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ESRP Storage Program

EMC VNXe3100 (500 User) Mailbox Resiliency Storage Solution for Microsoft Exchange 2010

Tested with: ESRP – Storage Version 3.0
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Content

Overview

This document provides information on an EMC® VNXe3100™ 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 for Additional 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 the Microsoft Exchange Server software. For more details on the *Microsoft ESRP – Storage* program, visit the website 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 VNXe3100 platform.

The EMC VNXe3100 delivers exceptional flexibility for the small-to-medium business user, combining a unique, application-driven management environment with a complete consolidation for all IP storage needs. The VNXe3100 provides a simplified and affordable IP storage solutions designed specifically for customers who require enterprise-class reliability in a system that is very easy to install, configure, manage, and service. It eliminates the need to hire storage experts by consolidating application data onto a networked storage solution. Easy-to-use application-aware wizards automate the storage provisioning for Microsoft Exchange, VMware datastores, shared folders, generic iSCSI volumes and Hyper-V using embedded best practices engines.

The key feature of the VNXe platform is that storage is strongly tied to an application so that the storage view of the environment can easily be translated into the applications that drive a business.

VNXe supports the following applications:

- Microsoft Exchange
- VMware datastores
- Hyper-V datastores
- Shared folders (CIFS and NFS)
- Generic application storage using iSCSI

Apart from the application-centric design, customers can benefit from the new VNXe features such as:

- Next-generation unified storage optimized for virtualized applications.
- Capacity optimization features that includes file deduplication and compression, thin provisioning, and application-consistent snapshots and replicas.
- High availability, designed to deliver five 9s availability.
- Multiprotocol support for file and block.
- Simplified management with EMC Unisphere™ for a single management interface for all file, block, and replication needs.
- File-level retention (FLR) feature provides a way to set file-based permissions to limit write access to the files for a specific period of time. On a VNXe platform, the FLR feature can be enabled for shared folders and VMware NFS datastores.

Designing and sizing the storage for Exchange 2010 is a complicated process, which is driven by performance, reliability, and scalability to meet the recommended guidelines and metrics of Exchange 2010 and the organization requirements. This solution describes the optimal way to configure Exchange 2010 mailbox resiliency with VNXe platforms.

The performance results and best practices described in this document provide proven guidelines to configure VNXe3100 for high-performance Exchange email environments with mailbox resiliency. For this solution, a VNXe3100 platform with 600 GB 15k rpm SAS disks was used and configured for 500 Exchange 2010 users with an I/O profile of 0.24 IOPS and a mailbox size of 2 GB.

Solution Description

This solution makes use of the inbuilt high-availability and mailbox resiliency framework built into Microsoft Exchange Server 2010 Database Availability Groups (DAG).

A DAG is a group of up to 16 mailbox servers that hosts a set of databases and provides automatic database-level recovery from failures that affect individual servers or databases. Any server in a DAG can host a copy of a

mailbox database of any other server in the same DAG. When a server is added to a DAG, it works with the other servers in the same DAG to provide automatic recovery from failures that affect mailbox databases, such as a disk failure or server failure.

This solution uses two copies of each Exchange database. One of these copies is on the primary VNXe platform and the other copy is on the secondary VNXe platform. The storage is configured on the VNXe3100 platforms with a RAID 5 (4+1) on the first shelf. Each RAID group holds a single Exchange database with its log.

VNXe platforms are application-aware and has inbuilt intelligence to calculate the storage space requirements according to the mailbox count and mailbox size specified.

The following steps describe how storage is created and allocated to the Exchange server:

1. A storage pool is created specifically for Exchange 2010 over a RAID 5 (4+1) RAID group, which provides the storage space required for databases and logs. VNXe automatically recommends the disk type that is appropriate for storage.
2. An Exchange storage resource which is a member of DAG is created over the pool. This membership decides the provisioning best practices that will be applied. The Exchange storage resource holds the virtual disks for Exchange database and log which share the same backend spindles. These virtual disks are sized according to the number of mailboxes and the individual mailbox size specified.

Microsoft Exchange 2010 on EMC VNXe Series—Deployment Guide available on EMC Powerlink® provides more information on the Exchange storage provisioning wizard of the VNXe platform.

If this disk layout is properly configured, it aligns with the Microsoft Exchange Server recommendations of a well-performing system—from both a disk capacity and end-user perspective.

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

Figure 1 shows the reference architecture for the tested Exchange 2010 solution on a VNXe3100 platform.

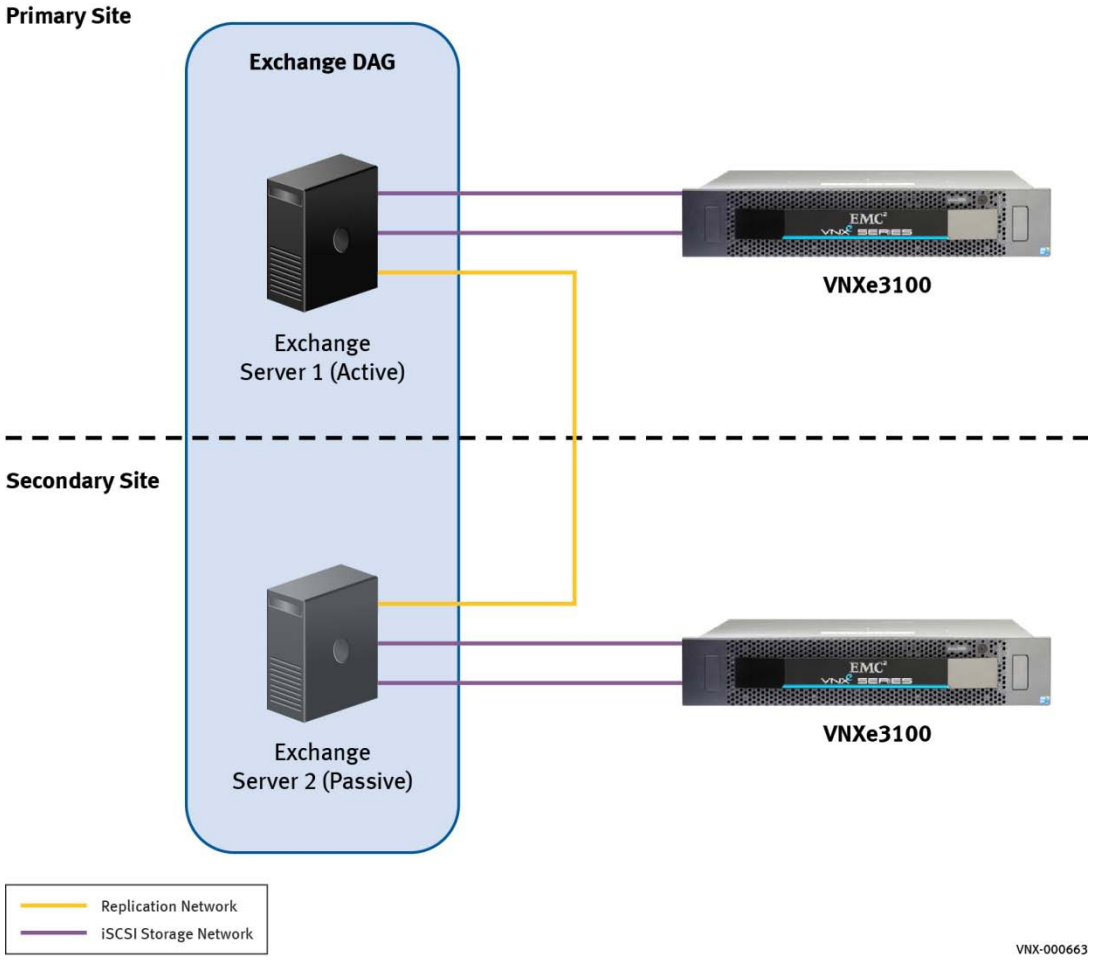

Figure 1 Reference Architecture

Figure 2 shows the disk layout for the tested Exchange 2010 solution on VNXe3100.

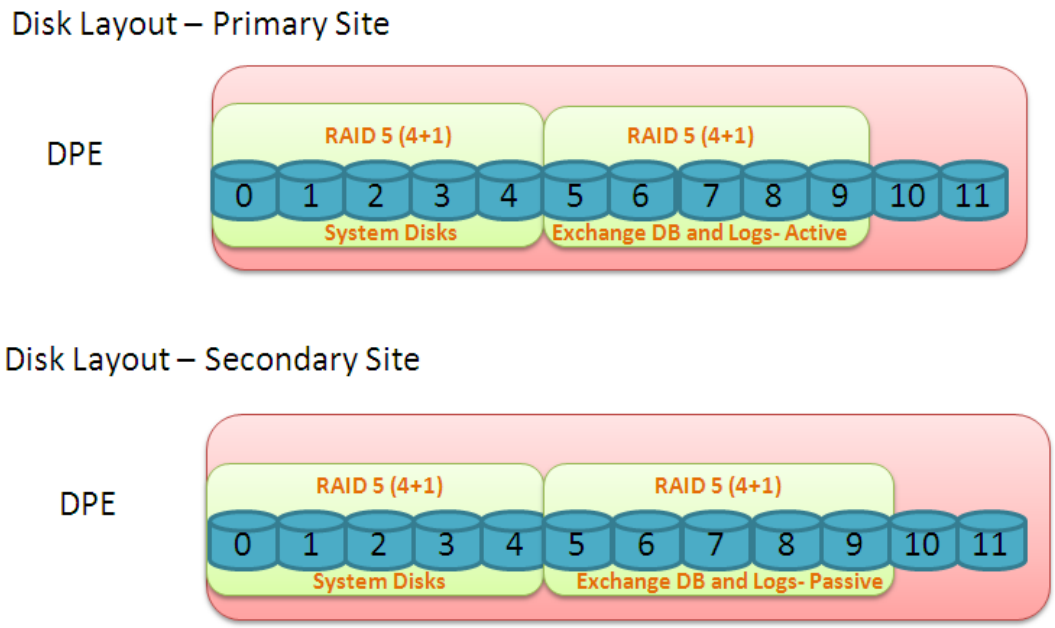

Figure 2 Disk Configuration

Each RAID group consists of both database and logs.

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 scalable Exchange solution.

Other factors that affect the server scalability are:

- Processor utilization
- Physical and virtual 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 of ESRP storage. Therefore, the number of mailboxes hosted per server as part of the tested configuration may not necessarily be viable for some customer deployment.

For more information on how to identify and address performance bottlenecks in an Exchange system, refer to the article Troubleshooting Microsoft Exchange Server Performance, available at http://go.microsoft.com/fwlink/?LinkId=23454.

Targeted Customer Profile

This solution is intended for small-to-medium enterprise Exchange customers to consolidate the Exchange users on a high-performance, highly-available storage platform.

The solution is designed to support the customer profile with the following assumptions:

- 500 Exchange 2010 users
- Two Exchange mailbox servers in an Exchange 2010 DAG configuration of which one is active
- User I/O profile tested is 0.20 IOPs/user with 20 percentage headroom (200 messages sent/received per mailbox per day)
- User mailbox size is 2 GB
- Database maintenance strategy used is Background Database Maintenance 24x7
- Mailbox Resiliency with 2 copies of each mailbox database is used.
- Two VNXe3100 platforms (one tested)

Tested Deployment

The tables in this section summarize the testing environment.

Simulated Exchange Configuration

Table 1 describes the simulated Exchange configuration.

Table 1: Simulated Exchange Configuration

Number of Exchange mailboxes simulated	500
Number of DAGs	1
Number of servers/DAG	2
Number of active mailboxes/server	500
Number of databases/host	1
Number of copies/database	2
Number of mailboxes/database	500
Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)	0.24
Database LUN size	1.58 TB
Log LUN size	100 GB
Total database size for performance testing	1.27 TB
% storage capacity used by Exchange database**	80.37%

**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.

Storage Hardware

Table 2 describes the storage hardware.

Table 2: Storage Hardware details

Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	iSCSI
Storage model and OS/firmware revision	VNXe3100, VNXe Operating environment 2.0.2.13042
Number of storage controllers	2
Number of storage ports	2
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	Intel[R] PRO/1000 PT without jumbo frames enabled
Number of HBAs/host	1 dual-port NIC
Host server type	Server 2950 with 2 x Intel 2.99 GHz Xeon CPU and 8 GB memory
Total number of disks tested in solution	5
Maximum number of spindles that can be hosted in the storage	96

Storage Software

Table 3 describes the storage software.

Table 3: Storage Software Details

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	14.01.0218.012
Replication solution name/version	N/A

Storage Disk Configuration (Mailbox Store Disks)

Table 4 lists the storage disk configuration for the environment.

Table 4: Storage Disk Configuration

Disk type, speed and firmware revision	15k rpm SAS disks
Raw capacity per disk (GB)	600 GB
Number of physical disks in test	5
Total raw storage capacity (GB)	3000 GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	Five disks per two LUNs
RAID level	RAID 5 (4+1)
Total formatted capacity	2140 GB
Storage capacity utilization	71.3 %
Database capacity utilization	43.34%

Storage Disk Configuration (Transactional Log Disks)

Table 5 describes the storage disk configuration of transactional log disks for the environment. Transactional log disks use the same disks as mailbox store database.

Table 5: Storage Disk Configuration (Transactional Log Disks)

Disk type, speed and firmware revision	15k rpm SAS disks
Raw capacity per disk (GB)	600 GB
Number of Spindles in test	5
total raw storage capacity (GB)	3,000 GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	Five disks per two LUNs
RAID level	RAID 5 (4+1)
Total formatted capacity	2140 GB

Best Practices

In this solution, each RAID 5 (4+1) configuration satisfies the capacity and performance requirements for 500 users with a mailbox size of 2 GB and a user profile of 0.24 IOPS (including 20 percent overhead). This ensures that the response times remain well within the required Microsoft thresholds. After 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, visit the following EMC website: http://www.emc.com/solutions/application-environment/microsoft/solutions-for-microsoft-exchange-unified-communications.htm

For Exchange 2010 best practices on storage design, refer to the *Deployment Guidelines for Microsoft Exchange 2010 with EMC Unified Storage – Best Practices Planning* white paper available on Powerlink.

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 database and log volumes with a 64 KB boundary.
2. Isolate 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 case of a disk-related Microsoft Exchange performance issue.
3. When DAG is being used, the maximum database size can be up to 2 TB.
4. Performance and storage capacity should be the primary consideration when 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 the Exchange server and the storage for iSCSI traffic must be isolated from the management network and other network in the data center to get the best performance.
6. When DAG is used, the database and log can be placed on the same disks, otherwise place the database and log on different sets of disks.

Backup Strategy

N/A

Contact for Additional 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. The html report for each test is provided in the following sections.

- Appendix B: Stress Testing
- Appendix C: Performance Testing
- Appendix E: Read-Only Backup Test Results
- Appendix F: SoftRecovery Testing

Reliability

A number of tests in the framework are to check Reliability tests runs for 24 hours. The goal is to verify if 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 VNXe3100 provided the following results:

- No errors reported in the event log files
- No errors reported in the database and log checksum process.

Appendix B: Stress Testing (24-hour Performance Test) on page 17 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 2 hours. The test is to show how long it takes for the storage to respond to an I/O under load. Table 6 shows the sum of all of the logical disk I/Os and average of all the logical disk I/O latency in the 2-hour test duration.

Individual Server Metrics

Table 6 shows the sum of I/Os across Storage Groups and the average latency across all Storage Groups on a per-server basis.

Table 6: Individual Server Metrics

Database I/O	
Database Disks Transfers/sec	164.23
Database Disks Reads/sec	103.74
Database Disks Writes/sec	60.49
Average Database Disk Read Latency (ms)	9.55
Average Database Disk Write Latency (ms)	7.67
Transaction Log I/O	
Log Disks Writes/sec	50.74
Average Log Disk Write Latency (ms)	3.73

Database Backup/Recovery Performance

There are two tests reports in this section. Table 7 is used to measure the sequential read rate of the database files. Table 8 is used 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 are backed up through VSS. Table 7 shows the average rate for a single database file.

Table 7: Database Read-Only Performance

MB read/s per database	88.01
MB read/s total per server	88.01

Transaction Log Recovery/Replay Performance

The test is to measure the maximum rate at which the log files can be replayed against the databases. Table 8 shows the average rate for 500 log files played in a single storage group. Each log file is 1 MB in size.

Table 8: Transaction Log Recovery/Reply Performance

Average time (s) to play one log file	1.77

Conclusion

VNXe3100 is more than capable to support deployments of up to 500 users at 0.24 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 VNXe3100 can support a high-performance Exchange configuration.

This document is developed by storage solution providers, and reviewed by the Microsoft Exchange Product team. The test results or data presented in this document is based on the tests introduced in the ESRP test framework. Customers should not quote the data directly for predeployment 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 1,316 users for a jetstress thread count of seven. If more than 1,316 users are required, then extra IOPS support must be added to this solution (indicated in orange in Figure 1).

As the number of users decrease, the average mailbox size increases.

Figure 1 shows the maximum mailbox size per user that can be increased if required by adding capacity in the form of additional spindles to the configuration (indicated in yellow in Figure 1).

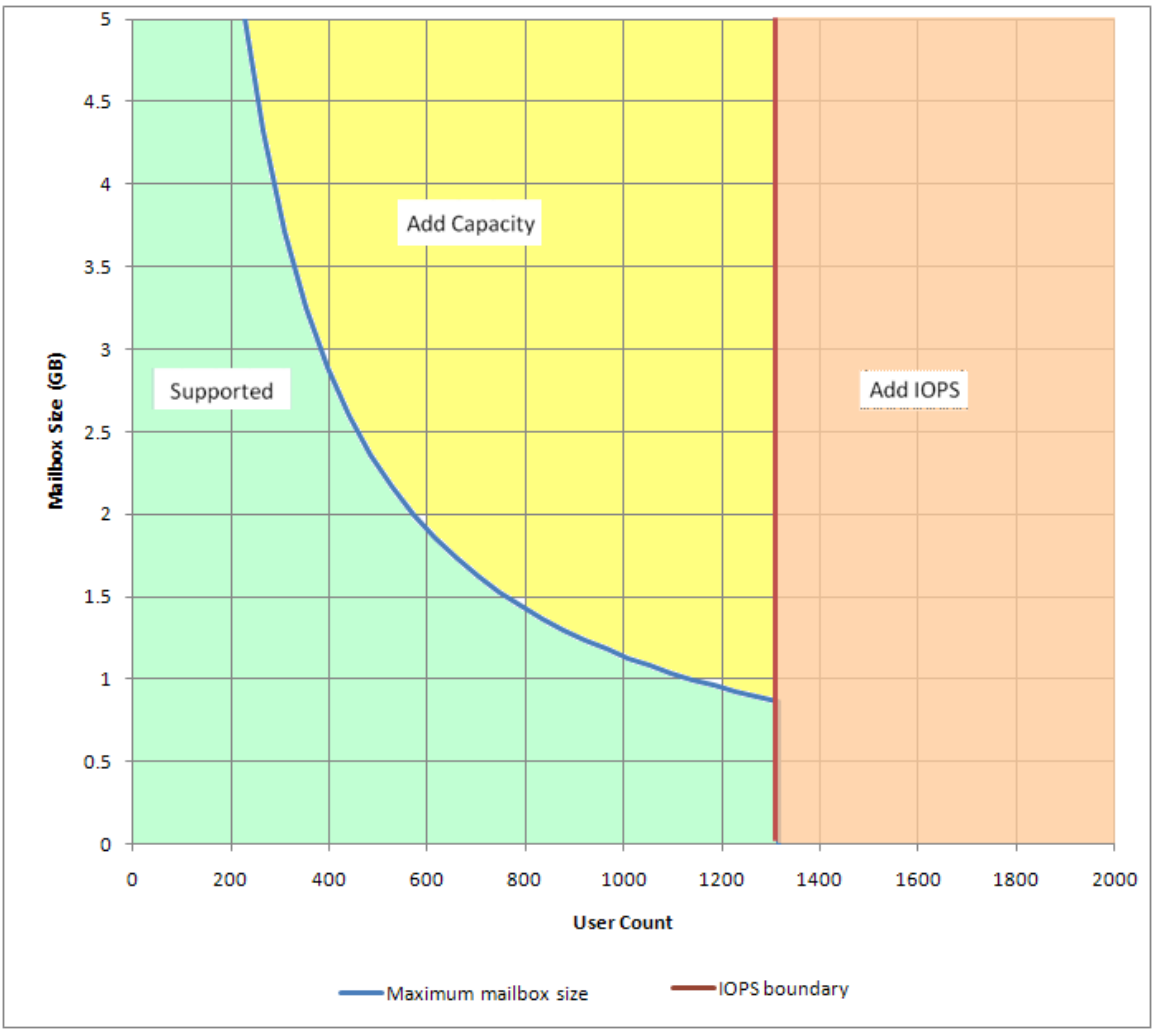

Figure 3: Disk Configuration

It can be noted from the graph that the tested environment supports the desired mailbox size for 500 Exchange 2010 users.

Table 9 lists some of the maximum user counts and approximate mailbox size that this solution supports.

Table 9: Maximum User Count

Maximum user count	Mailbox size (GB)
250	4
500	2
750	1.5
1.000	1

Appendix B: Stress Testing (24-hour Performance Test)

Microsoft Exchange Jetstress 2010

Performance Test Result Report

Test Summary

Overall Test Result	**Pass**
Machine Name	EX8PESRP02
Test Description	
Test Start Time	4/22/2011 9:14:48 AM
Test End Time	4/23/2011 9:17:17 AM
Collection Start Time	4/22/2011 9:17:13 AM
Collection End Time	4/23/2011 9:17:11 AM
Jetstress Version	14.01.0180.003
Ese Version	14.01.0218.012
Operating System	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2011_4_22_9_14_54.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	164.621
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	1391572090880
Final Database Size (bytes)	1397351841792
Database Files (Count)	1

Jetstress System Parameters

Thread Count	2 (per database)
Minimum Database Cache	32.0 MB
Maximum Database Cache	256.0 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	2

Database Configuration

Instance3100.1 Log Path: L:\
Database: E:\Jetstress001001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database 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
Instance3100.1	9.970	8.422	103.115	61.506	33098.904	35788.001	0.000	4.196	0.000	47.980	0.000	5053.987

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3100.1	28.438	261862.997

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3100.1	0.992	232474.918

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database 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
Instance3100.1	9.970	8.422	131.553	61.506	8255 1.082	3578 8.001	5.581	4.196	0.992	47.980	23247 4.918	5053 .987

Host System Performance

Counter	Average	Minimum	Maximum

% Processor Time	1.284	0.077	27.105
Available MBytes	6946.861	6600.000	6978.000
Free System Page Table Entries	33555450.994	33554997.000	33556103.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	41188557.796	40898560.000	41582592.000
Pool Paged Bytes	98157393.509	96256000.000	102350848.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 4/22/2011 9:14:48 AM -- Jetstress testing begins ...
4/22/2011 9:14:48 AM -- Prepare testing begins ...
4/22/2011 9:14:52 AM -- Attaching databases ...
4/22/2011 9:14:52 AM -- Prepare testing ends.
4/22/2011 9:14:52 AM -- Dispatching transactions begins ...
4/22/2011 9:14:52 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
4/22/2011 9:14:52 AM -- Database flush thresholds: (start: 2.5 MB, stop: 5.1 MB)
4/22/2011 9:14:53 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/22/2011 9:14:54 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/22/2011 9:14:56 AM -- Operation mix: Sessions 2, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/22/2011 9:14:56 AM -- Performance logging begins (interval: 15000 ms).
4/22/2011 9:14:56 AM -- Attaining prerequisites:
4/22/2011 9:17:13 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 241664000.0 (lower bound: 241591900.0, upper bound: none)
4/23/2011 9:17:14 AM -- Performance logging ends.
4/23/2011 9:17:14 AM -- JetInterop batch transaction stats: 415070.
4/23/2011 9:17:14 AM -- Dispatching transactions ends.
4/23/2011 9:17:14 AM -- Shutting down databases ...
4/23/2011 9:17:17 AM -- Instance3100.1 (complete)
4/23/2011 9:17:17 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_22_9_14_54.blg has 5766 samples.
4/23/2011 9:17:17 AM -- Creating test report ...
4/23/2011 9:17:32 AM -- Instance3100.1 has 10.0 for I/O Database Reads Average Latency.
4/23/2011 9:17:32 AM -- Instance3100.1 has 4.2 for I/O Log Writes Average Latency.
4/23/2011 9:17:32 AM -- Instance3100.1 has 4.2 for I/O Log Reads Average Latency.
4/23/2011 9:17:32 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/23/2011 9:17:32 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/23/2011 9:17:32 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_22_9_14_54.xml has 5756 samples queried.

Stress Test Report – Checksum Statistics

Microsoft Exchange Jetstress 2010

Test Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number	File length / seconds taken

				pages	
E:\Jetstress001001.edb	42643794	0	0	0	1332618 MBytes / 9521 sec
(Sum)	42643794	0	0	0	1332618 MBytes / 9522 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:	0.036	0.000	2239.306	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	18.900	16.528	23.817
Available MBytes	7173.877	7133.000	7177.000
Free System Page Table Entries	33555592.587	33555575.000	33556103.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	42414105.842	42360832.000	42545152.000
Pool Paged Bytes	101460685.123	101085184.000	101838848.000

Test Log 4/22/2011 9:14:48 AM -- Jetstress testing begins ...
4/22/2011 9:14:48 AM -- Prepare testing begins ...
4/22/2011 9:14:52 AM -- Attaching databases ...
4/22/2011 9:14:52 AM -- Prepare testing ends.
4/22/2011 9:14:52 AM -- Dispatching transactions begins ...
4/22/2011 9:14:52 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
4/22/2011 9:14:52 AM -- Database flush thresholds: (start: 2.5 MB, stop: 5.1 MB)
4/22/2011 9:14:53 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/22/2011 9:14:54 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
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4/22/2011 9:17:13 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 241664000.0 (lower bound: 241591900.0, upper bound: none)
4/23/2011 9:17:14 AM -- Performance logging ends.
4/23/2011 9:17:14 AM -- JetInterop batch transaction stats: 415070.
4/23/2011 9:17:14 AM -- Dispatching transactions ends.
4/23/2011 9:17:14 AM -- Shutting down databases ...
4/23/2011 9:17:17 AM -- Instance3100.1 (complete)
4/23/2011 9:17:17 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_22_9_14_54.blg has 5766 samples.
4/23/2011 9:17:17 AM -- Creating test report ...
4/23/2011 9:17:32 AM -- Instance3100.1 has 10.0 for I/O Database Reads Average Latency.
4/23/2011 9:17:32 AM -- Instance3100.1 has 4.2 for I/O Log Writes Average Latency.
4/23/2011 9:17:32 AM -- Instance3100.1 has 4.2 for I/O Log Reads Average Latency.
4/23/2011 9:17:32 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.

4/23/2011 9:17:32 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/23/2011 9:17:32 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_22_9_14_54.xml has 5756 samples queried.
4/23/2011 9:17:32 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_22_9_14_54.html is saved.
4/23/2011 9:17:34 AM -- Performance logging begins (interval: 30000 ms).
4/23/2011 9:17:34 AM -- Verifying database checksums ...
4/23/2011 11:56:16 AM -- E: (100% processed)
4/23/2011 11:56:16 AM -- Performance logging ends.
4/23/2011 11:56:16 AM -- C:\Program Files\Exchange Jetstress\DBChecksum_2011_4_23_9_17_32.blg has 317 samples.

Appendix C: Performance Testing

Microsoft Exchange Jetstress 2010

Performance Test Result Report

Test Summary

Overall Test Result	**Pass**
Machine Name	EX8PESRP02
Test Description	
Test Start Time	4/21/2011 12:53:19 AM
Test End Time	4/21/2011 2:56:13 AM
Collection Start Time	4/21/2011 12:56:09 AM
Collection End Time	4/21/2011 2:56:01 AM
Jetstress Version	14.01.0180.003
Ese Version	14.01.0218.012
Operating System	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2011_4_21_0_53_25.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	164.679
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	1391572090880
Final Database Size (bytes)	1392092184576
Database Files (Count)	1

Jetstress System Parameters

Thread Count	2 (per database)

Minimum Database Cache	32.0 MB
Maximum Database Cache	256.0 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	2

Database Configuration

Instance3904.1 Log Path: L:\
Database: E:\Jetstress001001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database 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
Instance3904.1	9.554	7.667	103.737	60.942	33189.237	37501.199	0.000	3.731	0.000	50.736	0.000	5072.901

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3904.1	28.956	261798.214

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3904.1	1.053	232549.996

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Aver	I/O Database Writes Aver	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Avera	I/O Database Writes Avera	I/O Log Reads Average	I/O Log Writes Average	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average

	age Latency (msec)	age Latency (msec)			ge Bytes	ge Bytes	Latency (msec)	Latency (msec)				Bytes
Instance 3904.1	9.554	7.667	132.693	60.942	8307 6.008	3750 1.199	5.573	3.731	1.053	50.736	23254 9.996	5072 .901

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.213	0.597	14.787
Available MBytes	6959.940	6949.000	6975.000
Free System Page Table Entries	33555373.742	33555039.000	33556102.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	41927150.933	41680896.000	42811392.000
Pool Paged Bytes	103488930.133	103141376.000	106082304.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 4/21/2011 12:53:19 AM -- Jetstress testing begins ...
4/21/2011 12:53:19 AM -- Prepare testing begins ...
4/21/2011 12:53:23 AM -- Attaching databases ...
4/21/2011 12:53:23 AM -- Prepare testing ends.
4/21/2011 12:53:23 AM -- Dispatching transactions begins ...
4/21/2011 12:53:23 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
4/21/2011 12:53:23 AM -- Database flush thresholds: (start: 2.5 MB, stop: 5.1 MB)
4/21/2011 12:53:25 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/21/2011 12:53:25 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/21/2011 12:53:27 AM -- Operation mix: Sessions 2, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/21/2011 12:53:27 AM -- Performance logging begins (interval: 15000 ms).
4/21/2011 12:53:27 AM -- Attaining prerequisites:
4/21/2011 12:56:09 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 241819600.0 (lower bound: 241591900.0, upper bound: none)
4/21/2011 2:56:09 AM -- Performance logging ends.
4/21/2011 2:56:09 AM -- JetInterop batch transaction stats: 37072.
4/21/2011 2:56:09 AM -- Dispatching transactions ends.
4/21/2011 2:56:09 AM -- Shutting down databases ...
4/21/2011 2:56:13 AM -- Instance3904.1 (complete)
4/21/2011 2:56:13 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_0_53_25.blg has 490 samples.
4/21/2011 2:56:13 AM -- Creating test report ...
4/21/2011 2:56:15 AM -- Instance3904.1 has 9.6 for I/O Database Reads Average Latency.
4/21/2011 2:56:15 AM -- Instance3904.1 has 3.7 for I/O Log Writes Average Latency.
4/21/2011 2:56:15 AM -- Instance3904.1 has 3.7 for I/O Log Reads Average Latency.
4/21/2011 2:56:15 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/21/2011 2:56:15 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/21/2011 2:56:15 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_0_53_25.xml has 479 samples queried.

Performance test report – Checksum Statistics

Microsoft Exchange Jetstress 2010

Test Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
E:\Jetstress001001.edb	42483282	0	0	0	1327602 MBytes / 9599 sec
(Sum)	42483282	0	0	0	1327602 MBytes / 9599 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:	0.036	0.000	2213.265	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	18.521	15.475	25.337
Available MBytes	7204.991	7198.000	7213.000
Free System Page Table Entries	33555600.307	33555574.000	33556102.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	43052837.718	42819584.000	43216896.000
Pool Paged Bytes	105646908.188	103546880.000	106684416.000

Test Log 4/21/2011 12:53:19 AM -- Jetstress testing begins ...
4/21/2011 12:53:19 AM -- Prepare testing begins ...
4/21/2011 12:53:23 AM -- Attaching databases ...
4/21/2011 12:53:23 AM -- Prepare testing ends.
4/21/2011 12:53:23 AM -- Dispatching transactions begins ...
4/21/2011 12:53:23 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
4/21/2011 12:53:23 AM -- Database flush thresholds: (start: 2.5 MB, stop: 5.1 MB)
4/21/2011 12:53:25 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/21/2011 12:53:25 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/21/2011 12:53:27 AM -- Operation mix: Sessions 2, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/21/2011 12:53:27 AM -- Performance logging begins (interval: 15000 ms).

4/21/2011 12:53:27 AM -- Attaining prerequisites:
4/21/2011 12:56:09 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 241819600.0 (lower bound: 241591900.0, upper bound: none)
4/21/2011 2:56:09 AM -- Performance logging ends.
4/21/2011 2:56:09 AM -- JetInterop batch transaction stats: 37072.
4/21/2011 2:56:09 AM -- Dispatching transactions ends.
4/21/2011 2:56:09 AM -- Shutting down databases ...
4/21/2011 2:56:13 AM -- Instance3904.1 (complete)
4/21/2011 2:56:13 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_0_53_25.blg has 490 samples.
4/21/2011 2:56:13 AM -- Creating test report ...
4/21/2011 2:56:15 AM -- Instance3904.1 has 9.6 for I/O Database Reads Average Latency.
4/21/2011 2:56:15 AM -- Instance3904.1 has 3.7 for I/O Log Writes Average Latency.
4/21/2011 2:56:15 AM -- Instance3904.1 has 3.7 for I/O Log Reads Average Latency.
4/21/2011 2:56:15 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/21/2011 2:56:15 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/21/2011 2:56:15 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_0_53_25.xml has 479 samples queried.
4/21/2011 2:56:15 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_0_53_25.html is saved.
4/21/2011 2:56:16 AM -- Performance logging begins (interval: 30000 ms).
4/21/2011 2:56:16 AM -- Verifying database checksums ...
4/21/2011 5:36:16 AM -- E: (100% processed)
4/21/2011 5:36:16 AM -- Performance logging ends.
4/21/2011 5:36:16 AM -- C:\Program Files\Exchange Jetstress\DBChecksum_2011_4_21_2_56_15.blg has 319 samples.

Appendix D: Maximum Solution IOPS Test Results

The storage configuration shown in Figure 2 on page 8 is the EMC-recommended configuration for a 500 Exchange user workload with 0.24 IOPS per user. The results shown for the seven-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 seven without modifying any of the other components. The achieved IOPS increased from 164 to 317 with a 93 percent increase. Though 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.

Microsoft Exchange Jetstress 2010

Performance Test Result Report

Test Summary

Overall Test Result	**Pass**
Machine Name	EX8PESRP02
Test Description	
Test Start Time	4/21/2011 6:08:52 AM
Test End Time	4/21/2011 8:10:05 AM
Collection Start Time	4/21/2011 6:10:03 AM
Collection End Time	4/21/2011 8:10:03 AM
Jetstress Version	14.01.0180.003
Ese Version	14.01.0218.012
Operating System	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2011_4_21_6_8_56.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	316.969
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	1392092184576
Final Database Size (bytes)	1392981377024
Database Files (Count)	1

Jetstress System Parameters

Thread Count	7 (per database)
Minimum Database Cache	32.0 MB
Maximum Database Cache	256.0 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	2

Database Configuration

Instance3292.1 Log Path: L:\

Database: E:\Jetstress001001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database 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
Instance3292.1	17.952	17.925	200.781	116.188	32883.170	36040.349	0.000	7.446	0.000	55.868	0.000	7758.968

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3292.1	22.890	261911.164

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3292.1	1.828	232570.467

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database 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
Instance3292.1	17.952	17.925	223.671	116.188	5632 1.531	3604 0.349	7.370	7.446	1.828	55.868	23257 0.467	7758 .968

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.502	1.611	18.971
Available MBytes	6978.790	6972.000	6984.000
Free System Page Table Entries	33555477.496	33555004.000	33556102.000

Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	41027652.267	40910848.000	41103360.000
Pool Paged Bytes	99516066.133	99106816.000	99840000.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 4/21/2011 6:08:52 AM -- Jetstress testing begins ...
4/21/2011 6:08:52 AM -- Prepare testing begins ...
4/21/2011 6:08:54 AM -- Attaching databases ...
4/21/2011 6:08:54 AM -- Prepare testing ends.
4/21/2011 6:08:54 AM -- Dispatching transactions begins ...
4/21/2011 6:08:54 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
4/21/2011 6:08:54 AM -- Database flush thresholds: (start: 2.5 MB, stop: 5.1 MB)
4/21/2011 6:08:56 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/21/2011 6:08:56 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/21/2011 6:08:59 AM -- Operation mix: Sessions 7, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/21/2011 6:08:59 AM -- Performance logging begins (interval: 15000 ms).
4/21/2011 6:08:59 AM -- Attaining prerequisites:
4/21/2011 6:10:03 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 242065400.0 (lower bound: 241591900.0, upper bound: none)
4/21/2011 8:10:03 AM -- Performance logging ends.
4/21/2011 8:10:03 AM -- JetInterop batch transaction stats: 63923.
4/21/2011 8:10:04 AM -- Dispatching transactions ends.
4/21/2011 8:10:04 AM -- Shutting down databases ...
4/21/2011 8:10:05 AM -- Instance3292.1 (complete)
4/21/2011 8:10:05 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_6_8_56.blg has 484 samples.
4/21/2011 8:10:05 AM -- Creating test report ...
4/21/2011 8:10:07 AM -- Instance3292.1 has 18.0 for I/O Database Reads Average Latency.
4/21/2011 8:10:07 AM -- Instance3292.1 has 7.4 for I/O Log Writes Average Latency.
4/21/2011 8:10:07 AM -- Instance3292.1 has 7.4 for I/O Log Reads Average Latency.
4/21/2011 8:10:07 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/21/2011 8:10:07 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/21/2011 8:10:07 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_6_8_56.xml has 479 samples queried.

Maximum IOPS Test Result Report –Checksum statistics

Microsoft Exchange Jetstress 2010

Test Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
E:\Jetstress001001.edb	42510418	0	0	0	1328450

					MBytes / 9632 sec
(Sum)	42510418	0	0	0	1328450 MBytes / 9632 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:	0.036	0.000	2207.111	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	18.592	16.294	29.106
Available MBytes	7219.625	7178.000	7228.000
Free System Page Table Entries	33555523.628	33555062.000	33556102.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	42186086.400	42016768.000	42414080.000
Pool Paged Bytes	100601216.000	99991552.000	101662720.000

Test Log 4/21/2011 6:08:52 AM -- Jetstress testing begins ...
4/21/2011 6:08:52 AM -- Prepare testing begins ...
4/21/2011 6:08:54 AM -- Attaching databases ...
4/21/2011 6:08:54 AM -- Prepare testing ends.
4/21/2011 6:08:54 AM -- Dispatching transactions begins ...
4/21/2011 6:08:54 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
4/21/2011 6:08:54 AM -- Database flush thresholds: (start: 2.5 MB, stop: 5.1 MB)
4/21/2011 6:08:56 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/21/2011 6:08:56 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/21/2011 6:08:59 AM -- Operation mix: Sessions 7, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/21/2011 6:08:59 AM -- Performance logging begins (interval: 15000 ms).
4/21/2011 6:08:59 AM -- Attaining prerequisites:
4/21/2011 6:10:03 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 242065400.0 (lower bound: 241591900.0, upper bound: none)
4/21/2011 8:10:03 AM -- Performance logging ends.
4/21/2011 8:10:03 AM -- JetInterop batch transaction stats: 63923.
4/21/2011 8:10:04 AM -- Dispatching transactions ends.
4/21/2011 8:10:04 AM -- Shutting down databases ...
4/21/2011 8:10:05 AM -- Instance3292.1 (complete)
4/21/2011 8:10:05 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_6_8_56.blg has 484 samples.
4/21/2011 8:10:05 AM -- Creating test report ...
4/21/2011 8:10:07 AM -- Instance3292.1 has 18.0 for I/O Database Reads Average Latency.
4/21/2011 8:10:07 AM -- Instance3292.1 has 7.4 for I/O Log Writes Average Latency.
4/21/2011 8:10:07 AM -- Instance3292.1 has 7.4 for I/O Log Reads Average Latency.
4/21/2011 8:10:07 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/21/2011 8:10:07 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/21/2011 8:10:07 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_21_6_8_56.xml has 479 samples queried.
4/21/2011 8:10:07 AM -- C:\Program Files\Exchange

Jetstress\Performance_2011_4_21_6_8_56.html is saved.
4/21/2011 8:10:08 AM -- Performance logging begins (interval: 30000 ms).
4/21/2011 8:10:08 AM -- Verifying database checksums ...
4/21/2011 10:50:41 AM -- E: (100% processed)
4/21/2011 10:50:41 AM -- Performance logging ends.
4/21/2011 10:50:41 AM -- C:\Program Files\Exchange Jetstress\DBChecksum_2011_4_21_8_10_7.blg has 320 samples.

Appendix E: Read-Only Backup Test Results

Microsoft Exchange Jetstress 2010

Database Backup Test Result Report

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance3484.1	1327098.59	04:11:19	88.01

Jetstress System Parameters

Thread Count	2 (per database)
Minimum Database Cache	32.0 MB
Maximum Database Cache	256.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance3484.1 Log Path: K:\
Database: E:\Jetstress001001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (mse	I/O Database Writes Average Latency (mse	I/O Database 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

	c)	c)										
Instance 3484.1	4.778	0.000	352.108	0.000	26214 4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	11.815	10.187	17.866
Available MBytes	7248.301	7204.000	7254.000
Free System Page Table Entries	33555489.382	33555062.000	33556102.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	47001232.829	46456832.000	48185344.000
Pool Paged Bytes	103136929.147	102883328.000	106553344.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 5/7/2011 8:25:30 AM -- Jetstress testing begins ...
5/7/2011 8:25:30 AM -- Prepare testing begins ...
5/7/2011 8:25:34 AM -- Attaching databases ...
5/7/2011 8:25:34 AM -- Prepare testing ends.
5/7/2011 8:25:38 AM -- Performance logging begins (interval: 30000 ms).
5/7/2011 8:25:38 AM -- Backing up databases ...
5/7/2011 12:36:57 PM -- Performance logging ends.
5/7/2011 12:36:57 PM -- Instance3484.1 (100% processed)
5/7/2011 12:36:58 PM -- C:\Program Files\Exchange Jetstress\ESRP\DatabaseBackup_2011_5_7_8_25_34.blg has 502 samples.
5/7/2011 12:36:58 PM -- Creating test report ...

Appendix F: SoftRecovery Testing

Microsoft Exchange Jetstress 2010

SoftRecovery Test Result Report

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance3156.1	501	884.8959542

Database Configuration

Instance3156.1 Log Path: L:\
Database: E:\Jetstress001001.edb

Transactional I/O Performance

MSExchange Database ==>	I/O Database Read	I/O Database Writ	I/O Database Read	I/O Database Write	I/O Database Reads	I/O Database Write	I/O Log Reads	I/O Log Writes	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Avera	I/O Log Writes

Instances	s Average Latency (msec)	es Average Latency (msec)	s/sec	s/sec	Average Bytes	s Average Bytes	Average Latency (msec)	Average Latency (msec)			ge Bytes	Average Bytes
Instance3156.1	19.419	7.063	414.666	3.390	41550.355	32468.749	6.915	0.000	5.085	0.000	229243.347	0.000

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3156.1	23.899	261840.786

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database 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
Instance3156.1	19.419	7.063	438.565	3.390	53554.769	32468.749	6.915	0.000	5.085	0.000	229243.347	0.000

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	3.185	0.581	12.015
Available MBytes	6866.884	6841.000	7094.000
Free System Page Table Entries	33555582.506	33555065.000	33556103.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	43218864.692	43102208.000	43286528.000
Pool Paged Bytes	108794406.487	106258432.000	207568896.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 4/25/2011 12:56:04 AM -- Jetstress testing begins ...
4/25/2011 12:56:04 AM -- Prepare testing begins ...
4/25/2011 12:56:07 AM -- Attaching databases ...
4/25/2011 12:56:07 AM -- Prepare testing ends.
4/25/2011 12:56:07 AM -- Dispatching transactions begins ...
4/25/2011 12:56:07 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
4/25/2011 12:56:07 AM -- Database flush thresholds: (start: 2.5 MB, stop: 5.1 MB)

4/25/2011 12:56:09 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/25/2011 12:56:09 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/25/2011 12:56:11 AM -- Operation mix: Sessions 2, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/25/2011 12:56:11 AM -- Performance logging begins (interval: 15000 ms).
4/25/2011 12:56:11 AM -- Generating log files ...
4/25/2011 2:04:57 AM -- L:\ (100.2% generated)
4/25/2011 2:04:57 AM -- Performance logging ends.
4/25/2011 2:04:57 AM -- JetInterop batch transaction stats: 21694.
4/25/2011 2:04:57 AM -- Dispatching transactions ends.
4/25/2011 2:04:57 AM -- Shutting down databases ...
4/25/2011 2:05:00 AM -- Instance3156.1 (complete)
4/25/2011 2:05:00 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_25_0_56_9.blg has 274 samples.
4/25/2011 2:05:00 AM -- Creating test report ...
4/25/2011 2:05:01 AM -- Instance3156.1 has 9.3 for I/O Database Reads Average Latency.
4/25/2011 2:05:01 AM -- Instance3156.1 has 3.9 for I/O Log Writes Average Latency.
4/25/2011 2:05:01 AM -- Instance3156.1 has 3.9 for I/O Log Reads Average Latency.
4/25/2011 2:05:01 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/25/2011 2:05:01 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/25/2011 2:05:01 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_25_0_56_9.xml has 273 samples queried.
4/25/2011 2:05:01 AM -- C:\Program Files\Exchange Jetstress\Performance_2011_4_25_0_56_9.html is saved.
4/25/2011 2:05:03 AM -- Performance logging begins (interval: 2000 ms).
4/25/2011 2:05:03 AM -- Recovering databases ...
4/25/2011 2:19:48 AM -- Performance logging ends.
4/25/2011 2:19:48 AM -- Instance3156.1 (884.8959542)
4/25/2011 2:19:49 AM -- C:\Program Files\Exchange Jetstress\SoftRecovery_2011_4_25_2_5_1.blg has 439 samples.
4/25/2011 2:19:49 AM -- Creating test report ...

SoftRecovery Test Report – Test Results

Microsoft Exchange Jetstress 2010

SoftRecovery Test Result Report

Test Summary

Overall Test Result	**Pass**
Machine Name	EX8PESRP02
Test Description	
Test Start Time	4/25/2011 12:56:04 AM
Test End Time	4/25/2011 2:05:00 AM
Collection Start Time	4/25/2011 12:56:26 AM
Collection End Time	4/25/2011 2:04:43 AM

Jetstress Version	14.01.0180.003
Ese Version	14.01.0218.012
Operating System	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2011_4_25_0_56_9.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	166.291
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	1391572090880
Final Database Size (bytes)	1391874080768
Database Files (Count)	1

Jetstress System Parameters

Thread Count	2 (per database)
Minimum Database Cache	32.0 MB
Maximum Database Cache	256.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance3156.1	Log Path: L:\ Database: E:\Jetstress001001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database 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
Instance3156.1	9.250	9.508	105.074	61.217	32769.667	37439.931	0.000	3.938	0.000	52.390	0.000	5075.676

Host System Performance

Counter	Average	Minimum	Maximum

% Processor Time	1.009	0.493	2.962
Available MBytes	6880.318	6868.000	7084.000
Free System Page Table Entries	33555416.668	33555005.000	33556103.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	43054072.526	43040768.000	43130880.000
Pool Paged Bytes	106210490.861	105996288.000	109105152.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

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