

ESRP Storage Program

EMC CLARiiON AX4-5i (1,400 User) Storage Solution for Microsoft Exchange Server 2007 SP1

Tested with: ESRP - Storage Version 2.1
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EMC Corporation
Corporate Headquarters
Hopkinton, MA 01748-9103
1-508-435-1000
www.EMC.com

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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	30

Overview

This document provides information on the EMC®CLARiiON® AX4-5i 1,400 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>

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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 5. In this configuration, organizations can run Exchange with the ability to quickly grow, using EMC CLARiiON to stripe or concatenate additional drives.

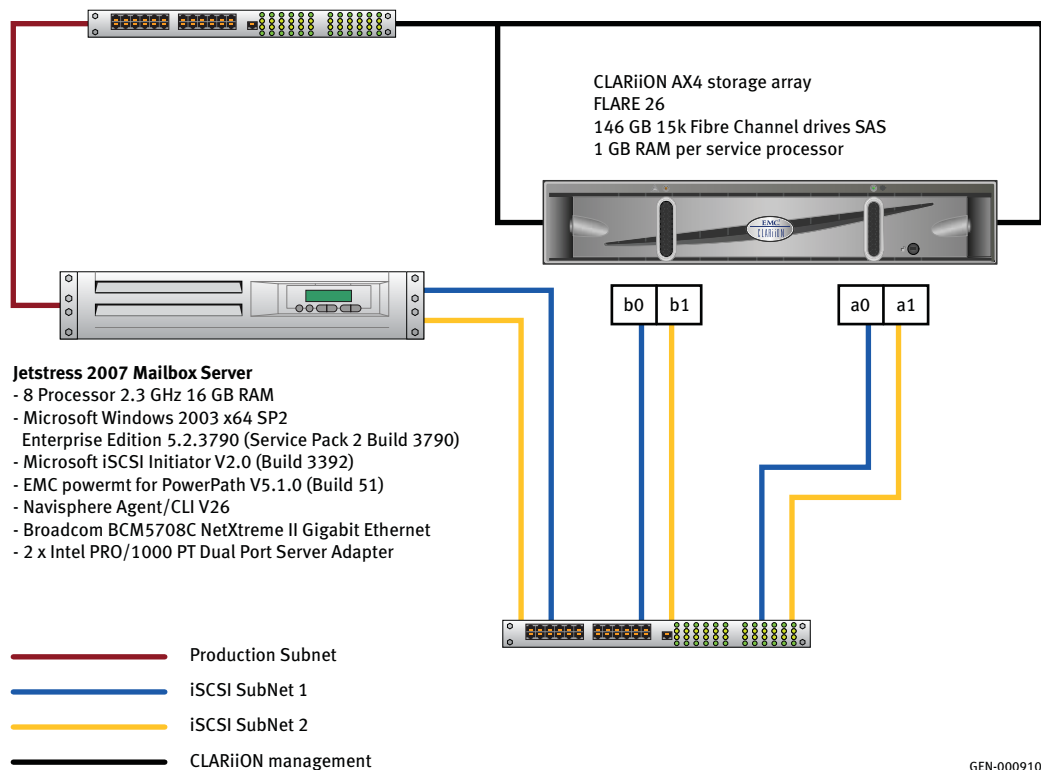
Customers using the RAID 5 configuration aim to utilize as much space as possible and also avail of the fault tolerance capabilities of RAID 5.

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 for RAID 5. 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 5 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 1,400 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 220 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	1,400
Number of hosts	1
Number of mailboxes/hosts	1,400
Number of storage groups/host	2
Number of mailbox stores/storage group	2
Number of mailboxes/mailbox store	700
Number of mailbox store LUNs/storage group	1
Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)	.5
Database LUN size	2:199.5 GB
Log LUN size	25 GB
Backup LUN size/storage group	N/A
Total database size for performance testing	334 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	http://www.windowservercatalog.com/item.aspx?idItem=53f4f795-0c47-2df1-24b7-690341b1769e 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 [®] 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)	199 GB
Number of disks per LUN	4
RAID level	RAID 5

Table 4 Disk configuration (mailbox store) (continued)

Item	Description
Total formatted capacity	399 GB
Storage capacity utilization	75%
Database capacity utilization	64%

Primary storage disk configuration (transactional log disks)

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

Table 5 Disk configuration

Item	Description
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), review 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.

Database I/O	
Database disks transfers/sec	592.486
Database disks reads/sec	274.574
Database disks writes/sec	317.912
Average database disk read latency (ms)	0.0175
Average database disk write latency (ms)	0.006
Transaction log I/O	
Log disks writes/sec	176.279
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)	0.543521266
---	-------------

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	42.35
MB read/sec total	84.7

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

Performance test result report

Test summary

Overall Test Result	Pass
Machine Name	8B8MGD1
Test Description	
Test Start Time	8/6/2008 1:43:24 PM
Test End Time	8/6/2008 3:48:42 PM
Jetstress Version	08.02.0050.000
Ese Version	08.01.0240.005
Operating System	Microsoft Windows Server 2003 R2 Service Pack 2 (5.2.3790.131072)
Performance Log	C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\perf\Performance_2008_8_6_13_43_28.blg

Database sizing and throughput

Achieved I/O per Second	592.487
Capacity Percentage	100%
Target I/O per Second	100%
Initial database size	229876989952
Final database size	231862992896
Database files (count)	2

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

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (O:)	0.017	0.006	137.987	160.157	(n/a)
Database (P:)	0.018	0.006	136.587	157.755	(n/a)
Log (M:)	0.000	0.002	0.000	88.278	4625.368
Log (N:)	0.000	0.002	0.000	88.001	4594.503

Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	1.168	0.352	2.201
Available MBytes	14837.677	14832.000	14880.000
Free System Page Table Entries	16757846.000	16757846.000	16757846.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70276736.000	70135808.000	70451200.000
Pool Paged Bytes	50126600.533	50065408.000	50192384.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test log

8/6/2008 1:43:23 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\perf\perf.xml"

8/6/2008 1:43:23 PM -- Jetstress testing begins ...

8/6/2008 1:43:24 PM -- Prepare testing begins ...

8/6/2008 1:43:26 PM -- Attaching databases ...

8/6/2008 1:43:26 PM -- Prepare testing ends.

8/6/2008 1:43:26 PM -- Dispatching transactions begins ...

8/6/2008 1:43:26 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)

8/6/2008 1:43:26 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

8/6/2008 1:43:28 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

8/6/2008 1:43:28 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

8/6/2008 1:43:29 PM -- Operation mix: Sessions 7, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

8/6/2008 1:43:29 PM -- Performance logging begins (interval: 15000 ms).

8/6/2008 1:43:29 PM -- Attaining prerequisites:

8/6/2008 1:48:39 PM -- \MSEExchange Database(JetstressCmd)\Database Cache Size, Last: 483344400.0 (lower bound: 483183800.0, upper bound: none)

8/6/2008 3:48:41 PM -- Performance logging ends.

8/6/2008 3:48:41 PM -- JetInterop batch transaction stats: 37373, and 37067.

8/6/2008 3:48:41 PM -- Dispatching transactions ends.

8/6/2008 3:48:41 PM -- Shutting down databases ...

8/6/2008 3:48:42 PM -- Instance564.1 (complete), and Instance564.2 (complete)

8/6/2008 3:48:42 PM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\perf\Performance_2008_8_6_13_43_28.blg has 500 samples.

8/6/2008 3:48:42 PM -- Creating test report ...

8/6/2008 3:48:45 PM -- Volume O: has 0.0171 for Avg. Disk sec/Read.

8/6/2008 3:48:45 PM -- Volume P: has 0.0180 for Avg. Disk sec/Read.

8/6/2008 3:48:45 PM -- Volume M: has 0.0024 for Avg. Disk sec/Write.

8/6/2008 3:48:45 PM -- Volume M: has 0.0000 for Avg. Disk sec/Read.

8/6/2008 3:48:45 PM -- Volume N: has 0.0024 for Avg. Disk sec/Write.

8/6/2008 3:48:45 PM -- Volume N: has 0.0000 for Avg. Disk sec/Read.

8/6/2008 3:48:45 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

8/6/2008 3:48:45 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

8/6/2008 3:48:45 PM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\perf\Performance_2008_8_6_13_43_28.xml has 479 samples queried.

Jetstress SoftRecovery

Microsoft Exchange Server Jetstress SoftRecovery test result report

SoftRecovery statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance352.1	500	276.25
Instance352.2	511	273.25

Disk subsystem performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (O:)	0.076	0.015	1063.356	17.209	(n/a)
Database (P:)	0.070	0.014	1098.283	17.665	(n/a)
Log (M:)	0.001	0.000	60.120	1.785	2801.155
Log (N:)	0.001	0.001	61.558	1.913	3054.560

Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	4.943	3.027	11.719
Available MBytes	14884.928	14814.000	15349.000
Free System Page Table Entries	16757846.000	16757846.000	16757846.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	69838758.957	68853760.000	70553600.000
Pool Paged Bytes	50297633.391	50065408.000	50622464.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test log

8/6/2008 11:58:34 AM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c
"C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\perf.xml"

8/6/2008 11:58:34 AM -- Jetstress testing begins ...

8/6/2008 11:58:34 AM -- Prepare testing begins ...

8/6/2008 11:58:36 AM -- Attaching databases ...

8/6/2008 11:58:36 AM -- Prepare testing ends.

8/6/2008 11:58:36 AM -- Dispatching transactions begins ...

8/6/2008 11:58:36 AM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)

8/6/2008 11:58:36 AM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

8/6/2008 11:58:38 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

8/6/2008 11:58:38 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

8/6/2008 11:58:39 AM -- Operation mix: Sessions 7, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

8/6/2008 11:58:39 AM -- Performance logging begins (interval: 15000 ms).

8/6/2008 11:58:39 AM -- Generating log files ...

8/6/2008 12:42:15 PM -- m: (100.2% generated), and n: (102.4% generated)

8/6/2008 12:42:16 PM -- Performance logging ends.

8/6/2008 12:42:16 PM -- JetInterop batch transaction stats: 14021, and 14263.

8/6/2008 12:42:16 PM -- Dispatching transactions ends.

8/6/2008 12:42:16 PM -- Shutting down databases ...

8/6/2008 12:42:17 PM -- Instance352.1 (complete), and Instance352.2 (complete)

8/6/2008 12:42:17 PM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\Performance_2008_8_6_11_58_38.blg has 174 samples.

8/6/2008 12:42:17 PM -- Creating test report ...

8/6/2008 12:42:17 PM -- Volume O: has 0.0167 for Avg. Disk sec/Read.

8/6/2008 12:42:17 PM -- Volume P: has 0.0176 for Avg. Disk sec/Read.

8/6/2008 12:42:17 PM -- Volume M: has 0.0024 for Avg. Disk sec/Write.

8/6/2008 12:42:17 PM -- Volume M: has 0.0002 for Avg. Disk sec/Read.

8/6/2008 12:42:17 PM -- Volume N: has 0.0023 for Avg. Disk sec/Write.

8/6/2008 12:42:17 PM -- Volume N: has 0.0003 for Avg. Disk sec/Read.

8/6/2008 12:42:17 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

8/6/2008 12:42:17 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

8/6/2008 12:42:17 PM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\Performance_2008_8_6_11_58_38.xml has 173 samples queried.

8/6/2008 12:42:18 PM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\Performance_2008_8_6_11_58_38.html is saved.

8/6/2008 12:42:18 PM -- Performance logging begins (interval: 2000 ms).

8/6/2008 12:42:18 PM -- Recovering databases ...

8/6/2008 12:46:55 PM -- Performance logging ends.

8/6/2008 12:46:55 PM -- Instance352.1 (276.25), and Instance352.2 (273.25)

8/6/2008 12:46:55 PM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\SoftRecovery_2008_8_6_12_42_18.blg has 138 samples.

8/6/2008 12:46:55 PM -- Creating test report ...

Microsoft Exchange Server Jetstress SoftRecovery test result report

Test summary

Overall Test Result	Pass
Machine Name	8B8MGD1
Test Description	
Test Start Time	8/6/2008 11:58:34 AM
Test End Time	8/6/2008 12:42:17 PM
Jetstress Version	08.02.0050.000
Ese Version	08.01.0240.005
Operating System	Microsoft Windows Server 2003 R2 Service Pack 2 (5.2.3790.131072)
Performance Log	C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\Performance_2008_8_6_11_58_38.blg

Database sizing and throughput

Achieved I/O per Second	629.998
Capacity Percentage	100%
Target I/O per Second	100%
Initial database size	229124112384
Final database size	229881184256
Database files (count)	2

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

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (O:)	0.017	0.006	140.237	172.180	(n/a)
Database (P:)	0.018	0.006	142.474	175.106	(n/a)
Log (M:)	0.000	0.002	0.003	93.798	4612.997
Database (N:)	0.000	0.002	0.003	96.960	4581.128

Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	1.274	0.417	2.461
Available MBytes	14861.385	14824.000	15298.000
Free System Page Table Entries	16757846.000	16757846.000	16757846.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	69389370.851	68866048.000	69451776.000
Pool Paged Bytes	50210156.874	49991680.000	51040256.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test log

8/6/2008 11:58:34 AM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\perf.xml"

8/6/2008 11:58:34 AM -- Jetstress testing begins ...

8/6/2008 11:58:34 AM -- Prepare testing begins ...

8/6/2008 11:58:36 AM -- Attaching databases ...

8/6/2008 11:58:36 AM -- Prepare testing ends.

8/6/2008 11:58:36 AM -- Dispatching transactions begins ...

8/6/2008 11:58:36 AM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)

8/6/2008 11:58:36 AM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

8/6/2008 11:58:38 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

8/6/2008 11:58:38 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

8/6/2008 11:58:39 AM -- Operation mix: Sessions 7, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

8/6/2008 11:58:39 AM -- Performance logging begins (interval: 15000 ms).

8/6/2008 11:58:39 AM -- Generating log files ...

8/6/2008 12:42:15 PM -- m: (100.2% generated), and n: (102.4% generated)

8/6/2008 12:42:16 PM -- Performance logging ends.

8/6/2008 12:42:16 PM -- JetInterop batch transaction stats: 14021, and 14263.

8/6/2008 12:42:16 PM -- Dispatching transactions ends.

8/6/2008 12:42:16 PM -- Shutting down databases ...

8/6/2008 12:42:17 PM -- Instance352.1 (complete), and Instance352.2 (complete)

8/6/2008 12:42:17 PM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\Performance_2008_8_6_11_58_38.blg has 174 samples.

8/6/2008 12:42:17 PM -- Creating test report ...

8/6/2008 12:42:17 PM -- Volume O: has 0.0167 for Avg. Disk sec/Read.

8/6/2008 12:42:17 PM -- Volume P: has 0.0176 for Avg. Disk sec/Read.

8/6/2008 12:42:17 PM -- Volume M: has 0.0024 for Avg. Disk sec/Write.

8/6/2008 12:42:17 PM -- Volume M: has 0.0002 for Avg. Disk sec/Read.

8/6/2008 12:42:17 PM -- Volume N: has 0.0023 for Avg. Disk sec/Write.

8/6/2008 12:42:17 PM -- Volume N: has 0.0003 for Avg. Disk sec/Read.

8/6/2008 12:42:17 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

8/6/2008 12:42:17 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

8/6/2008 12:42:17 PM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\soft recovery\Performance_2008_8_6_11_58_38.xml has 173 samples queried.

Microsoft Exchange Server 2007 Jetstress - 24-hour stress

Stress test result report

Test summary

Overall Test Result	Pass
Machine Name	8B8MGD1
Test Description	
Test Start Time	8/7/2008 11:58:09 PM
Test End Time	8/9/2008 12:03:37 AM
Jetstress Version	08.02.0050.000
Ese Version	08.01.0240.005
Operating System	Microsoft Windows Server 2003 R2 Service Pack 2 (5.2.3790.131072)
Performance Log	C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\stress\Stress_2008_8_7_23_58_14.blg

Database sizing and throughput

Achieved I/O per Second	555.302
Capacity Percentage	100%
Target I/O per Second	100%
Initial database size	228482383872
Final database size	248352899072
Database files (count)	2

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

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (O:)	0.017	0.006	135.914	141.300	(n/a)
Database (P:)	0.018	0.006	136.184	141.904	(n/a)
Log (M:)	0.000	0.003	0.000	78.059	4752.949
Log (N:)	0.000	0.002	0.000	78.684	4721.962

Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	1.231	0.273	3.138
Available MBytes	14692.112	14679.000	14726.000
Free System Page Table Entries	16757846.000	16757846.000	16757846.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	69236307.911	69210112.000	69406720.000
Pool Paged Bytes	187751797.333	187641856.000	188362752.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test log

8/7/2008 11:58:09 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\stress\perf.xml"

8/7/2008 11:58:09 PM -- Jetstress testing begins ...

8/7/2008 11:58:09 PM -- Prepare testing begins ...

8/7/2008 11:58:12 PM -- Attaching databases ...

8/7/2008 11:58:12 PM -- Prepare testing ends.

8/7/2008 11:58:12 PM -- Dispatching transactions begins ...

8/7/2008 11:58:12 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)

8/7/2008 11:58:12 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

8/7/2008 11:58:14 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.1 seconds/read).

8/7/2008 11:58:14 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.1 seconds/write).

8/7/2008 11:58:15 PM -- Operation mix: Sessions 7, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

8/7/2008 11:58:15 PM -- Performance logging begins (interval: 15000 ms).

8/7/2008 11:58:15 PM -- Attaining prerequisites:

8/8/2008 12:03:31 AM -- \MSExchange Database(JetstressCmd)\Database Cache Size, Last: 483246100.0 (lower bound: 483183800.0, upper bound: none)

8/9/2008 12:03:33 AM -- Performance logging ends.

8/9/2008 12:03:33 AM -- JetInterop batch transaction stats: 363269, and 363791.

8/9/2008 12:03:35 AM -- Dispatching transactions ends.

8/9/2008 12:03:35 AM -- Shutting down databases ...

8/9/2008 12:03:37 AM -- Instance3004.1 (complete), and Instance3004.2 (complete)

8/9/2008 12:03:37 AM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\stress\Stress_2008_8_7_23_58_14.blg has 5781 samples.

8/9/2008 12:03:37 AM -- Creating test report ...

8/9/2008 12:04:36 AM -- Volume O: has 0.0175 for Avg. Disk sec/Read.

8/9/2008 12:04:36 AM -- Volume P: has 0.0181 for Avg. Disk sec/Read.

8/9/2008 12:04:36 AM -- Volume M: has 0.0025 for Avg. Disk sec/Write.

8/9/2008 12:04:36 AM -- Volume M: has 0.0000 for Avg. Disk sec/Read.

8/9/2008 12:04:36 AM -- Volume N: has 0.0025 for Avg. Disk sec/Write.

8/9/2008 12:04:36 AM -- Volume N: has 0.0000 for Avg. Disk sec/Read.

8/9/2008 12:04:36 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.

8/9/2008 12:04:36 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

8/9/2008 12:04:36 AM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\stress\Stress_2008_8_7_23_58_14.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
Instance1244.1	109252.90	00:42:57	42.39
Instance1244.2	109252.90	00:43:02	42.31

Jetstress system parameters

Thread count	7 (per storage group)
Log buffers	9000
Minimum database cache	32.0 MB
Maximum database cache	256.0 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 (o:)	0.003	2.08674463937622E-05	Database (o:)	0.003	2.08674463937622E-05
Database (P:)	0.003	1.28167641325536E-05	Database (P:)	0.003	1.28167641325536E-05
Log (M:)	0.000	3.01587301587302E-05	Log (M:)	0.000	3.01587301587302E-05
Log (N:)	0.000	1.64578111946533E-05	Log (N:)	0.000	1.64578111946533E-05

Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	6.980	6.328	8.464
Available MBytes	15374.721	15358.000	15377.000
Free System Page Table Entries	16757846.000	16757846.000	16757846.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	68671392.744	68661248.000	69169152.000
Pool Paged Bytes	49842295.070	49815552.000	50597888.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test log

8/6/2008 10:51:00 AM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\nobu\perf.xml"

8/6/2008 10:51:00 AM -- Jetstress testing begins ...

8/6/2008 10:51:00 AM -- Prepare testing begins ...

8/6/2008 10:51:03 AM -- Attaching databases ...

8/6/2008 10:51:03 AM -- Prepare testing ends.

8/6/2008 10:51:06 AM -- Performance logging begins (interval: 15000 ms).

8/6/2008 10:51:06 AM -- Streaming backup databases ...

8/6/2008 11:34:09 AM -- Performance logging ends.

8/6/2008 11:34:09 AM -- Instance1244.1 (100% processed), and Instance1244.2 (100% processed)

8/6/2008 11:34:09 AM -- C:\ax4q2\133GB R5 to 133GB r10\R54drive\R5 ESRP R2\nobu\StreamingBackup_2008_8_6_10_51_3.blg has 172 samples.

8/6/2008 11:34:09 AM -- 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 30 GB mailbox, up to 1,400 users with a 220 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	3 GB
200 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	1.5 GB
300 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	1 GB
400 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	790 MB
500 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	630 MB
600 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	530 MB
700 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	450 MB
800 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	390 MB
900 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	350 MB
1000 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	310 MB
1100 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	290 MB

Table 6 Range of mailbox configurations

Configuration	Host	Profile	User mailbox size
1200 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	260 MB
1300 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	240 MB
1400 mailboxes	One host attached; up to 64 hosts possible	User I/O profile .40	220 MB

