

**ESRP Storage Program
EMC Celerra NX4 (500 User)
Mailbox Resiliency Storage Solution for
Microsoft Exchange 2010**

Tested with: ESRP – Storage Version 3.0
Tested Date: 06/25/2010

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Overview

This document provides information on an EMC® Celerra® NX4 storage solution for Microsoft Exchange Server, based on the *Microsoft Exchange Solution Reviewed Program (ESRP) – Storage* program*. For any questions or comments regarding the contents of this document, see [Contact Information](#).

*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, visit the website at <http://www.microsoft.com/technet/prodtechnol/exchange/2007/esrp.mspx>.

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Features

This document describes an approach that can be used to configure Microsoft Exchange 2010 with an EMC Celerra NX4 storage system.

EMC Celerra NX4 meets the storage needs of a wide range of applications that include:

- Mail or messaging
- Databases
- File or print and web services
- Distributed applications
- Remote replication

In addition, NX4 supports a wide range of server operating systems such as Microsoft Windows, Linux, Solaris, AIX, and HP-UX.

Celerra NX4 is a high-performance, full-function Internet Protocol (IP) storage platform. It delivers network-attached storage (NAS) and Internet SCSI (iSCSI) capabilities to consolidate application storage and file servers. Easy to deploy and simple to manage, the NX4 is unified IP storage for

customers looking for enterprise-class capabilities packaged for specific application, departments, and locations.

Celerra NX4 also supports 10 gigabit Ethernet (GbE) optical Fibre Channel (FC) connections.

Regardless of the configuration, Celerra platforms offer a full suite of advanced functionality:

- Robust snap and replication capabilities offer protection of data
- The Celerra File Mover application programming interface (API) offers automated policy-based movement of files between tiers of storage
- File-Level Retention (FLR) provides disk-based Write Once Read Many (WORM) functionality, which is useful for archiving Exchange e-mails
- Automated volume management and Virtual Provisioning™ improve storage utilization
- Celerra deduplication with compression eliminates redundant data and can reduce file system capacity up to 50 percent

The performance results and best practices described in this document provide proven guidelines for configuring Celerra NX4 for high-performance Exchange e-mail environments. For this solution, an integrated Celerra NX4 storage system with 600 GB 10k rpm SAS disks was used and configured for 500 Exchange 2010 users. Each of the 500 users consisted of a 150 messages/sent/received/user/day profile of 0.18 IOPS and a mailbox size of 3 GB.

Solution Description

This solution is intended for small to medium size businesses that plan to deploy Exchange 2010 on the EMC storage and for businesses that will utilize the Database Availability Group (DAG) feature introduced in Exchange Server 2010. The solution design represents an Exchange 2010 environment that supports 500 users in a mailbox resiliency configuration across two Celerra NX4 storage arrays. This solution is designed to provide an excellent performance and flexibility for the present and future needs of Exchange users.

The solution design provides a configuration with no single point of failure, where each Exchange database is RAID-protected by a NX4 array and replicated to a different server on a secondary array. All 500 users in this solution are placed in one DAG across three mailbox servers (two servers in the primary site and one in the remote site). The DAG was designed with three copies of the Exchange databases (two copies on one NX4 storage array and the third copy on the other NX4 array in the secondary site). The two mailbox servers that reside in the primary site are designed to support 500 users in the active/passive configuration — 250 active users during normal operation and 500 users in case of database switchover from the other mailbox server in the same site. That is, if the Exchange mailbox

server within the same site fails, its passive copies are activated on the other local DAG member within the site.

Note: This configuration can also be compared to a design where Exchange 2010 is deployed in a stand-alone configuration (no DAG), and where a single Celerra NX4 array provides service to all 500 users on a single mailbox server.

In this particular testing, one server was used to simulate the Exchange environment.

[Table 1](#) describes the characteristics of the storage configuration.

Table 1: Storage configuration

Number of users	500
Number of Exchange servers	3
IOPS per user	0.18 (including 20% overhead)
Mailbox size	3 GB
Number of disks required for databases and logs	6
Disk type	600 GB 10k SAS drives
RAID type	RAID 5 (5+1)

Using the performance characteristics of Celerra NX4 architecture, disk drives (600 GB, 10k) and six spindles with I/O capability are required to provide the necessary performance to match the I/O requirements of 500 users with 0.18 IOPS and a 3:2 read/write ratio.

Figure 1 shows the reference architecture for the tested Exchange solution on Celerra NX4.

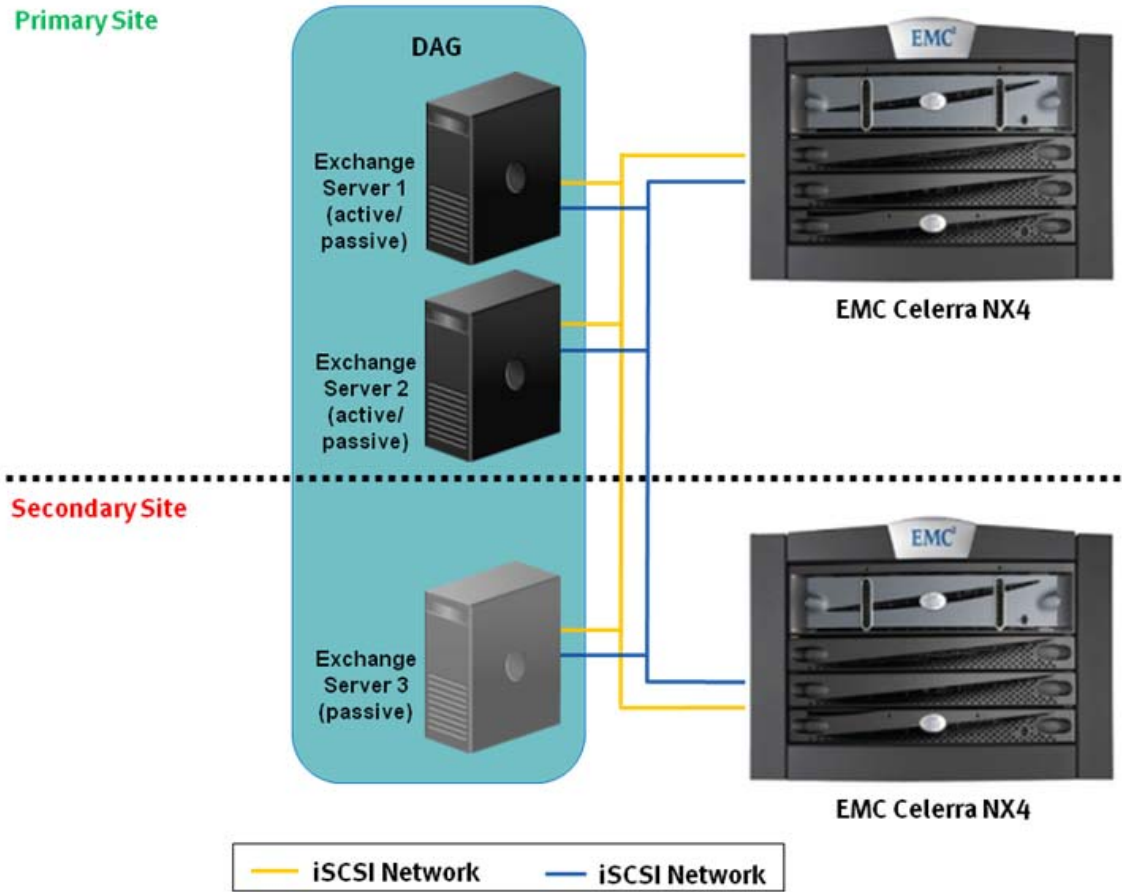


Figure 1: Reference architecture

Figure 2 shows the disk layout for the tested Exchange solution on Celerra NX4. A 5+1 RAID 5 group is used for this solution. On the RAID group, four logical unit numbers (LUNs) are created to host two Exchange databases and its logs. The 500 users are evenly distributed among two Exchange databases.

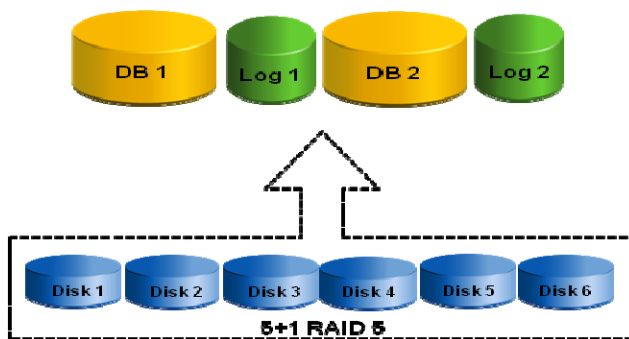


Figure 2: Disk configuration

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 take into consideration when designing a scale-up Exchange solution. Other factors that affect the server scalability are server processor utilization, physical server and virtual machine memory limitations, resource requirements for other applications, directory and network service latencies, network infrastructure limitations, replication and recovery requirements, and client usage profiles. All these factors are beyond the scope for ESRP-Storage.

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, refer to Troubleshooting Microsoft Exchange Server Performance, available at <http://technet.microsoft.com/en-us/library/dd335215.aspx>.

Targeted Customer Profile

The solution is intended for small-to-medium Exchange customers to consolidate Exchange users on a high-performance, highly-available storage platform. This solution is designed to support 500 Exchange users with the following assumptions:

- Three Exchange servers — two in the primary site in active/passive configuration and one in the secondary site (one tested and simulating 500 users in a switchover or failover condition)
- 150 messages user profile — 0.15 IOPS per user (0.18 tested for 20 percent headroom)
- 3 GB mailbox size
- Native Exchange 2010 DAG is used for mailbox resiliency and high availability. These features function as the primary data protection mechanism for Exchange data.
- 24x7 background database maintenance enabled
- Two Celerra NX4 storage systems (one tested)

Tested Deployment

The tables in this section summarize the testing environment.

Simulated Exchange Configuration

Table 2 describes the simulated exchange configuration.

Table 2: Simulated Exchange configuration

Number of Exchange mailboxes simulated	500
Number of DAGs	1
Number of servers/DAG	3
Number of active mailboxes/server	500
Number of databases/host	2
Number of copies/database	3
Number of mailboxes/database	250
Simulated profile: IOPS per mailbox (include 20% headroom)	0.18
Database LUN size	1.2 TB
Log LUN size	50 GB
Total database size for performance testing	2,014 GB
% storage capacity used by Exchange database**	82%

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

Storage Hardware

Table 3 describes the storage hardware.

Table 3: Hardware

Storage connectivity (FC, SAS, SATA, iSCSI)	iSCSI
Storage model and OS/firmware revision	EMC Celerra NX4 and EMC DART 5.6.49.3
Storage cache	2 GB split for read/write
Number of storage controllers	4 (2 front end and 2 back end)
Number of storage ports	4 (total 8 ports of which 4 are passive or redundant)
Maximum bandwidth of storage connectivity to host	2 x 1 Gb/s iSCSI, total bandwidth 2 Gb/s
Switch type/model/firmware revision	Cisco/6509-E/IOS version 12.2

HBA model and firmware	Broadcom BCM5708C NetXtreme II GigE (NDIS VBD Client) without jumbo frames enabled
Number of HBAs/host	2 dual-port HBAs
Host server type	Server 2950 with 4 x Intel 2.99 GHz Xeon CPU and 32 GB memory
Total number of disks tested in solution	6
Maximum number of spindles that can be hosted in the storage	60

Storage Software

Table 4 describes the storage software.

Table 4: Storage software

HBA driver	Microsoft iSCSI software initiator inbuilt with Microsoft Windows Server 2008 R2 64-bit
HBA QueueTarget Setting	N/A
HBA QueueDepth Setting	N/A
Multipathing	MCS with round-robin policy
Host OS	Microsoft Windows Server 2008 R2 64-bit
ESE.dll file version	14.00.0639.019
Replication solution name/version	N/A

Storage Disk Configuration (Mailbox Store Disks)

Table 5 lists the storage disk configuration for the environment

Table 5: Storage disk configuration

Disk type, speed, and firmware revision	10k rpm SAS disks
Raw capacity per disk (GB)	600 GB
Number of physical disks in test	6
Total raw storage capacity (GB)	3,600 GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	6 disks per two LUNs
RAID-level	RAID 5 (5+1)
Total formatted capacity	2,682.5 GB
Storage capacity utilization	75%
Database capacity utilization	56%

Storage Disk Configuration (Transactional Log Disks)

Table 6 describes the storage disk configuration of transactional log disks for the environment. The transactional log disk utilizes the same disks as the mailbox store database.

Table 6: Storage disk configuration

Disk type, speed, and firmware revision	10k rpm SAS disks
Raw capacity per disk (GB)	600 GB
Number of spindles in test	6
Total raw storage capacity (GB)	3,600 GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	6 disks per two LUNs
Raid level	RAID 5 (5+1)
Total formatted capacity	2,682.5 GB

Best Practices

In this solution, each RAID 5 (5+1) configuration satisfies the capacity and performance requirements for 500 users with a mailbox size of 3 GB and a user profile of 0.18 IOPS (including 20 percent overhead), ensuring that response times remain well within the required Microsoft thresholds. Once the number of disks is determined for the original Exchange data, this number must be scaled up to satisfy each copy of the data within a DAG.

Microsoft Exchange Server 2010 has changed significantly since early versions of Exchange, particularly when it comes to I/O and storage. There have been many changes to the core schema and the extensible storage engine (ESE) to reduce I/O. The changes also enable the use of RAID 5 as an optimal RAID configuration.

For more information on EMC solutions for Microsoft Exchange Server, refer:

<http://www.emc.com/solutions/application-environment/microsoft/solutions-for-microsoft-exchange-unified-communications.htm>

Exchange Server is a disk-intensive application. Based on the testing run, using the ESRP framework, EMC recommends the Exchange 2010 best practices to improve the storage performance.

Core Storage

Based on the testing run, using an ESRP framework, EMC recommends the following best practices to improve the storage performance with Exchange solutions:

1. Use the default alignment (in Microsoft Windows 2008) while creating volumes for Microsoft Exchange-related disks. Format the iSCSI disks with a 64 KB boundary.
2. Isolate the Microsoft Exchange Server database workload from other I/O-intensive applications or workloads. This ensures the highest level of performance for Exchange and simplifies troubleshooting in the event of a disk-related Microsoft Exchange performance issue.
3. When DAG is used with a minimum of three database copies, the maximum database size can be up to 2 TB.
4. Performance and capacity should be the primary consideration while sizing and configuring the disks. In other words, keep the mailbox size requirement in mind while tuning for the best performance.
5. The network traffic between Exchange Server and the storage for iSCSI traffic should be isolated from the management network and other networks in the data center to get best performance.

Backup Strategy

N/A

Contact Information

EMC recommends you to consult the EMC professional services to assist with the design and development of a similar solution. For information regarding 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 <http://powerlink.EMC.com>.

Test Result Summary

This section provides a high-level summary of the test data from ESRP and the link to the detailed HTML reports, which are generated by the ESRP testing framework.

Reliability

A number of tests in the framework are to check reliability tests run for 24 hours. The goal is to verify if the storage can handle high I/O load for a long period of time. Both log and database files are analyzed for integrity after the stress test to ensure that there is no database or log corruption.

The reliability test executed on EMC Celerra NX4 provided the following results:

- No errors reported on the event log file for storage reliability testing
- No errors reported during the database and log checksum process

[Appendix B: Stress Test Report \(24-hour performance test\)](#) on page 18 provides the Jetstress performance results (24-hour performance test).

Storage Performance Results

The primary storage performance testing is designed to exercise the storage with a maximum sustainable Exchange type of I/O for two hours. The test is to show how long it takes for the storage to respond to an I/O under load. The following data is the sum of the logical disk I/Os and the average of all the logical disk I/O latency in the two-hour test duration.

Individual Server Metrics

[Table 7](#) shows the sum of I/Os across all databases and the average latency across all databases on the Exchange Server.

Table 7: Individual server metrics

Database I/O	
Database Disks Transfers/sec	122.1
Database Disks Reads/sec	75
Database Disks Writes/sec	47.1
Average Database Disk Read Latency (ms)	9.5
Average Database Disk-Write Latency (ms)	3.2
Transaction log I/O	
Log Disks Writes/sec	45.964
Average Log Disk-Write Latency (ms)	1.5835

[Appendix C: Performance Test Results](#) on page 23 provides the two-hour Jetstress performance test results.

Appendix D: Maximum Solution IOPS Test on page 28 provides results that characterize the maximum performance of the disk layout.

Database Backup/Recovery Performance

There are two test reports in this section. The first test is to measure the sequential read rate of the database files and the second test is to measure the recovery/replay performance (playing transaction logs in to the database).

Database Read-Only Performance

The test is to measure the maximum rate at which databases could be backed up using VSS.

Table 8 shows the average rate for a single database file.

Table 8: Database read-only performance

MB read/sec per database	64.72
MB read/sec total per server	129.44

Transaction Log Recovery/Replay Performance

This test is to measure the maximum rate at which the log files can be replayed against the databases.

Table 9 shows the average rate for 500 log files played in a single storage group. Each log file is 1 MB in size.

Table 9: Transaction log recovery/replay performance

Average time to play one log file (sec)	2.38
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Appendix E: Soft Recovery Test Results on page 33 shows the results that characterizes the log replay performance.

Conclusion

As this document illustrates, EMC's Celerra NX4 is more than capable of supporting deployments of up to 500 users at 0.18 IOPS per user. A careful analysis of each environment must be performed to understand the specific requirements of the architecture and to adopt a solution that best fits those needs. The information included in this document verifies that NX4 can support a high-performance Exchange configuration.

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

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

Appendix A: User Mailbox Sizing

Two limiting factors are used to estimate maximum user mailbox sizes for Exchange — disk storage capacity and IOPS on the database spindles. The maximum number of users operating at the 20 ms database latency limit was interpolated from the four-thread test results and the five-thread test results as 1,750 users. If support for more than 1,750 users is desired, then extra IOPS support must be added to this solution (indicated in red in the graph).

As the number of users decrease, the average mailbox size will increase. In the following figure, we have graphed the maximum mailbox size per user and noted that if we wish to increase that number, capacity in the form of additional spindles must be added to the configuration (indicated in yellow in the graph).

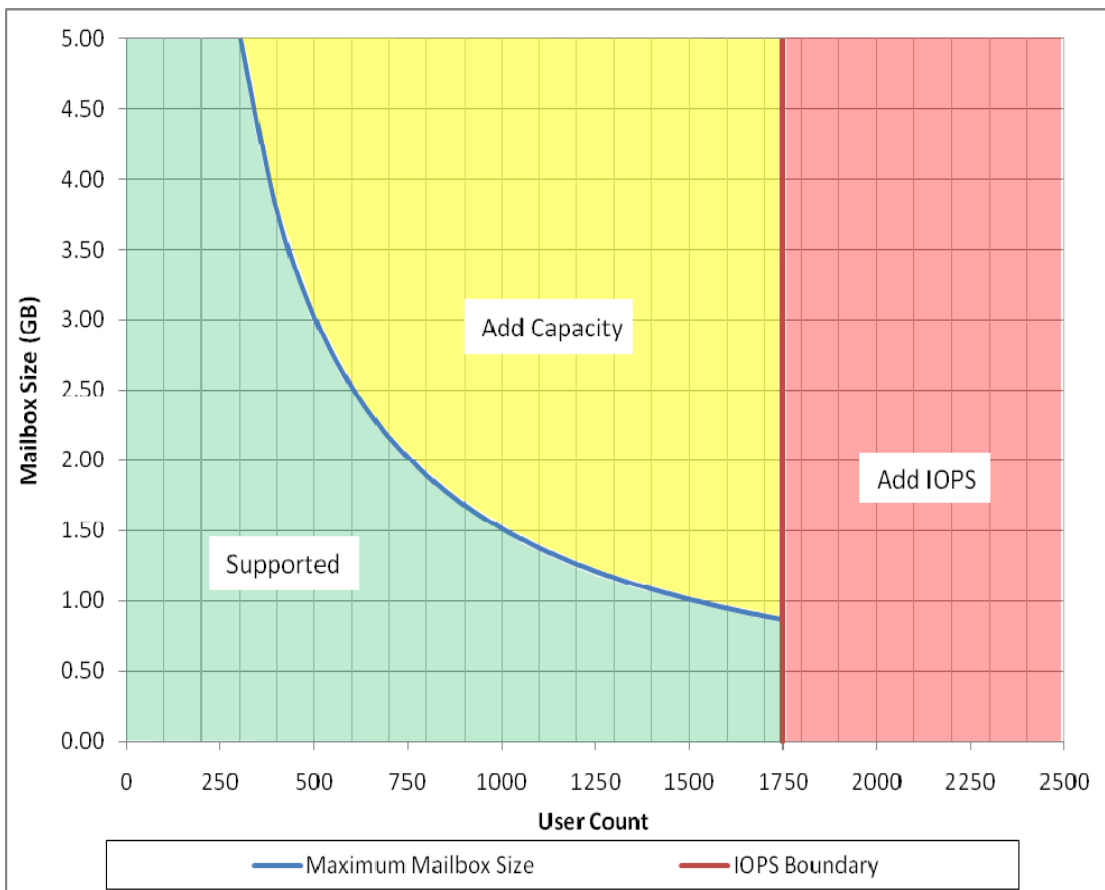


Figure 3: Disk configuration

From the graph, we see that we are able to plot the desired size of the mailboxes to the number of users in the environment (the green portion in the graph).

The following table lists some of the maximum user counts to mailbox size.

Table 10: Maximum user count

Maximum user count	Mailbox size (GB)
300	5
500	3
750	2
1,000	1.5
1,500	1

Appendix B: Stress Test Report (24-hour performance test)

Performance Test Result Report

Test Summary

Overall Test Result **Pass**

Machine Name RTPSOL399

Test Description

Test Start Time 6/25/2010 5:17:01 PM

Test End Time 6/26/2010 5:22:51 PM

Collection Start Time 6/25/2010 5:22:49 PM

Collection End Time 6/26/2010 5:22:40 PM

Jetstress Version 14.01.0180.003

Ese Version 14.00.0639.019

Operating System Windows Server 2008 R2 Enterprise (6.1.7600.0)

Performance Log C:\Program Files\Exchange\Jetstress\24hr\Performance_2010_6_25_17_17_7.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second 125.018

Capacity Percentage 100%

Throughput Percentage 100%

Initial Database Size (bytes) 2161312399360

Final Database Size (bytes) 2166035185664

Database Files (Count) 2

Jetstress System Parameters

Thread Count 1 (per database)

Minimum Database Cache 64.0 MB

Maximum Database Cache 512.0 MB

Insert Operations 40%

Delete Operations 20%

Replace Operations 5%

Read Operations 35%

Lazy Commits 70%

Run Background Database Maintenance True

Number of Copies per Database 3

Database Configuration

Instance2672.1 Log Path: G:\log1
 Database: E:\db1\Jetstress001001.edb

Instance2672.2 Log Path: H:\log2
 Database: F:\db2\Jetstress002001.edb

Transactional I/O Performance

MSExchange Database Instance	I/O Data base Reads Average Latency (msec)	I/O Data base Writes Average Latency (msec)	I/O Data base Reads/sec	I/O Database Writes/sec	I/O Database Average Reads Bytes	I/O Database Average Write Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2672.1	9.273	3.506	38.383	24.167	35744.731	36515.688	0.000	1.560	0.000	21.906	0.000	4572.920
Instance2672.2	9.220	3.482	38.335	24.133	35831.312	36531.369	0.000	1.544	0.000	21.969	0.000	4583.165

Background Database Maintenance I/O Performance

MSExchange Database Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2672.1	29.985	261750.257
Instance2672.2	29.918	261761.385

Log Replication I/O Performance

MSExchange Database Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2672.1	0.809	156768.350
Instance2672.2	0.812	157370.583

Total I/O Performance

MSExchange => Instance	I/O Data base Reads	I/O Data base Writes	I/O Data base Reads/s/sec	I/O Data base Writes/s/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/s/sec	I/O Log Writes/s/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance 2672.1	9.273	3.506	68.368	24.167	134866.912	36515.688	4.418	1.560	0.809	21.906	156768.350	4572.920
Instance 2672.2	9.220	3.482	68.253	24.133	134865.618	36531.369	4.217	1.544	0.812	21.969	157370.583	4583.165

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.679	0.314	11.230
Available MBytes	30400.779	30365.000	30449.000
Free System Page Table Entries	33555589.556	33555555.000	33555592.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	41684435.621	41373696.000	42065920.000
Pool Paged Bytes	69649259.834	67592192.000	96358400.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

6/25/2010 5:17:01 PM -- Jetstress testing begins ...
6/25/2010 5:17:01 PM -- Prepare testing begins ...
6/25/2010 5:17:04 PM -- Attaching databases ...
6/25/2010 5:17:04 PM -- Prepare testing ends.
6/25/2010 5:17:04 PM -- Dispatching transactions begins ...
6/25/2010 5:17:04 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
6/25/2010 5:17:04 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
6/25/2010 5:17:07 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
6/25/2010 5:17:07 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
6/25/2010 5:17:09 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
6/25/2010 5:17:09 PM -- Performance logging begins (interval: 15000 ms).
6/25/2010 5:17:09 PM -- Attaining prerequisites:
6/25/2010 5:22:49 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 484360200.0 (lower bound: 483183800.0, upper bound: none)
6/26/2010 5:22:49 PM -- Performance logging ends.
6/26/2010 5:22:49 PM -- JetInterop batch transaction stats: 169090 and 168874.
6/26/2010 5:22:49 PM -- Dispatching transactions ends.
6/26/2010 5:22:49 PM -- Shutting down databases ...
6/26/2010 5:22:51 PM -- Instance2672.1 (complete) and Instance2672.2 (complete)
6/26/2010 5:22:51 PM -- <C:\Program Files\Exchange>

[Jetstress\24hr\Performance_2010_6_25_17_17_7.blg](#) has 5779 samples.

6/26/2010 5:22:51 PM -- Creating test report ...

6/26/2010 5:23:09 PM -- Instance2672.1 has 9.3 for I/O Database Reads Average Latency.

6/26/2010 5:23:09 PM -- Instance2672.1 has 1.6 for I/O Log Writes Average Latency.

6/26/2010 5:23:09 PM -- Instance2672.1 has 1.6 for I/O Log Reads Average Latency.

6/26/2010 5:23:09 PM -- Instance2672.2 has 9.2 for I/O Database Reads Average Latency.

6/26/2010 5:23:09 PM -- Instance2672.2 has 1.5 for I/O Log Writes Average Latency.

6/26/2010 5:23:09 PM -- Instance2672.2 has 1.5 for I/O Log Reads Average Latency.

6/26/2010 5:23:09 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

6/26/2010 5:23:09 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

6/26/2010 5:23:09 PM -- [C:\Program Files\Exchange](#)

[Jetstress\24hr\Performance_2010_6_25_17_17_7.xml](#) has 5756 samples queried.

Stress test report – Checksum Statistics

Test Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
E:\db1\Jetstress001001.edb	33050946	0	0	0	1032842 MBytes / 13868 sec
F:\db2\Jetstress002001.edb	33051202	0	0	0	1032850 MBytes / 14406 sec
(Sum)	66102148	0	0	0	2065692 MBytes / 14407 sec

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Read
E:	0.050	0.000	1191.160	0.000	65536.000
F:	0.052	0.000	1147.191	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	15.904	8.994	21.182
Available MBytes	30882.300	30834.000	30900.000
Free System Page Table Entries	33555580.835	33555557.000	33555592.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	43338325.333	43122688.000	43483136.000
Pool Paged Bytes	74072354.133	72597504.000	100806656.000

Test Log

6/25/2010 5:17:01 PM -- Jetstress testing begins ...

6/25/2010 5:17:01 PM -- Prepare testing begins ...

6/25/2010 5:17:04 PM -- Attaching databases ...

6/25/2010 5:17:04 PM -- Prepare testing ends.
6/25/2010 5:17:04 PM -- Dispatching transactions begins ...
6/25/2010 5:17:04 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
6/25/2010 5:17:04 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
6/25/2010 5:17:07 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
6/25/2010 5:17:07 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
6/25/2010 5:17:09 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
6/25/2010 5:17:09 PM -- Performance logging begins (interval: 15000 ms).
6/25/2010 5:17:09 PM -- Attaining prerequisites:
6/25/2010 5:22:49 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 484360200.0 (lower bound: 483183800.0, upper bound: none)
6/26/2010 5:22:49 PM -- Performance logging ends.
6/26/2010 5:22:49 PM -- JetInterop batch transaction stats: 169090 and 168874.
6/26/2010 5:22:49 PM -- Dispatching transactions ends.
6/26/2010 5:22:49 PM -- Shutting down databases ...
6/26/2010 5:22:51 PM -- Instance2672.1 (complete) and Instance2672.2 (complete)
6/26/2010 5:22:51 PM -- [C:\Program Files\Exchange Jetstress\24hr\Performance_2010_6_25_17_17_7.blg](#) has 5779 samples.
6/26/2010 5:22:51 PM -- Creating test report ...
6/26/2010 5:23:09 PM -- Instance2672.1 has 9.3 for I/O Database Reads Average Latency.
6/26/2010 5:23:09 PM -- Instance2672.1 has 1.6 for I/O Log Writes Average Latency.
6/26/2010 5:23:09 PM -- Instance2672.1 has 1.6 for I/O Log Reads Average Latency.
6/26/2010 5:23:09 PM -- Instance2672.2 has 9.2 for I/O Database Reads Average Latency.
6/26/2010 5:23:09 PM -- Instance2672.2 has 1.5 for I/O Log Writes Average Latency.
6/26/2010 5:23:09 PM -- Instance2672.2 has 1.5 for I/O Log Reads Average Latency.
6/26/2010 5:23:09 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/26/2010 5:23:09 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/26/2010 5:23:09 PM -- [C:\Program Files\Exchange Jetstress\24hr\Performance_2010_6_25_17_17_7.xml](#) has 5756 samples queried.
6/26/2010 5:23:09 PM -- [C:\Program Files\Exchange Jetstress\24hr\Performance_2010_6_25_17_17_7.html](#) is saved.
6/26/2010 5:23:10 PM -- Performance logging begins (interval: 30000 ms).
6/26/2010 5:23:10 PM -- Verifying database checksums ...
6/26/2010 9:23:17 PM -- E: (100% processed) and F: (100% processed)
6/26/2010 9:23:17 PM -- Performance logging ends.
6/26/2010 9:23:17 PM -- [C:\Program Files\Exchange Jetstress\24hr\DBChecksum_2010_6_26_17_23_9.blg](#) has 480 samples.

Appendix C: Performance Test Results

Performance Test Result Report

Test Summary

Overall Test Result **Pass**

Machine Name RTPSOL399

Test Description

Test Start Time 6/24/2010 8:02:15 PM

Test End Time 6/24/2010 10:08:06 PM

Collection Start Time 6/24/2010 8:08:01 PM

Collection End Time 6/24/2010 10:07:56 PM

Jetstress Version 14.01.0180.003

Ese Version 14.00.0639.019

Operating System Windows Server 2008 R2 Enterprise (6.1.7600.0)

Performance Log C:\Program Files\Exchange\Jetstress\Performance_2010_6_24_20_2_20.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second 122.099

Capacity Percentage 100%

Throughput Percentage 100%

Initial Database Size (bytes) 2161312399360

Final Database Size (bytes) 2161756995584

Database Files (Count) 2

Jetstress System Parameters

Thread Count 1 (per database)

Minimum Database Cache 64.0 MB

Maximum Database Cache 512.0 MB

Insert Operations 40%

Delete Operations 20%

Replace Operations 5%

Read Operations 35%

Lazy Commits 70%

Run Background Database Maintenance True

Number of Copies per Database 3

Database Configuration

Instance2736.1 Log Path: G:\log1
 Database: E:\db1\Jetstress001001.edb

Instance2736.2 Log Path: H:\log2
 Database: F:\db2\Jetstress002001.edb

Transactional I/O Performance

MSExchange Database Instance	I/O Data base Reads Average Latency (msec)	I/O Data base Writes Average Latency (msec)	I/O Data base Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2736.1	9.565	3.205	37.896	23.824	35407.398	37151.382	0.000	1.589	0.000	23.224	0.000	4582.626
Instance2736.2	9.432	3.201	37.136	23.243	36042.568	37269.203	0.000	1.578	0.000	22.740	0.000	4627.430

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2736.1	29.641	261778.646
Instance2736.2	29.534	261730.334

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2736.1	0.859	164112.111
Instance2736.2	0.849	164065.910

Total I/O Performance

MSExchange => Instance	I/O Database Reads	I/O Database Writes	I/O Database Reads/s/sec	I/O Database Writes/s/sec	I/O Database Average Bytes	I/O Database Average Bytes	I/O Log Reads	I/O Log Writes	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Average Bytes	I/O Log Average Bytes
Instance 2736.1	9.565	3.205	67.538	23.824	134758.386	37151.3827	4.687	1.589	0.8594	23.224	164112.111	4582.626
Instance 2736.2	9.432	3.201	66.670	23.243	136019.026	37269.2034	4.504	1.578	0.8490	22.740	164065.910	4627.430

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.067	0.660	7.228
Available MBytes	30461.417	30429.000	30470.000
Free System Page Table Entries	33555590.513	33555570.000	33555593.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	41985476.267	41971712.000	42106880.000
Pool Paged Bytes	73110528.000	72007680.000	102596608.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

6/24/2010 8:02:15 PM -- Jetstress testing begins ...
6/24/2010 8:02:15 PM -- Prepare testing begins ...
6/24/2010 8:02:18 PM -- Attaching databases ...
6/24/2010 8:02:18 PM -- Prepare testing ends.
6/24/2010 8:02:18 PM -- Dispatching transactions begins ...
6/24/2010 8:02:18 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
6/24/2010 8:02:18 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
6/24/2010 8:02:20 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
6/24/2010 8:02:20 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
6/24/2010 8:02:22 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
6/24/2010 8:02:22 PM -- Performance logging begins (interval: 15000 ms).
6/24/2010 8:02:22 PM -- Attaining prerequisites:
6/24/2010 8:08:01 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 484245500.0 (lower bound: 483183800.0, upper bound: none)
6/24/2010 10:08:02 PM -- Performance logging ends.
6/24/2010 10:08:02 PM -- JetInterop batch transaction stats: 15529 and 15320.
6/24/2010 10:08:02 PM -- Dispatching transactions ends.
6/24/2010 10:08:02 PM -- Shutting down databases ...
6/24/2010 10:08:06 PM -- Instance2736.1 (complete) and Instance2736.2 (complete)
6/24/2010 10:08:06 PM -- <C:\Program Files\Exchange>

[Jetstress\Performance_2010_6_24_20_2_20.blg](#) has 502 samples.
 6/24/2010 10:08:06 PM -- Creating test report ...
 6/24/2010 10:08:08 PM -- Instance2736.1 has 9.6 for I/O Database Reads Average Latency.
 6/24/2010 10:08:08 PM -- Instance2736.1 has 1.6 for I/O Log Writes Average Latency.
 6/24/2010 10:08:08 PM -- Instance2736.1 has 1.6 for I/O Log Reads Average Latency.
 6/24/2010 10:08:08 PM -- Instance2736.2 has 9.4 for I/O Database Reads Average Latency.
 6/24/2010 10:08:08 PM -- Instance2736.2 has 1.6 for I/O Log Writes Average Latency.
 6/24/2010 10:08:08 PM -- Instance2736.2 has 1.6 for I/O Log Reads Average Latency.
 6/24/2010 10:08:08 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 6/24/2010 10:08:08 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 6/24/2010 10:08:08 PM -- [C:\Program Files\Exchange](#)
[Jetstress\Performance_2010_6_24_20_2_20.xml](#) has 479 samples queried.

Performance test report – Checksum Statistics

Test Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
E:\db1\Jetstress001001.edb	32985922	0	0	0	1030810 MBytes / 13806 sec
F:\db2\Jetstress002001.edb	32985666	0	0	0	1030802 MBytes / 14307 sec
(Sum)	65971588	0	0	0	2061612 MBytes / 14308 sec

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Read
E:	0.050	0.000	1195.338	0.000	65536.000
F:	0.052	0.000	1151.931	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	15.421	12.255	19.636
Available MBytes	30965.607	30935.000	30974.000
Free System Page Table Entries	33555581.933	33555567.000	33555593.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	43207292.773	43163648.000	43413504.000
Pool Paged Bytes	74127248.134	74043392.000	76865536.000

Test Log

6/24/2010 8:02:15 PM -- Jetstress testing begins ...
6/24/2010 8:02:15 PM -- Prepare testing begins ...
6/24/2010 8:02:18 PM -- Attaching databases ...
6/24/2010 8:02:18 PM -- Prepare testing ends.
6/24/2010 8:02:18 PM -- Dispatching transactions begins ...
6/24/2010 8:02:18 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
6/24/2010 8:02:18 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
6/24/2010 8:02:20 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
6/24/2010 8:02:20 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
6/24/2010 8:02:22 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
6/24/2010 8:02:22 PM -- Performance logging begins (interval: 15000 ms).
6/24/2010 8:02:22 PM -- Attaining prerequisites:
6/24/2010 8:08:01 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 484245500.0 (lower bound: 483183800.0, upper bound: none)
6/24/2010 10:08:02 PM -- Performance logging ends.
6/24/2010 10:08:02 PM -- JetInterop batch transaction stats: 15529 and 15320.
6/24/2010 10:08:02 PM -- Dispatching transactions ends.
6/24/2010 10:08:02 PM -- Shutting down databases ...
6/24/2010 10:08:06 PM -- Instance2736.1 (complete) and Instance2736.2 (complete)
6/24/2010 10:08:06 PM -- C:\Program Files\Exchange Jetstress\Performance_2010_6_24_20_2_20.blg has 502 samples.
6/24/2010 10:08:06 PM -- Creating test report ...
6/24/2010 10:08:08 PM -- Instance2736.1 has 9.6 for I/O Database Reads Average Latency.
6/24/2010 10:08:08 PM -- Instance2736.1 has 1.6 for I/O Log Writes Average Latency.
6/24/2010 10:08:08 PM -- Instance2736.1 has 1.6 for I/O Log Reads Average Latency.
6/24/2010 10:08:08 PM -- Instance2736.2 has 9.4 for I/O Database Reads Average Latency.
6/24/2010 10:08:08 PM -- Instance2736.2 has 1.6 for I/O Log Writes Average Latency.
6/24/2010 10:08:08 PM -- Instance2736.2 has 1.6 for I/O Log Reads Average Latency.
6/24/2010 10:08:08 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/24/2010 10:08:08 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/24/2010 10:08:08 PM -- C:\Program Files\Exchange Jetstress\Performance_2010_6_24_20_2_20.xml has 479 samples queried.
6/24/2010 10:08:08 PM -- C:\Program Files\Exchange Jetstress\Performance_2010_6_24_20_2_20.html is saved.
6/24/2010 10:08:09 PM -- Performance logging begins (interval: 30000 ms).
6/24/2010 10:08:09 PM -- Verifying database checksums ...
6/25/2010 2:06:37 AM -- E: (100% processed) and F: (100% processed)
6/25/2010 2:06:37 AM -- Performance logging ends.
6/25/2010 2:06:37 AM -- C:\Program Files\Exchange Jetstress\DBChecksum_2010_6_24_22_8_8.blg has 476 samples.

Appendix D: Maximum Solution IOPS Test Results

The storage configuration shown in [Figure 3](#) on page [16](#) is the EMC-recommended configuration for a 500 Exchange user workload with 0.18 IOPS per user. The results shown for the four-thread Jetstress test show that this storage configuration achieved excellent results, with considerable room for growth.

Often the observed user workload in customer environments is greater than expected. For example, the use of BlackBerry and MAPI journaling devices can significantly increase the I/O workload generated by a set of users. EMC prides itself on delivering solutions that meet and exceed customer requirements and hence the configurations are designed with considerable headroom.

The tested configuration could easily satisfy the ESRP criteria and subsequent tests were run to determine the upper limit of the configuration. The Jetstress thread count was increased from one to four without modifying any of the other components. The achieved IOPS increased from 122 to 292 with a 139 percent increase. While this workload is not recommended for customers, as it is close to the maximum acceptable disk latency for ESRP, it highlights the headroom for the recommended solution.

Performance Test Result Report

Test Summary

Overall Test Result **Pass**

Machine Name RTPSOL399

Test

Description

Test Start Time 6/27/2010 9:56:42 AM

Test End Time 6/27/2010 11:59:08 AM

Collection Start Time 6/27/2010 9:59:06 AM

Collection End Time 6/27/2010 11:58:54 AM

Jetstress Version 14.01.0180.003

Ese Version 14.00.0639.019

Operating System Windows Server 2008 R2 Enterprise (6.1.7600.0)

Performance Log C:\Program Files\Exchange Jetstress\4thread\Performance_2010_6_27_9_56_48.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second 292.355
Capacity Percentage 100%
Throughput Percentage 100%
Initial Database Size (bytes) 2161312399360
Final Database Size (bytes) 2162277089280
Database Files (Count) 2

Jetstress System Parameters

Thread Count 4 (per database)
Minimum Database Cache 64.0 MB
Maximum Database Cache 512.0 MB
Insert Operations 40%
Delete Operations 20%
Replace Operations 5%
Read Operations 35%
Lazy Commits 70%
Run Background Database Maintenance True
Number of Copies per Database 3

Database Configuration

Instance1744.1 Log Path: G:\log1
 Database: E:\db1\Jetstress001001.edb

Instance1744.2 Log Path: H:\log2
 Database: F:\db2\Jetstress002001.edb

Transactional I/O Performance

MSExchange Instance	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/s	I/O Database Writes/s	I/O Database Average Bytes	I/O Database Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/s	I/O Log Writes/s	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance 1744.1	17.626	8.370	90.737	55.595	33763.679	37500.525	0.000	3.815	0.000	44.618	0.000	5258.345
Instance 1744.2	17.913	7.845	90.550	55.473	33882.527	37509.641	0.000	3.770	0.000	44.652	0.000	5252.987

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance1744.1	26.102	261707.217
Instance1744.2	25.378	261751.764

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance1744.1	1.930	231090.842
Instance1744.2	1.930	232048.672

Total I/O Performance

MSExchange Database ==> Instances	I/O Data base Reads Average Latency (msec)	I/O Data base Writes Average Latency (msec)	I/O Data base Reads/s/sec	I/O Data base Writes/s/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/s/sec	I/O Log Writes/s/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance1744.1	17.626	8.370	116.839	55.595	84685.945	37500.525	9.677	3.815	1.930	44.618	231090.842	5258.345
Instance1744.2	17.913	7.845	115.927	55.473	83765.463	37509.641	9.668	3.770	1.930	44.652	232048.672	5252.987

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	4.052	1.876	10.035
Available MBytes	30455.545	30428.000	30462.000
Free System Page Table Entries	33555454.207	33555062.000	33555593.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	41566182.347	41443328.000	41734144.000
Pool Paged Bytes	70841004.092	69177344.000	98676736.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

6/27/2010 9:56:42 AM -- Jetstress testing begins ...
 6/27/2010 9:56:42 AM -- Prepare testing begins ...
 6/27/2010 9:56:45 AM -- Attaching databases ...
 6/27/2010 9:56:45 AM -- Prepare testing ends.
 6/27/2010 9:56:45 AM -- Dispatching transactions begins ...
 6/27/2010 9:56:45 AM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
 6/27/2010 9:56:45 AM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

6/27/2010 9:56:48 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

6/27/2010 9:56:48 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

6/27/2010 9:56:50 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

6/27/2010 9:56:50 AM -- Performance logging begins (interval: 15000 ms).

6/27/2010 9:56:50 AM -- Attaining prerequisites:

6/27/2010 9:59:06 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 484245500.0 (lower bound: 483183800.0, upper bound: none)

6/27/2010 11:59:06 AM -- Performance logging ends.

6/27/2010 11:59:06 AM -- JetInterop batch transaction stats: 34115 and 34404.

6/27/2010 11:59:07 AM -- Dispatching transactions ends.

6/27/2010 11:59:07 AM -- Shutting down databases ...

6/27/2010 11:59:08 AM -- Instance1744.1 (complete) and Instance1744.2 (complete)

6/27/2010 11:59:08 AM -- [C:\Program Files\Exchange Jetstress\4thread\Performance_2010_6_27_9_56_48.blg](#) has 488 samples.

6/27/2010 11:59:08 AM -- Creating test report ...

6/27/2010 11:59:10 AM -- Instance1744.1 has 17.6 for I/O Database Reads Average Latency.

6/27/2010 11:59:10 AM -- Instance1744.1 has 3.8 for I/O Log Writes Average Latency.

6/27/2010 11:59:10 AM -- Instance1744.1 has 3.8 for I/O Log Reads Average Latency.

6/27/2010 11:59:10 AM -- Instance1744.2 has 17.9 for I/O Database Reads Average Latency.

6/27/2010 11:59:10 AM -- Instance1744.2 has 3.8 for I/O Log Writes Average Latency.

6/27/2010 11:59:10 AM -- Instance1744.2 has 3.8 for I/O Log Reads Average Latency.

6/27/2010 11:59:10 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.

6/27/2010 11:59:10 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

6/27/2010 11:59:10 AM -- [C:\Program Files\Exchange Jetstress\4thread\Performance_2010_6_27_9_56_48.xml](#) has 478 samples queried.

Maximum Solution Test Report – Checksum Statistics

Test Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
E:\db1\Jetstress001001.edb	32993602	0	0	0	1031050 MBytes / 13825 sec
F:\db2\Jetstress002001.edb	32993858	0	0	0	1031058 MBytes / 14342 sec
(Sum)	65987460	0	0	0	2062108 MBytes / 14342 sec

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Read
E:	0.050	0.000	1193.847	0.000	65536.000
F:	0.052	0.000	1149.195	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	15.929	9.072	20.494
Available MBytes	30963.530	30910.000	30972.000
Free System Page Table Entries	33555549.973	33555063.000	33555593.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	42688116.998	42545152.000	42856448.000
Pool Paged Bytes	71940521.057	69742592.000	98332672.000

Test Log

6/27/2010 9:56:42 AM -- Jetstress testing begins ...
6/27/2010 9:56:42 AM -- Prepare testing begins ...
6/27/2010 9:56:45 AM -- Attaching databases ...
6/27/2010 9:56:45 AM -- Prepare testing ends.
6/27/2010 9:56:45 AM -- Dispatching transactions begins ...
6/27/2010 9:56:45 AM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
6/27/2010 9:56:45 AM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
6/27/2010 9:56:48 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
6/27/2010 9:56:48 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
6/27/2010 9:56:50 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
6/27/2010 9:56:50 AM -- Performance logging begins (interval: 15000 ms).
6/27/2010 9:56:50 AM -- Attaining prerequisites:
6/27/2010 9:59:06 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 484245500.0 (lower bound: 483183800.0, upper bound: none)
6/27/2010 11:59:06 AM -- Performance logging ends.
6/27/2010 11:59:06 AM -- JetInterop batch transaction stats: 34115 and 34404.
6/27/2010 11:59:07 AM -- Dispatching transactions ends.
6/27/2010 11:59:07 AM -- Shutting down databases ...
6/27/2010 11:59:08 AM -- Instance1744.1 (complete) and Instance1744.2 (complete)
6/27/2010 11:59:08 AM -- C:\Program Files\Exchange Jetstress\4thread\Performance_2010_6_27_9_56_48.blg has 488 samples.
6/27/2010 11:59:08 AM -- Creating test report ...
6/27/2010 11:59:10 AM -- Instance1744.1 has 17.6 for I/O Database Reads Average Latency.
6/27/2010 11:59:10 AM -- Instance1744.1 has 3.8 for I/O Log Writes Average Latency.
6/27/2010 11:59:10 AM -- Instance1744.1 has 3.8 for I/O Log Reads Average Latency.
6/27/2010 11:59:10 AM -- Instance1744.2 has 17.9 for I/O Database Reads Average Latency.
6/27/2010 11:59:10 AM -- Instance1744.2 has 3.8 for I/O Log Writes Average Latency.
6/27/2010 11:59:10 AM -- Instance1744.2 has 3.8 for I/O Log Reads Average Latency.
6/27/2010 11:59:10 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/27/2010 11:59:10 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/27/2010 11:59:10 AM -- C:\Program Files\Exchange Jetstress\4thread\Performance_2010_6_27_9_56_48.xml has 478 samples queried.
6/27/2010 11:59:11 AM -- C:\Program Files\Exchange Jetstress\4thread\Performance_2010_6_27_9_56_48.html is saved.
6/27/2010 11:59:11 AM -- Performance logging begins (interval: 30000 ms).
6/27/2010 11:59:11 AM -- Verifying database checksums ...
6/27/2010 3:58:14 PM -- E: (100% processed) and F: (100% processed)
6/27/2010 3:58:14 PM -- Performance logging ends.
6/27/2010 3:58:14 PM -- C:\Program Files\Exchange Jetstress\4thread\DBChecksum_2010_6_27_11_59_11.blg has 477 samples.

Appendix E: Soft Recovery Test Results

SoftRecovery Test Result Report

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance2852.1	508	1243.8391251
Instance2852.2	500	1160.8278046

Database Configuration

Instance2852.1 Log Path: G:\log1
Database: E:\db1\Jetstress001001.edb

Instance2852.2 Log Path: H:\log2
Database: F:\db2\Jetstress002001.edb

Transactional I/O Performance

MSExchange Instance	I/O Data base Reads Average Latency (msec)	I/O Data base Writes Average Latency (msec)	I/O Data base Reads/sec	I/O Database Writes/sec	I/O Database Average Bytes	I/O Database Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2852.1	159.211	69.576	319.867	2.452	4108	2320	6.25	0.00	3.682	0.010	14029	0.830
Instance2852.2	175.138	73.888	331.308	2.582	3869	2513	7.52	0.00	3.873	0.000	15478	0.000

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2852.1	10.989	261926.636
Instance2852.2	10.390	261898.313

Total I/O Performance

MSExchange => Instance	I/O Database Reads	I/O Database Writes	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Average Bytes	I/O Database Average Bytes	I/O Log Reads	I/O Log Writes	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Average Bytes	I/O Log Average Bytes
Instance 2852.1	159.211	69.576	330.856	2.452	4842	2320	6.25	0.00	3.682	0.010	14029	0.83
Instance 2852.2	175.138	73.888	341.698	2.582	4548	2513	7.52	0.00	3.873	0.000	15478	0.00

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	5.384	0.391	28.877
Available MBytes	30461.890	30442.000	30977.000
Free System Page Table Entries	33556101.460	33556088.000	33556104.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	43612179.883	41365504.000	43851776.000
Pool Paged Bytes	68251184.052	68222976.000	68370432.000
Database Page Fault Stalls/sec	0.002	0.000	0.497

Test Log

6/28/2010 2:43:36 PM -- Jetstress testing begins ...
6/28/2010 2:43:36 PM -- Prepare testing begins ...
6/28/2010 2:43:39 PM -- Attaching databases ...
6/28/2010 2:43:39 PM -- Prepare testing ends.
6/28/2010 2:43:39 PM -- Dispatching transactions begins ...
6/28/2010 2:43:39 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
6/28/2010 2:43:39 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
6/28/2010 2:43:42 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
6/28/2010 2:43:42 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
6/28/2010 2:43:43 PM -- Operation mix: Sessions 1, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
6/28/2010 2:43:43 PM -- Performance logging begins (interval: 15000 ms).
6/28/2010 2:43:43 PM -- Generating log files ...
6/28/2010 6:18:09 PM -- G:\log1 (101.8% generated) and H:\log2 (100.2% generated)
6/28/2010 6:18:09 PM -- Performance logging ends.
6/28/2010 6:18:09 PM -- JetInterop batch transaction stats: 21790 and 21572.
6/28/2010 6:18:09 PM -- Dispatching transactions ends.
6/28/2010 6:18:09 PM -- Shutting down databases ...
6/28/2010 6:18:15 PM -- Instance2852.1 (complete) and Instance2852.2 (complete)
6/28/2010 6:18:15 PM -- [C:\Program Files\Exchange Jetstress\soft recovery\Performance_2010_6_28_14_43_42.blg](#) has 857 samples.

6/28/2010 6:18:15 PM -- Creating test report ...
6/28/2010 6:18:18 PM -- Instance2852.1 has 10.7 for I/O Database Reads Average Latency.
6/28/2010 6:18:18 PM -- Instance2852.1 has 3.4 for I/O Log Writes Average Latency.
6/28/2010 6:18:18 PM -- Instance2852.1 has 3.4 for I/O Log Reads Average Latency.
6/28/2010 6:18:18 PM -- Instance2852.2 has 10.6 for I/O Database Reads Average Latency.
6/28/2010 6:18:18 PM -- Instance2852.2 has 3.4 for I/O Log Writes Average Latency.
6/28/2010 6:18:18 PM -- Instance2852.2 has 3.4 for I/O Log Reads Average Latency.
6/28/2010 6:18:18 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/28/2010 6:18:18 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/28/2010 6:18:18 PM -- C:\Program Files\Exchange Jetstress\soft recovery\Performance_2010_6_28_14_43_42.xml has 856 samples queried.
6/28/2010 6:18:18 PM -- C:\Program Files\Exchange Jetstress\soft recovery\Performance_2010_6_28_14_43_42.html is saved.
6/28/2010 6:18:20 PM -- Performance logging begins (interval: 2000 ms).
6/28/2010 6:18:20 PM -- Recovering databases ...
6/28/2010 6:39:04 PM -- Performance logging ends.
6/28/2010 6:39:04 PM -- Instance2852.1 (1243.8391251) and Instance2852.2 (1160.8278046)
6/28/2010 6:39:04 PM -- C:\Program Files\Exchange Jetstress\soft recovery\SoftRecovery_2010_6_28_18_18_18.blg has 618 samples.
6/28/2010 6:39:04 PM -- Creating test report ...

SoftRecovery Test Report – Test Results

Test Summary

Overall Test Result **Pass**

Machine Name RTPSOL399

Test

Description

Test Start Time 6/28/2010 2:43:36 PM

Test End Time 6/28/2010 6:18:15 PM

Collection Start Time 6/28/2010 2:43:58 PM

Collection End Time 6/28/2010 6:18:05 PM

Jetstress Version 14.01.0180.003

Ese Version 14.00.0639.019

Operating System Windows Server 2008 R2 Enterprise (6.1.7600.0)

Performance Log C:\Program Files\Exchange Jetstress\soft recovery\Performance_2010_6_28_14_43_42.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second 100.906

Capacity Percentage 100%

Throughput Percentage 100%

Initial Database Size (bytes) 2161312399360

Final Database Size (bytes) 2161924767744

Database Files (Count) 2

Jetstress System Parameters

Thread Count 1 (per database)
Minimum Database Cache 64.0 MB
Maximum Database Cache 512.0 MB
Insert Operations 40%
Delete Operations 20%
Replace Operations 5%
Read Operations 35%
Lazy Commits 70%

Database Configuration

Instance2852.1 Log Path: G:\log1
 Database: E:\db1\Jetstress001001.edb

Instance2852.2 Log Path: H:\log2
 Database: F:\db2\Jetstress002001.edb

Transactional I/O Performance

MSExchange Database Instance	I/O Data base Reads Average Latency (msec)	I/O Data base Writes Average Latency (msec)	I/O Data base Reads/s/sec	I/O Database Writes/s/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/s/sec	I/O Log Writes/s/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance 2852.1	10.650	4.160	31.192	19.291	32768.000	37442.984	0.000	3.369	0.000	19.013	0.000	4632.023
Instance 2852.2	10.607	4.112	31.233	19.190	32768.000	37435.302	0.000	3.373	0.000	18.792	0.000	4599.504

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.304	0.262	8.266
Available MBytes	30477.988	30453.000	30924.000
Free System Page Table Entries	33556101.903	33556086.000	33556104.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	41109162.268	40865792.000	41267200.000
Pool Paged Bytes	68210386.894	67588096.000	98295808.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

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6/28/2010 2:43:39 PM -- Attaching databases ...
6/28/2010 2:43:39 PM -- Prepare testing ends.
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6/28/2010 6:18:18 PM -- Instance2852.1 has 3.4 for I/O Log Reads Average Latency.
6/28/2010 6:18:18 PM -- Instance2852.2 has 10.6 for I/O Database Reads Average Latency.
6/28/2010 6:18:18 PM -- Instance2852.2 has 3.4 for I/O Log Writes Average Latency.
6/28/2010 6:18:18 PM -- Instance2852.2 has 3.4 for I/O Log Reads Average Latency.
6/28/2010 6:18:18 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/28/2010 6:18:18 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/28/2010 6:18:18 PM -- C:\Program Files\Exchange Jetstress\soft\recovery\Performance_2010_6_28_14_43_42.xml has 856 samples queried.