

## ESRP Storage Program

# EMC CLARiiON AX4-5i (1,500 User) Storage Solution for Microsoft Exchange Server 2007 SP1

**Tested with:** ESRP - Storage Version 2.1  
**Tested Date:** June 24, 2008

**EMC Corporation**  
*Corporate Headquarters*  
Hopkinton, MA 01748-9103  
1-508-435-1000  
[www.EMC.com](http://www.EMC.com)

EMC believes the information in this publication is accurate as of its publication date. The information is subject to change without notice.

THE INFORMATION IN THIS PUBLICATION IS PROVIDED "AS IS." EMC CORPORATION MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WITH RESPECT TO THE INFORMATION IN THIS PUBLICATION, AND SPECIFICALLY DISCLAIMS IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Use, copying, and distribution of any EMC software described in this publication requires an applicable software license.

EMC<sup>2</sup>, EMC, EMC ControlCenter, AlphaStor, ApplicationXtender, Avamar, Captiva, Catalog Solution, Celerra, Centera, CentraStar, CLARAlert, CLARiiON, ClientPak, CodeLink, Connectrix, Co-StandbyServer, Dantz, Direct Matrix Architecture, DiskXtender, DiskXtender 2000, Documentum, EmailXaminer, EmailXtender, EmailXtract, eRoom, FLARE, HighRoad, InputAcce!, Invista, Max Retriever, Navisphere, NetWorker, nLayers, OpenScale, Powerlink, PowerPath, Rainfinity, RepliStor, ResourcePak, Retrospect, Smarts, SnapShotServer, SnapView/IP, SRDF, Symmetrix, TimeFinder, VisualSAN, VSAM-Assist, WebXtender, where information lives, Xtender, and Xtender Solutions are registered trademarks and EMC Developers Program, EMC OnCourse, EMC Proven, EMC Snap, EMC Storage Administrator, Acartus, Access Logix, ArchiveXtender, Authentic Problems, Automated Resource Manager, AutoStart, AutoSwap, AVALONidm, C-Clip, Celerra Replicator, CLARevent, Codebook Correlation Technology, Common Information Model, CopyCross, CopyPoint, DatabaseXtender, Direct Matrix, EDM, E-Lab, Enginuity, FarPoint, Global File Virtualization, Graphic Visualization, InfoMover, Infoscape, MediaStor, MirrorView, NetWin, OnAlert, PowerSnap, RepliCare, SafeLine, SAN Advisor, SAN Copy, SAN Manager, SDMS, SnapImage, SnapSure, SnapView, StorageScope, Support-Mate, SymmAPI, SymmEnabler, Symmetrix DMX, UltraPoint, UltraScale, Viewlets, and VisualSRM are trademarks of EMC Corporation.

All other trademarks used herein are the property of their respective owners.

**Copyright © 1998 - 2008 EMC Corporation. All rights reserved.**

Published August, 2008

EMC CLARiiON AX4-5i (1,500 User) Storage Solution for Microsoft Exchange Server 2007 SP1

Part Number: H5539

---

## Table of Contents

Overview .....	4
Disclaimer.....	4
Features.....	4
Solution description.....	5
Targeted customer profile.....	7
Tested deployment.....	8
Best practices.....	12
Test result summary.....	13
Conclusion.....	15
Contact information.....	16
Appendix A: Jetstress results.....	17
Appendix B: Mailbox count configurations .....	27

---

## Overview

This document provides information on the EMC®CLARiiON® AX4-5i 1,500 User Storage Solution for Microsoft Exchange Server 2007 based on the *Microsoft Exchange Solution Reviewed Program (ESRP) - Storage* program. For any questions or comments regarding the contents of this document, see the “[Contact information](#)” section.

*The ESRP - Storage* program was developed by Microsoft Corporation to provide a common storage testing framework for vendors to provide information on its storage solutions for Microsoft Exchange Server software. For more details on the Microsoft ESRP - Storage program, copy the following URL into your browser:

<http://www.microsoft.com/technet/prodtechnol/exchange/2007/esrp.msp>

---

## Disclaimer

This document has been produced independently of Microsoft Corporation. Microsoft Corporation expressly disclaims responsibility for, and makes no warranty—express or implied—with respect to the accuracy of the contents of this document.

The information contained in this document represents the current view of EMC on the issues discussed as of the date of publication. Due to changing market conditions, it should not be interpreted as a commitment on the part of EMC. In addition, EMC cannot guarantee the accuracy of any information presented after the date of publication.

---

## Features

The EMC CLARiiON AX4 is a versatile and cost-effective solution for organizations looking for an alternative to server-based storage. The EMC CLARiiON AX4-5i delivers performance, scalability, and advanced data management features in one easy-to-use storage solution.

Advanced capabilities start with the scalability to meet both the needs of today and the requirements of tomorrow. Single-controller EMC CLARiiON AX4-5i models are a low-cost approach to deploying external storage. They provide an economical storage platform for applications such as backup-to-disk and a variety of data archiving tasks. Dual-controller models offer the superior availability, connectivity, and performance that business-critical data and applications require.

- 12 drives per enclosure
- Scaling up to 60 drives through four expansion enclosures
- Up to 60 TB of capacity
- Storage for up to 64 hosts

With both iSCSI and Fibre Channel (FC) models, the EMC CLARiiON AX4-5i enables organizations to choose the network interconnection that is right for their environments. The EMC CLARiiON AX4-5i iSCSI arrays support cost-effective, shared storage by utilizing widely available IP networking components for direct-attach to a network, using conventional Ethernet switches. EMC CLARiiON AX4-5i arrays, using 4 Gb/s FC connections, utilize low-cost host bus adapters to provide cost-effective, direct-attach configurations with a wide range of SAN switch options to create SANs for up to 64 high-availability servers. Each controller supports two front-end ports: either 4 Gb/s FC or 1 Gb/s iSCSI.

The EMC CLARiiON AX4-5i can be equipped with serial-attached SCSI (SAS) for performance-oriented applications and serial ATA (SATA) drives to deliver the lowest cost per gigabyte and highest capacity per drive. The ability to mix SAS and SATA drives within each enclosure provides the most flexible and economical system configurations for all needs.

The EMC CLARiiON AX4-5i series delivers functionality that releases the benefits of tiered storage. It is the answer to storage consolidation for heterogeneous environments. It supports Windows, Linux, AIX, HP-UX, Solaris, and VMware.

---

## Solution description

The solution described in this document utilizes a single disk enclosure, with a total of six drives. This enables an organization to successfully deploy Microsoft Exchange with an EMC CLARiiON AX4-5i.

The log file drives are configured as EMC two-disk RAID 1\_0. In this configuration, organizations can run Microsoft Exchange on the minimum amount of drives for fault tolerance. In addition, an organization has the ability to grow quickly, using the EMC CLARiiON AX4-5i to stripe or concatenate additional drive sets (in this configuration, two drives at a time) as needed, with no downtime or data loss when space or increased fault tolerance is required.

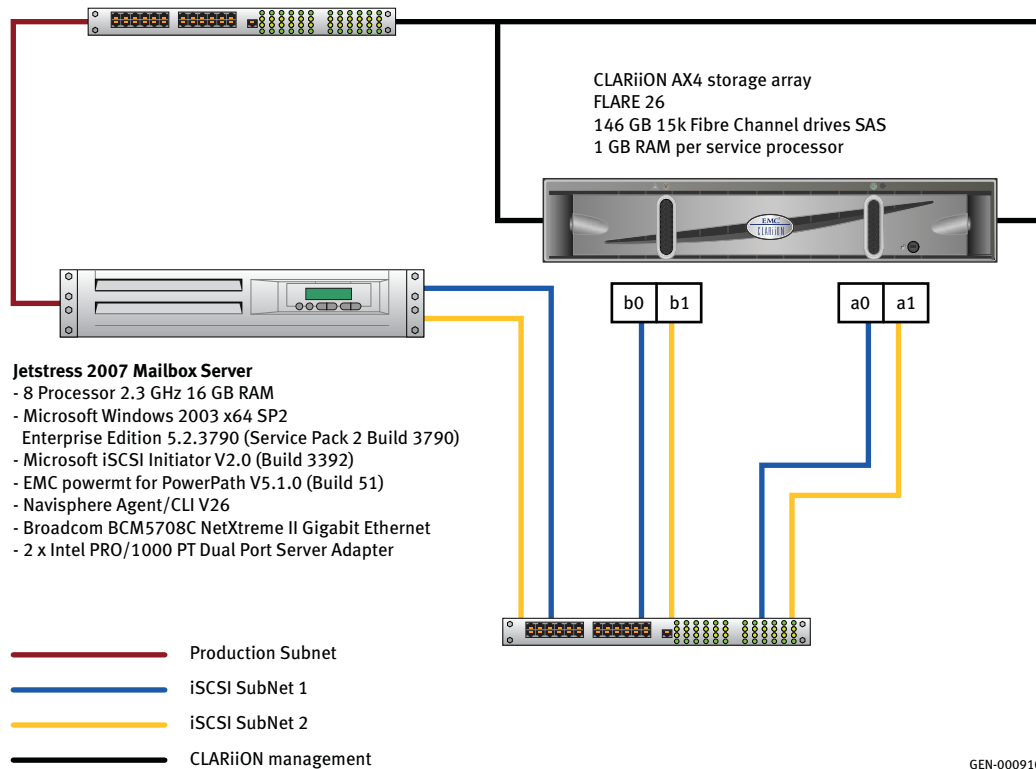
The database drives are configured as four-disk RAID 1\_0. In this configuration, organizations can run Exchange with the ability to quickly grow, using EMC CLARiiON to stripe or concatenate additional drives.

Sizing and configuring storage for use with the Microsoft Exchange Server is an intricate process, driven by many variables and factors that differ from one organization to another.

The method described in this ESRP submission is the *building block* method. When utilizing a low number of disks, organizations can use the building block method to simplify sizing and configuration to ensure the highest performance while staying fault tolerant.

The unit of measure—or building block—is designed to be scalable, based on the I/O and latency requirements of the customer. The building blocks are designed around the Microsoft Exchange database drives in increments, using RAID 1\_0 sets that give reproducible and scalable results as incremental building blocks are added.

Figure 1 illustrates the layout of the physical architecture.



GEN-000910

Figure 1 Physical architecture

The Windows Hardware Compatibility List link for the EMC CLARiiON AX4-5i is:

<http://www.windowsservercatalog.com/item.aspx?idItem=53f4f795-0c47-2df1-24b7-690341b1769e>

The ESRP-Storage program focuses on storage solution testing to address performance and reliability issues with storage design. However, storage is not the only factor to consider when designing a scalable Exchange solution. Other factors that affect the server scalability are:

- Server processor utilization
- Server physical and virtual memory limitations
- Resource requirements for other applications
- Directory and network service latencies
- Network infrastructure limitations
- Replication and recovery requirements
- Client usage profiles

Due to such variables, the number of mailboxes hosted per server, as part of the tested configuration, may not necessarily be viable for some customer deployments.

For more information on identifying and addressing performance bottlenecks in an Exchange system, see Microsoft's *Troubleshooting Microsoft Exchange Server Performance*, available at:

<http://go.microsoft.com/fwlink/?LinkId=23454>

---

## Targeted customer profile

This solution is intended for small and medium-sized businesses hosting 1,500 Exchange mailboxes. The configuration used for testing is described below:

- One host attached, up to 64 hosts possible
- User I/O profile of .40
- User mailbox size of 120 MB

## Tested deployment

The following tables summarize the tested environment.

### Simulated Exchange configuration

Table 1 lists the simulated Exchange configuration details.

**Table 1 Simulated Exchange configuration**

Item	Description
Number of Exchange mailboxes simulated	1,500
Number of hosts	1
Number of mailboxes/hosts	1,500
Number of storage groups/host	2
Number of mailbox stores/storage group	2
Number of mailboxes/mailbox store	750
Number of mailbox store LUNs/storage group	1
Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)	.5
Database LUN size	2:132 GB
Log LUN size	25 GB
Backup LUN size/storage group	N/A
Total database size for performance testing	228 GB
% formatted storage capacity used by Exchange database **	83%

\*\*Storage performance characteristics change based on the percentage utilization of the individual disks. Tests that use a small percentage of the storage (~25%) may exhibit reduced throughput if the storage capacity utilization is significantly increased beyond what is tested in this paper.

## Primary storage hardware

Table 2 lists the hardware used in the environment.

**Table 2 Hardware (list of all hardware used for the test)**

Item	Description
Storage type (FC, SAS, SATA, iSCSI)	iSCSI
Storage model and OS/firmware revision	<a href="http://www.windowsservercatalog.com/item.aspx?idItem=53f4f795-0c47-2df1-24b7-690341b1769e">http://www.windowsservercatalog.com/item.aspx?idItem=53f4f795-0c47-2df1-24b7-690341b1769e</a> EMC CLARiiON AX4-5i Firmware FLARE® V.26
Storage cache	1 GB
Number of storage controllers	2
Number of storage ports	4
Maximum bandwidth of storage connectivity to host	4 Gb/s
Switch type/model/firmware revision	Dell 5324 V2.0.0.39
HBA model and firmware	Intel PRO/1000 MT Network Connection
Number of HBAs/host	2
Host server type	[01]: EM64T Family 6 Model 15 Stepping 8 GenuineIntel ~2328 MHz [02]: EM64T Family 6 Model 15 Stepping 8 GenuineIntel ~2328 MHz [03]: EM64T Family 6 Model 15 Stepping 8 GenuineIntel ~2328 MHz [04]: EM64T Family 6 Model 15 Stepping 8 GenuineIntel ~2328 MHz Total Physical Memory: 15,743 MB
Total number of disks tested in solution	4
Maximum number of spindles that can be hosted in the storage	60

## Primary storage software

Table 3 lists the software used in the environment.

**Table 3 Software**

Item	Description
HBA driver	c:\windows\system32\drivers\ele5132.sys 9.9.13.0 built by: winDDK 6/19/2007 10:47am 348,568
HBA QueueTarget setting	N/A
HBA QueueDepth setting	N/A
Multipathing	Microsoft iSCSI Initiator Version 2.0 Build 3392 EMC powermt for PowerPath <sup>®</sup> version 5.1.0 (build 51)
Host OS	OS Name: Microsoft Windows Server 2003 Enterprise x64 Edition OS Version: 5.2.3790 Service Pack 1 Build 3790
ESE.dll file version	08.01.0240.005
Replication solution name/version	N/A

## Primary storage disk configuration (mailbox store disks)

Table 4 lists the disk configuration (mailbox store disks) for the environment.

**Table 4 Disk configuration (mailbox store)**

Item	Description
Disk type, speed and firmware revision	146 GB SAS 15k:E50A
Raw capacity per disk (GB)	133 GB
Number of physical disks in test	4
Total raw storage capacity (GB)	532 GB
Disk slice size (GB)	133 GB
Number of disks per LUN	4
RAID level	RAID 1_0

**Table 4 Disk configuration (mailbox store) (continued)**

<b>Item</b>	<b>Description</b>
Total formatted capacity	116 GB
Storage capacity utilization	50%
Database capacity utilization	42%

### Primary storage disk configuration (transactional log disks)

Table 5 lists the disk configuration (transactional log disks) for the environment.

**Table 5 Disk configuration**

<b>Item</b>	<b>Description</b>
Disk type, speed and firmware revision	146 GB SAS 15k:E50A
Raw capacity per disk (GB)	133 GB
Number of spindles in test	2
Total raw storage capacity (GB)	266 GB
Disk slice size	25
Number of slices per LUN or number of disks per LUN	2
RAID level	RAID 1_0
Total formatted capacity	50 GB

---

## Best practices

Microsoft Exchange Server is a disk-intensive application. It is characterized as a very bursty read/write operation to the database files, with a sequential (mostly 512 byte) write operation to the transaction logs. It is this random, bursty workload—with periods of high peaks—that makes designing a well-performing storage solution with Microsoft Exchange Server a challenge. Different corporate environments have different user and storage requirements, so storage design cannot be based simply on generalizations.

Based on the testing run using an ESRP framework, EMC recommends following these best practices to improve storage performance with Exchange solutions. For Microsoft's Exchange 2007 best practices on storage design, visit:

<http://technet.microsoft.com/en-us/library/bb124518.aspx>

1. Use diskpart (in Microsoft Windows 2003 SP2 x64) to align all disks used with Microsoft Exchange, using a value of 64 for CLARiiON. This aligns all of the Exchange-related NTFS partitions on a 64 KB boundary.
2. Isolate the Microsoft Exchange Database workload from other I/O intensive applications or workloads. This ensures the highest levels of performance for Microsoft Exchange and makes troubleshooting efforts easier in the event of a disk-related Microsoft Exchange performance issue.
3. TcpAckFrequency = 1 for each iSCSI connection. Refer to: <http://support.microsoft.com/kb/328890>
4. Size and configure the environment for spindle performance as a primary consideration, with storage capacity as secondary.
5. Configure iSCSI using PowerPath 5.1.0 utilizing a balanced path approach. Log in with NIC0 into the A0(Spa) and B0(Spb), and NIC1 into B1(Spb) and A1(Spa).
6. Tuning the AX4 storage system parameters is important in obtaining best performance. The following list details the optimal parameters for Exchange:
  - Cache page size of 8 KB
  - Balance read and write caching
  - Read and write cache enabled for all LUNs
  - Read cache minimum of 50-100 MB for prefetch

---

## Test result summary

This section provides a high-level summary of the test data from ESRP, as well as links to the detailed reports that are generated by the ESRP testing framework. The results are located in [“Appendix A: Jetstress results” on page 17](#).

---

### Reliability

A number of the tests in the framework are designed to test reliability over a 24-hour period. The goal of these tests is to verify that the storage can handle a high I/O load for a long period of time while replicating synchronously. Following the stress test, both log and database files are analyzed for integrity to ensure there is no database/log corruption.

- No errors were reported in the event log file for the storage reliability testing.
- No errors were reported for the database and log checksum.
- The backup-to-disk test is not applicable.
- No errors were reported during the database checksum on the remote storage database.

---

### Primary storage performance results

To see the Jetstress performance results (2-hour performance test), see the section [“Microsoft Exchange Server 2007 Jetstress - 2-hour performance” on page 17](#).

Performance testing exercises the storage with maximum sustainable Exchange-type I/O for two hours. The test is used to show how long it takes for the storage to respond to an I/O under load. The data included in the following tables is a sample taken from each of the attached hosts. It is the average of all the logical disks in the two-hour test duration.

Each server is listed separately, and the aggregate numbers across all servers are listed in [“Individual server metrics” on page 14](#).

**Individual server metrics**

The information in this table includes the sum of I/Os across storage groups and the average latency across all storage groups on a per-server basis.

<b>Database I/O</b>	
Database disks transfers/sec	673.73
Database disks reads/sec	315.119
Database disks writes/sec	358.611
Average database disk read latency (ms)	15
Average database disk write latency (ms)	6
<b>Transaction log I/O</b>	
Log disks writes/sec	193.173
Average log disk write latency (ms)	0.002

**Recovery performance**

The SoftRecovery test is to measure the read I/O performance metrics by running a checksum on all the databases and log files.

**Log read-only performance**

The test is to measure the maximum rate at which the log files can be played against the databases. The following table shows the average rate for 500 log files played in a single storage group. Each log file is 1 MB in size.

Average time to play one log file (sec)	0.775272547
---	-------------

**Streaming backup/recovery performance**

For the version 1.0 release, only streaming backup type is supported for testing in the framework. There are two tests in this section. The first one is to measure the read I/O performance metrics by running checksum on all the databases and log files. The second test is to measure the end-to-end performance when the databases are backed up to disks.

## Database read-only performance

The test is to measure the maximum rate at which databases could be streaming backed up. The following table shows the average rate for a single database file.

### Server 1

MB read/sec per storage group	46.345
MB read/sec total	92.69

---

## Conclusion

This document has been developed by EMC, and reviewed by the Microsoft Exchange Product team. The test results/data presented in this document are based on the tests introduced in the ESRP test framework. The customers should not quote the data directly for their predeployment verification. It is still necessary to go through the exercises to validate the storage design for a specific customer environment.

The ESRP program is not designed to be a benchmark program; tests are not designed to get the maximum throughput for a given solution. Rather, it is focused on producing recommendations from vendors for the Exchange application. Therefore, the data presented in this document should not be used for direct comparisons among the solutions.

## Contact information

EMC recommends that you consult with EMC Professional Services to assist with the design and deployment of a similar solution. For information about this or any other EMC solution, use the following numbers:

United States: **(800) 782-4362 (SVC-4EMC)**

Canada: **(800) 543-4782 (543-4SVC)**

Worldwide: **(508) 497-7901**

For additional information on EMC products and services available to customers and partners, refer to:

<http://EMC.com>

or to

<http://Powerlink.EMC.com>

## Appendix A: Jetstress results

This section provides a high-level summary of the test data from ESRP.

### Microsoft Exchange Server 2007 Jetstress - 2-hour performance

#### SoftRecovery Test Result Report

##### SoftRecovery statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance2308.1	500	385.25
Instance2308.2	509	397

##### Disk subsystem performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (K:)	0.126	0.026	677.240	12.198	(n/a)
Database (L:)	0.123	0.023	711.047	12.142	(n/a)
Log (I:)	0.001	0.001	41.886	1.460	2280.177
Log (J:)	0.001	0.000	42.056	1.366	1986.296

##### Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	3.205	1.346	9.082
Available MBytes	14891.646	14826.000	15355.000
Free System Page Table Entries	16757846.000	16757846.000	16757846.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	69743171.232	68661248.000	70713344.000
Pool Paged Bytes	49654235.798	49491968.000	50040832.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

**Test log**

8/5/2008 9:29:01 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft recovery\perf.xml"

8/5/2008 9:29:01 PM -- Jetstress testing begins ...

8/5/2008 9:29:01 PM -- Prepare testing begins ...

8/5/2008 9:29:04 PM -- Attaching databases ...

8/5/2008 9:29:04 PM -- Prepare testing ends.

8/5/2008 9:29:04 PM -- Dispatching transactions begins ...

8/5/2008 9:29:04 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)

8/5/2008 9:29:04 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

8/5/2008 9:29:06 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

8/5/2008 9:29:06 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

8/5/2008 9:29:07 PM -- Operation mix: Sessions 7, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

8/5/2008 9:29:07 PM -- Performance logging begins (interval: 15000 ms).

8/5/2008 9:29:07 PM -- Generating log files ...

8/5/2008 10:11:41 PM -- i: (100.2% generated), and j: (102.0% generated)

8/5/2008 10:11:42 PM -- Performance logging ends.

8/5/2008 10:11:42 PM -- JetInterop batch transaction stats: 13984, and 14118.

8/5/2008 10:11:42 PM -- Dispatching transactions ends.

8/5/2008 10:11:42 PM -- Shutting down databases ...

8/5/2008 10:11:42 PM -- Instance2308.1 (complete), and Instance2308.2 (complete)

8/5/2008 10:11:42 PM -- C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft recovery\Performance\_2008\_8\_5\_21\_29\_6.blg has 170 samples.

8/5/2008 10:11:42 PM -- Creating test report ...

8/5/2008 10:11:43 PM -- Volume K: has 0.0161 for Avg. Disk sec/Read.

8/5/2008 10:11:43 PM -- Volume L: has 0.0166 for Avg. Disk sec/Read.

8/5/2008 10:11:43 PM -- Volume I: has 0.0024 for Avg. Disk sec/Write.

8/5/2008 10:11:43 PM -- Volume I: has 0.0013 for Avg. Disk sec/Read.

8/5/2008 10:11:43 PM -- Volume J: has 0.0023 for Avg. Disk sec/Write.

8/5/2008 10:11:43 PM -- Volume J: has 0.0017 for Avg. Disk sec/Read.

8/5/2008 10:11:43 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

8/5/2008 10:11:43 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

8/5/2008 10:11:43 PM -- C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft recovery\Performance\_2008\_8\_5\_21\_29\_6.xml has 169 samples queried.

8/5/2008 10:11:43 PM -- C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft recovery\Performance\_2008\_8\_5\_21\_29\_6.html is saved.

8/5/2008 10:11:44 PM -- Performance logging begins (interval: 2000 ms).

8/5/2008 10:11:44 PM -- Recovering databases ...

8/5/2008 10:18:22 PM -- Performance logging ends.

8/5/2008 10:18:22 PM -- Instance2308.1 (385.25), and Instance2308.2 (397)

8/5/2008 10:18:22 PM -- C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft  
 recovery\SoftRecovery\_2008\_8\_5\_22\_11\_43.blg has 198 samples.  
 8/5/2008 10:18:22 PM -- Creating test report ...

## Microsoft Exchange Server SoftRecovery Test Result Report

### Performance test result report

#### Test summary

<b>Overall Test Result</b>	<b>Pass</b>
<b>Machine Name</b>	8B8MGD1
<b>Test Description</b>	
<b>Test Start Time</b>	8/5/2008 9:29:01 PM
<b>Test End Time</b>	8/5/2008 10:11:42 PM
<b>Jetstress Version</b>	08.02.0050.000
<b>Ese Version</b>	08.01.0240.005
<b>Operating System</b>	Microsoft Windows Server 2003 R2 Service Pack 2 (5.2.3790.131072)
<b>Performance Log</b>	C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft recovery\Performance_2008_8_5_21_29_6.blg

#### Database sizing and throughput

<b>Achieved I/O per Second</b>	640.521
<b>Capacity Percentage</b>	100%
<b>Target I/O per Second</b>	100%
<b>Initial database size</b>	229124112384
<b>Final database size</b>	229874892800
<b>Database files (count)</b>	2

**Jetstress system parameters**

<b>Thread count</b>	7 (per storage group)
<b>Log buffers</b>	9000
<b>Minimum database cache</b>	64.0 MB
<b>Maximum database cache</b>	512.0 MB
<b>Insert operations</b>	40%
<b>Delete operations</b>	30%
<b>Replace operations</b>	5%
<b>Read operations</b>	25%
<b>Lazy commits</b>	55%

**Disk subsystem performance**

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (K:)	0.016	0.006	143.045	175.145	(n/a)
Database (L:)	0.017	0.006	144.814	177.516	(n/a)
Log (I:)	0.001	0.002	0.049	96.983	4638.502
Log (J:)	0.002	0.002	0.050	98.424	4642.860

**Host system performance**

Counter	Average	Minimum	Maximum
% Processor Time	1.295	0.599	2.526
Available MBytes	14868.665	14831.000	15305.000
Free System Page Table Entries	16757846.000	16757846.000	16757846.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	68714688.753	68247552.000	68751360.000
Pool Paged Bytes	49533289.412	49369088.000	50233344.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

**Test log**

8/5/2008 9:29:01 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft recovery\perf.xml"

8/5/2008 9:29:01 PM -- Jetstress testing begins ...

8/5/2008 9:29:01 PM -- Prepare testing begins ...

8/5/2008 9:29:04 PM -- Attaching databases ...

8/5/2008 9:29:04 PM -- Prepare testing ends.

8/5/2008 9:29:04 PM -- Dispatching transactions begins ...

8/5/2008 9:29:04 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)

8/5/2008 9:29:04 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

8/5/2008 9:29:06 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

8/5/2008 9:29:06 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

8/5/2008 9:29:07 PM -- Operation mix: Sessions 7, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

8/5/2008 9:29:07 PM -- Performance logging begins (interval: 15000 ms).

8/5/2008 9:29:07 PM -- Generating log files ...

8/5/2008 10:11:41 PM -- i: (100.2% generated), and j: (102.0% generated)

8/5/2008 10:11:42 PM -- Performance logging ends.

8/5/2008 10:11:42 PM -- JetInterop batch transaction stats: 13984, and 14118.

8/5/2008 10:11:42 PM -- Dispatching transactions ends.

8/5/2008 10:11:42 PM -- Shutting down databases ...

8/5/2008 10:11:42 PM -- Instance2308.1 (complete), and Instance2308.2 (complete)

8/5/2008 10:11:42 PM -- C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft recovery\Performance\_2008\_8\_5\_21\_29\_6.blg has 170 samples.

8/5/2008 10:11:42 PM -- Creating test report ...

8/5/2008 10:11:43 PM -- Volume K: has 0.0161 for Avg. Disk sec/Read.

8/5/2008 10:11:43 PM -- Volume L: has 0.0166 for Avg. Disk sec/Read.

8/5/2008 10:11:43 PM -- Volume I: has 0.0024 for Avg. Disk sec/Write.

8/5/2008 10:11:43 PM -- Volume I: has 0.0013 for Avg. Disk sec/Read.

8/5/2008 10:11:43 PM -- Volume J: has 0.0023 for Avg. Disk sec/Write.

8/5/2008 10:11:43 PM -- Volume J: has 0.0017 for Avg. Disk sec/Read.

8/5/2008 10:11:43 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

8/5/2008 10:11:43 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

8/5/2008 10:11:43 PM -- C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\soft recovery\Performance\_2008\_8\_5\_21\_29\_6.xml has 169 samples queried.

## Microsoft Exchange Server 2007 Jetstress - 24-hour stress

### Stress test result report

#### Test summary

<b>Overall Test Result</b>	<b>Pass</b>
<b>Machine Name</b>	8B8MGD1
<b>Test Description</b>	
<b>Test Start Time</b>	8/6/2008 9:34:36 PM
<b>Test End Time</b>	8/7/2008 9:39:29 PM
<b>Jetstress Version</b>	08.02.0050.000
<b>Ese Version</b>	08.01.0240.005
<b>Operating System</b>	Microsoft Windows Server 2003 R2 Service Pack 2 (5.2.3790.131072)
<b>Performance Log</b>	C:\ax4q2\133GB R5 to 133GB r10\R10\ESRP R2\stress\Stress_2008_8_6_21_34_41.blg

#### Database sizing and throughput

<b>Achieved I/O per Second</b>	654.295
<b>Capacity Percentage</b>	100%
<b>Target I/O per Second</b>	100%
<b>Initial database size</b>	230975897600
<b>Final database size</b>	253199417344
<b>Database files (count)</b>	2

**Jetstress system parameters**

<b>Thread count</b>	7 (per storage group)
<b>Log buffers</b>	9000
<b>Minimum database cache</b>	64.0 MB
<b>Maximum database cache</b>	512.0 MB
<b>Insert operations</b>	40%
<b>Delete operations</b>	30%
<b>Replace operations</b>	5%
<b>Read operations</b>	25%
<b>Lazy commits</b>	55%

**Disk subsystem performance**

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (K:)	0.014	0.006	161.392	165.334	(n/a)
Database (L:)	0.015	0.006	161.751	165.817	(n/a)
Log (I:)	0.000	0.002	0.000	88.729	4889.178
Log (J:)	0.000	0.002	0.000	90.169	4815.152

**Host system performance**

Counter	Average	Minimum	Maximum
% Processor Time	1.460	0.352	3.672
Available MBytes	14764.773	14752.000	14815.000
Free System Page Table Entries	16757846.000	16757846.000	16757846.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	69671702.756	69509120.000	69718016.000
Pool Paged Bytes	118334848.000	118247424.000	118996992.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

**Test log**

8/6/2008 9:34:36 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\ax4q2\133GB R5 to 133GB r10\R10\ESRP R2\stress\perf.xml"

8/6/2008 9:34:36 PM -- Jetstress testing begins ...

8/6/2008 9:34:36 PM -- Prepare testing begins ...

8/6/2008 9:34:39 PM -- Attaching databases ...

8/6/2008 9:34:39 PM -- Prepare testing ends.

8/6/2008 9:34:39 PM -- Dispatching transactions begins ...

8/6/2008 9:34:39 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)

8/6/2008 9:34:39 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

8/6/2008 9:34:41 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.1 seconds/read).

8/6/2008 9:34:41 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.1 seconds/write).

8/6/2008 9:34:42 PM -- Operation mix: Sessions 7, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

8/6/2008 9:34:42 PM -- Performance logging begins (interval: 15000 ms).

8/6/2008 9:34:42 PM -- Attaining prerequisites:

8/6/2008 9:39:26 PM -- \MSEExchange Database(JetstressCmd)\Database Cache Size, Last: 483287000.0 (lower bound: 483183800.0, upper bound: none)

8/7/2008 9:39:28 PM -- Performance logging ends.

8/7/2008 9:39:28 PM -- JetInterop batch transaction stats: 421877, and 423087.

8/7/2008 9:39:28 PM -- Dispatching transactions ends.

8/7/2008 9:39:28 PM -- Shutting down databases ...

8/7/2008 9:39:29 PM -- Instance420.1 (complete), and Instance420.2 (complete)

8/7/2008 9:39:29 PM -- C:\ax4q2\133GB R5 to 133GB r10\R10\ESRP R2\stress\Stress\_2008\_8\_6\_21\_34\_41.blg has 5778 samples.

8/7/2008 9:39:29 PM -- Creating test report ...

8/7/2008 9:40:28 PM -- Volume K: has 0.0145 for Avg. Disk sec/Read.

8/7/2008 9:40:28 PM -- Volume L: has 0.0153 for Avg. Disk sec/Read.

8/7/2008 9:40:28 PM -- Volume I: has 0.0023 for Avg. Disk sec/Write.

8/7/2008 9:40:28 PM -- Volume I: has 0.0000 for Avg. Disk sec/Read.

8/7/2008 9:40:28 PM -- Volume J: has 0.0023 for Avg. Disk sec/Write.

8/7/2008 9:40:28 PM -- Volume J: has 0.0000 for Avg. Disk sec/Read.

8/7/2008 9:40:28 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

8/7/2008 9:40:28 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

8/7/2008 9:40:28 PM -- C:\ax4q2\133GB R5 to 133GB r10\R10\ESRP R2\stress\Stress\_2008\_8\_6\_21\_34\_41.xml has 5759 samples queried.

## JetStress streaming backup

### Microsoft Exchange Server Jetstress streaming backup test result report

#### Streaming backup statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance1948.1	109252.90	00:39:16	46.37
Instance1948.2	109252.90	00:39:18	46.32

#### Jetstress system parameters

Thread count	7 (per storage group)
Log buffers	9000
Minimum database cache	64.0 MB
Maximum database cache	512.0 MB
Insert operations	40%
Delete operations	30%
Replace operations	5%
Read operations	25%
Lazy commits	55%

#### Disk subsystem performance Disk subsystem performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (K:)	0.003	1.5521978021978E-05	371.170	0.009	(n/a)
Database (L:)	0.003	1.48062463851938E-05	370.683	0.011	(n/a)
Log (I:)	0.000	2.68315018315018E-05	0.000	0.006	24.615
Log (J:)	0.000	1.81818181818182E-05	0.000	0.005	28.643

**Host system performance**

Counter	Average	Minimum	Maximum
% Processor Time	7.693	6.745	8.659
Available MBytes	15379.038	15373.000	15382.000
Free System Page Table Entries	16758036.000	16758036.000	16758036.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	68057335.847	68038656.000	68538368.000
Pool Paged Bytes	48997969.529	48959488.000	49520640.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

**Test log**

8/5/2008 8:32:48 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\nobu\nobu.xml"

8/5/2008 8:32:48 PM -- Jetstress testing begins ...

8/5/2008 8:32:48 PM -- Prepare testing begins ...

8/5/2008 8:32:51 PM -- Attaching databases ...

8/5/2008 8:32:51 PM -- Prepare testing ends.

8/5/2008 8:32:54 PM -- Performance logging begins (interval: 15000 ms).

8/5/2008 8:32:54 PM -- Streaming backup databases ...

8/5/2008 9:12:14 PM -- Performance logging ends.

8/5/2008 9:12:14 PM -- Instance1948.1 (100% processed), and Instance1948.2 (100% processed)

8/5/2008 9:12:14 PM -- C:\ax4q2\133GB R5 to 133GB r10\ESRP R2\nobu\StreamingBackup\_2008\_8\_5\_20\_32\_51.blg has 157 samples.

8/5/2008 9:12:14 PM -- Creating test report ...

## Appendix B: Mailbox count configurations

Based on the performance of the test and approximate achieved 180 IOPS and a simulated profile of .40, the possible range of mailbox configurations is from 100 users with a 1,850 MB mailbox, up to 1,500 users with a 120 MB mailbox.

Table 6 displays the small- to medium-sized customer types suitable for this solution.

**Table 6** Range of mailbox configurations

Configuration	Host	Profile	User mailbox size
100 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	1850 MB
200 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	920 MB
300 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	610 MB
400 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	460 MB
500 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	370 MB
600 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	300 MB
700 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	260 MB
800 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	230 MB
900 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	200 MB
1000 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	180 MB
1100 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	160 MB
1200 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	150 MB

Table 6 Range of mailbox configurations

Configuration	Host	Profile	User mailbox size
1300 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	140 MB
1400 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	130 MB
1500 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	120 MB