed. The LoadGen system was used only for validating performance and sizing of the virtual Exchange 2007 infrastructure. The Exchange backup/mount host can be deployed either as a stand-alone server or as a virtual machine. The primary function of this system is to run consistency checks on the Exchange database and log volumes when using the Advanced Backup module. More information on the Basic Backup and Advanced Backup modules can be found in the Reference Architecture document for this solution.

The primary system used for testing Exchange Server 2007 performance on a virtualized mail server was done on a Dell 2950 server with two dual-core Xeon 2.4GHz CPUs and 16 GB of physical RAM. Jetstress and LoadGen testing were done against a virtual machine configured with 2 vCPUs and 12 GB RAM and compared to performance of Exchange on the same server and storage hardware running in a non-virtualized configuration.<sup>vi</sup>

A second Dell 2950 server was used to test VMware VMotion, HA and DRS functionality of the Exchange virtual machine while under stress from LoadGen testing.

Figure 4: Dell PowerEdge servers in test environment



## 2.4 Layer 4: Microsoft Exchange Server 2007

Exchange Server 2007 is the fourth and final layer which sits on top of the infrastructure of VMware virtualization, Dell PowerEdge servers and EMC CLARiiON CX3-20 iSCSI storage. The latest version of Exchange contains significant improvements in reliability, scalability, and unified messaging. Several new server roles are introduced as Exchange Server 2007 moves to a more modular architecture. One major change to Exchange Server 2007 is that it only comes in an x64-bit version and requires Windows Server 2003 x64 as the underlying operating system. As a result, many organizations will need to invest in new x64-bit hardware as part of their deployment. The upgrade cycle represents an opportunity to leverage VMware virtualization technology as your organization begins to test, evaluate and deploy Exchange 2007.

## 3.0 Performance

With Exchange Server 2007, the amount of disk I/O has significantly decreased over prior versions. When using 64-bit hardware, additional memory is available for database caching, thus reducing disk I/O. Increased I/O size (8 KB in Exchange Server vs. 4 KB in Exchange 2003) combined with changes to the Exchange database and the internal I/O activities of Exchange further reduce the requirements on the disk subsystem.

Figure 5 shows the results of Jetstress testing of the 1,000 user storage design on EMC Clariion CX3-20 iSCSI storage and Dell PowerEdge 2950 servers. Performance was measured in a VMware virtual machine and compared to running Exchange Server 2007 in a non-virtualized configuration on identical server and storage hardware. Results were comparable between the virtualized and non-virtualized tests.

Processor utilization during LoadGen tests show minimal impact of virtualizing the Exchange workload for this user count. Testing 2-way and 4-way systems showed no significant advantage to using more than 2 vCPUs inside the virtual machine for this user profile (Figure 6).

Figure 5 Solution Test Results

	Thread Count	Achieved IOPS	Database read latency (ms) SG1, SG2, SG3, SG4	Database write latency (ms) SG1, SG2, SG3, SG4	Log write latency (ms) SG1, SG2, SG3, SG4
Jetstress - Physical	14	1379.992	19, 20, 19, 19	6, 6, 6, 6	2, 2, 2, 2
Jetstress - Virtual	14	1366.697	19, 19, 18, 19	7, 7, 7, 7	3, 3, 3, 3

Running Microsoft LoadGen 2007 with 4 storage groups for 1,000 Users with a database profile of MMB3 and Outlook User (Action) Profile at MMB4 and insuring all required logging is recorded resulted in performance comparable to the non-virtualized environment (Figure 7). In both cases user response times were well within acceptable limits.

Overall performance was very comparable in the virtual and non-virtual environments with slight variations in certain areas.

#### 4.0 Conclusions

Enhancements in architecture and performance improve the operation of Exchange Server 2007 in a virtual environment. For those customers who are well versed in VMware Infrastructure 3 and are beginning to test and evaluate Exchange 2007, planning a new implementation, or migrating from a previous version, there is now an opportunity to extend your virtual infrastructure to include Exchange 2007 using the VMware/Dell/EMC virtual solution for Exchange Server 2007.

By virtualizing Exchange 2007, organizations can realize benefits that are not possible when running Exchange on native hardware. These benefits include dynamic resource optimization, live migration across physical servers, simplified and reduced evaluation and deployment cycles, rapid server provisioning, better leverage of high-performance 64-bit hardware and simplified disaster recovery. These benefits can translate into real business objectives of reduced IT costs, better use of IT resources, and increased reliability of the messaging environment.

#### 5.0 Take the Next Steps

For more information on this solution including the Reference Architecture document and Best Practices guide, please contact your EMC, VMware or Dell representative.

Figure 6: Server CPU utilization during LoadGen testing (Compares 2-way and 4-way physical server to 2vCPU and 4vCPU virtual machine)

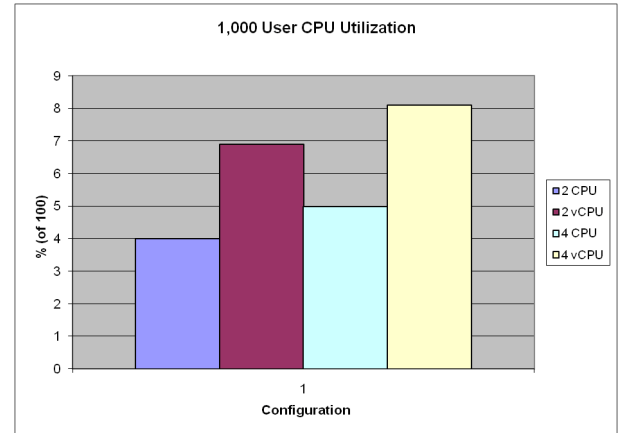
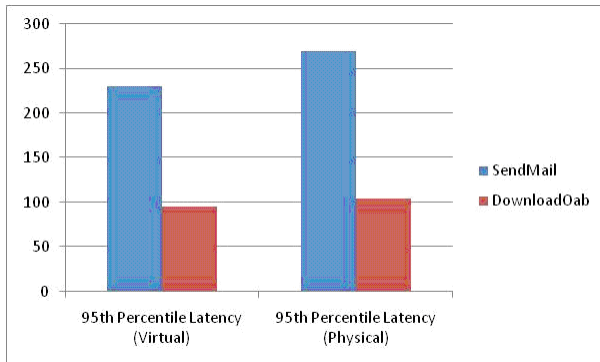


Figure 7: Sample latency measures during LoadGen test comparing virtual performance to native performance (95th percentile)



## 6.0 Microsoft Support Considerations

Since Exchange is a powerful business tool that is a core part of daily business for some companies, it is strongly encouraged that administrators understand the current support policies in place from Microsoft before undertaking this implementation. According to Microsoft KB article Q897615, Microsoft will use “commercially reasonable efforts” to investigate issues with Microsoft applications running with non-Microsoft hardware virtualization software for Microsoft customers with Premier-level support. This applies to all Microsoft products.

Many VMware partners also provide end-to-end support for Microsoft Software running in VMware environments. For the latest information on these policies, please see the following:

[http://www.vmware.com/support/policies/ms\\_support\\_statement.html](http://www.vmware.com/support/policies/ms_support_statement.html)

## 7.0 References

### VMware

- Deploying Microsoft Exchange in VMware Infrastructure: [http://www.VMware.com/pdf/exchange\\_best\\_practices.pdf](http://www.VMware.com/pdf/exchange_best_practices.pdf)

<sup>i</sup> Validation Test Report: EMC Solutions for Microsoft Exchange 2007 VMware Guest versus Physical Hardware EMC CLARiiON CX3 Series

<sup>ii</sup> VMware Infrastructure Adoption Trends – Customer Research Findings, December 2006

<sup>iii</sup> VMware Infrastructure Adoption Trends – Customer Research Findings, December 2006

<sup>iv</sup> Validation Test Report: EMC Solutions for Microsoft Exchange 2007 VMware Guest versus Physical Hardware EMC CLARiiON CX3 Series

<sup>v</sup> Validation Test Report: EMC Solutions for Microsoft Exchange 2007 VMware Guest versus Physical Hardware EMC CLARiiON CX3 Series

<sup>vi</sup> For testing purposes, physical systems had CPU and RAM capped using maxmem and numproc switches in the boot.ini file to match CPU and RAM resources of the Exchange virtual machine (12GB RAM and 2vCPU)

- Performance Tuning Best Practices for ESX Server 3: [http://www.VMware.com/pdf/vi\\_performance\\_tuning.pdf](http://www.VMware.com/pdf/vi_performance_tuning.pdf)
- Server Configuration Guide: [http://www.VMware.com/pdf/vi3\\_server\\_config.pdf](http://www.VMware.com/pdf/vi3_server_config.pdf)
- SAN Configuration Guide: [http://www.VMware.com/pdf/vi3\\_esx\\_san\\_cfg.pdf](http://www.VMware.com/pdf/vi3_esx_san_cfg.pdf)

### EMC

Access to these documents is based on your PowerLink login credentials. If you do not have access to the content listed below, contact your EMC representative:

- EMC Solutions for Microsoft Exchange 2007 on CLARiiON CX3 Series using VMware Virtual Infrastructure - Applied Best Practices Guide
- EMC VMware Guest vs. Physical Hardware Exchange 2007 CX3 Series Validation Test Report
- CLARiiON Integration with VMware ESX Server - Applied Technology white paper
- Replication Manager Product Guide
- Replication Manager Product Guide
- Replication Manager Administrator's Guide
- Replication Manager Support Matrix

Note: The validation test report is available only to EMC personnel and partners.

### Dell

- Dell TechCenter Community: <http://www.delltechcenter.com/page/Exchange+and+VMware>
- Dell PowerEdge: [http://www.dell.com/content/products/features.aspx/pedge\\_6850](http://www.dell.com/content/products/features.aspx/pedge_6850)
- Dell Resource website on VMware: <http://www.dell.com/content/topics/global.aspx/alliances/en/vmware?c=us&cs=555&l=en&s=biz>
- Dell whitepapers on Microsoft Exchange 2003: [http://www.dell.com/downloads/global/solutions/Dell\\_Exchange\\_SMB.pdf](http://www.dell.com/downloads/global/solutions/Dell_Exchange_SMB.pdf)
- <http://www.dell.com/downloads/global/power/ps1q05-20040216-Stanford.pdf>



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