

ESRP Storage Program

EMC Celerra NX4 (800 User) Storage Solution for Microsoft Exchange Server 2007 SP1

Tested with: ESRP – Storage Version 2.1
Tested Date: 7/18/2008

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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, refer to [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 <http://www.microsoft.com/technet/prodtechnol/exchange/2007/esrp.msp>

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Features

This document describes an approach that can be used to configure Microsoft Exchange 2007 with an EMC Celerra NX4 storage system. The EMC Celerra NX4 meets the storage needs of a wide range of applications that include:

- Mail/Messaging
- Databases
- File/Print and Web services
- Distributed applications
- Remote replication

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

The Celerra NX4 is a high-performance, full function IP storage platform. It delivers NAS and iSCSI capabilities to consolidate application storage and file servers. Easy to deploy and simple to manage, the NX4 is all-in-one IP storage for customers looking for enterprise-class capabilities packaged for specific applications, departments, or locations.

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

- Robust snap and replication capabilities offer protection of data
- Celerra File Mover API allows automated policy-based movement of files between tiers of storage
- File Level Retention provides disk-based Write Once Read Many (WORM) functionality, which is useful for archiving Exchange emails
- Automated Volume Management and Virtual Provisioning improve storage utilization

The performance results and best practices discussed in this document provide proven guidelines for configuring the Celerra NX4 for high-performance Exchange environments. For this solution, an integrated Celerra NX4 storage system was used and configured for 800 Exchange 2007 users. Each of the 800 users had a profile of 0.5 IOPS and a 250 MB mailbox.

Solution Description

Sizing and configuring storage for use with Microsoft Exchange server is a complicated process, driven by many variables and factors, which vary from organization to organization.

One method often used to simplify the sizing and configuration of large amounts of EMC Celerra NX4 storage for use with Microsoft Exchange Server 2007 is to define a unit of measure. This unit of measure is known as a building block. The building block of Microsoft Exchange Server 2007 is defined as six-disk spindles, four spindles for Exchange database and two spindles for Exchange log.

The testing in this document proves that one building block meets and exceeds the recommended Microsoft Exchange server metrics for reliability, scalability, and performance.

This unit of measure or building block needs to be scalable. In that way, an organization can simply take this building block and multiply it by some factor until the desired number of Microsoft Exchange Server users has been met while satisfying the Microsoft Exchange Server recommended performance metrics.

If each unit is properly configured, it matches the Microsoft Exchange server recommendations for a healthy-performing system – from disk and an end-user perspective.

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

Table 1 describes the characteristics of the storage configuration.

Table 1: Server Characteristics

| | |
|--|----------------------------------|
| Number of users | 800 |
| Number of Exchange servers | 1 |
| IOPS per user | 0.5 |
| Mailbox size | 250 MB |
| Number of disks required for logs and database | 6 (4 for database and 2 for log) |
| Disk type | 146 GB 15k SAS drives |
| RAID type | 1/0 |

Using the performance characteristics of the Celerra NX4 architecture and the I/O capability of the 146 GB, 15k disk drives, six spindles are required to provide the necessary performance to match the I/O requirements of 800; 0.5 IOPS users with a 1:1 read/write ratio.

Figure 1 illustrates the single building block disk layout on a Celerra NX4.

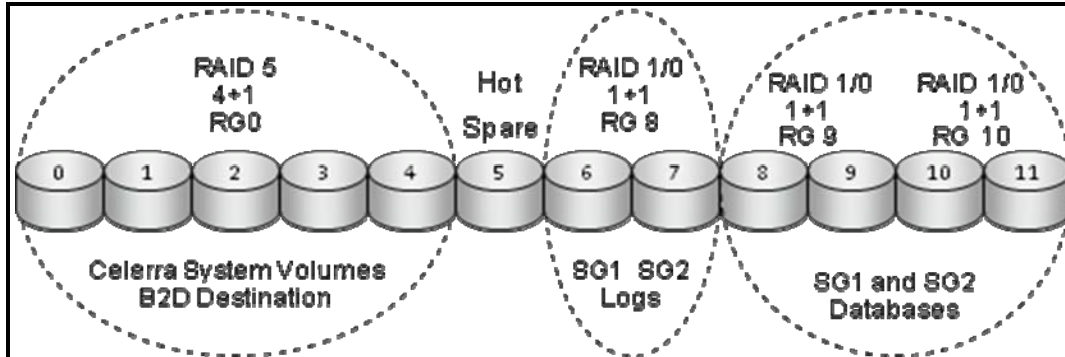


Figure 1: Disk Configuration

The Exchange databases for SG1 and SG2 are striped over four disk spindles from two 1+1 RAID 1/0 groups. The logs for SG1 and SG2 will be stored on a single 1+1 RAID 1/0 group.

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, server 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 for 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 identifying and addressing performance bottlenecks in an Exchange system, refer to Microsoft's Troubleshooting Microsoft Exchange Server Performance, available at <http://go.microsoft.com/fwlink/?LinkId=23454>.

Targeted Customer Profile

The following are the details of the customer type used for this solution:

- One Exchange Jetstress Server
- User I/O profile for testing — 0.42 (0.5 IOPs tested)
- User mailbox size for testing — 250 MB
- Two Exchange storage groups per server
- One Mailbox database per storage group

Tested Deployment

Table 2 lists the simulated Exchange configuration.

Table 2: Simulated exchange configuration

| | |
|---|-----------|
| Number of Exchange mailboxes simulated | 800 |
| Number of hosts | 1 |
| Number of mailboxes/host | 800 |
| Number of storage groups/host | 2 |
| Number of mailbox stores/storage group | 1 |
| Number of mailboxes/mailbox store | 800 |
| Number of mailbox store LUNs/storage group | 1 |
| Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom) | 0.5 |
| Database LUN size | 118.1 GB |
| Log LUN size | 20 GB |
| Backup LUN size/storage group | 199.1 GB |
| Total database size for performance testing | 194.44 GB |
| % storage capacity used by Exchange database** | 82.3% |

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

Primary Storage Hardware

Table 3: Hardware used for the testlist the Hardware used in the environment.

Table 3: Hardware used for the test

| | |
|--|---|
| Storage connectivity (Fibre Channel, SAS, SATA, iSCSI) | iSCSI |
| Storage model and OS/firmware revision | EMC Celerra Version 5.6.39.0 |
| Storage cache | 2 GB Split for Write/Read |
| Number of storage controllers | 4 (2 Frontend, 2 Backend) |
| Number of storage ports | 4 (of the total 8 ports, 4 are passive/redundant) |
| Maximum bandwidth of storage | 2x1Gb iSCSI Total bandwidth 4 Gb/s |

| | |
|--|---|
| connectivity to host | |
| Switch type/model/firmware revision | Cisco /6509-E/ IOS version 12.2 |
| HBA model and firmware | Intel PRO/1000 PT Dual Port server |
| Number of HBAs/host | 2 Dual Port HBAs |
| Host server type | Dell PowerEdge 6950 |
| Total number of disks tested in solution | 11 (6 for databases and logs, 5 for backup) |
| Maximum number of spindles that can be hosted in the storage | 60 |

Primary Storage Software

Table 4 lists the software configuration used in the environment.

Table 4: Primary Storage Software

| | |
|-----------------------------------|---|
| HBA driver | Microsoft iSCSI Initiator 2.06-build3497, driver version: 9.12.18.0 |
| HBA QueueTarget Setting | N/A |
| HBA QueueDepth Setting | N/A |
| Multi-Pathing | Multiple connections per session |
| Host OS | Microsoft Windows Server 2003 Enterprise X64 edition SP2 |
| ESE.dll file version | 08.01.0240.005 |
| Replication solution name/version | N/A |

Primary Storage Disk Configuration (mailbox store disks)

Table 5 lists the disk configuration (mailbox store disks) for the environment

Table 5: Storage Disk configuration

| | |
|---|-----------------------------------|
| Disk type, speed and firmware revision | 3 Gbps SAS 15k rpm, firmware ES01 |
| Raw capacity per disk (GB) | 146 GB |
| Number of physical disks in test | 4 |
| total raw storage capacity (GB) | 584 GB |
| Disk slice size (GB) | N/A |
| Number of slices per LUN or number of disks per LUN | 2 disks per LUN |
| RAID level | RAID 1/0 |
| Total formatted capacity | 237.34 GB |
| Storage capacity utilization | 40.6% |
| Database capacity utilization | 33.29% |

Primary Storage Disk Configuration (Transactional Log Disks)

Table 6 shows the disk configuration (transactional log disks) for the environment

Table 6: Storage Disk Configuration (Transactional Log Disks)

| | |
|---|-----------------------------------|
| Disk type, speed and firmware revision | 3 Gbps SAS 15k rpm ,firmware ES01 |
| Raw capacity per disk (GB) | 146 GB |
| Number of Spindles in test | 2 |
| Total raw storage capacity (GB) | 292 GB |
| Disk slice size (GB) | N/A |
| Number of slices per LUN or number of disks per LUN | 2 disks per LUN |
| RAID level | RAID 1/0 |
| Total formatted capacity | 39.8 GB |

Streaming backup

Table 7 lists the storage disk configuration for the Streaming Backup test.

Table 7: Storage Configuration for Streaming Backup to Disk

| | |
|---|-----------------------------------|
| Disk type, speed and firmware revision | 3 Gbps SAS 15k rpm, firmware ES01 |
| Raw capacity per disk (GB) | 146 GB SAS |
| Number of spindles in test | 5 |
| Total raw storage capacity (GB) | 730 GB |
| Disk slice size (GB) | N/A |
| Number of slices per LUN or number of disks per LUN | 2 |
| RAID level | RAID 5 (4+1) |
| Total formatted capacity | 396 GB |

Best Practices

Exchange server is a disk-intensive application. Based on the testing run using the ESRP framework, EMC recommends the best practices explained in this section to improve the storage performance.

The Exchange 2007 best practices on storage design, is available at <http://technet.microsoft.com/en-us/library/bb124518.aspx>

Core Storage

The following are the best practices for core storage:

1. Use DISKPART (in Microsoft Windows Server 2003 Enterprise X64 Edition SP2) to align all Microsoft Exchange related disks. Use a value of 64 for iSCSI LUNs to align the NTFS partitions at a 64 KB boundary.
2. Isolate the Microsoft Exchange Server database workload from other I/O-intensive applications or workloads. This ensures the highest levels of performance for Microsoft Exchange and simplifies troubleshooting in the event of a disk-related Microsoft Exchange performance problem.
3. The Microsoft Exchange Server logs and databases should be separated onto different physical disks and in different RAID groups.
4. Size and configure the environment based on disk spindle performance which is a primary consideration. Wherein, the spindle or storage capacity is a secondary issue. In other words, adjust the size for performance first so that the capacity requirements also work.

Backup Strategy

A well-designed and implemented disaster recovery strategy should be a top priority for every Microsoft Exchange Server deployment. Proper planning must be done prior to configuration to meet the required service-level agreements (SLAs) for server downtime. Various backup and restore strategies can be implemented, depending on the requirements of the environment. EMC offers multiple solutions to protect an Exchange environment. EMC Replication Manager can manage snapshot and replication in an Exchange environment. EMC NetWorker® allows an Exchange environment to be backed up to tape or to disk. Both of these products work in conjunction with Volume Shadow Copy Services (VSS) as proven techniques, having undergone vigorous testing.

In this solution, the tested method for backup was a one stage disk-to-disk backup. With this configuration, several best practice considerations must be understood to achieve optimal performance.

Some of the best practices are as follows:

- Disk to disk backup LUNs should be configured in separate disk groups. Workload isolation will optimize the performance of the streaming backups and minimize the impact on the production workload.
- Higher capacity SATA drives should be utilized if the environment requires additional backup copies of the data on the primary disks.

Test Results 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 ESRP testing framework.

Reliability

A number of tests in the framework are to check Reliability test runs 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 will be analyzed for integrity after the stress test to ensure no database/log corruption.

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

- No errors were reported in the event log file for the storage reliability testing
- No errors were reported for the database and log checksum
- No errors were reported in the event log file for the backup-to-disk test

The Jetstress performance results (24-hour performance test) can be found in [Appendix A - Stress Test Report \(24 hrs Performance Test\)](#).

Primary Storage Performance Results

The Primary Storage performance testing is designed to exercise the storage with 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 8](#) shows performance results of all the logical disk I/Os and average of all the logical disks I/O latency during the 2-hour test.

Table 8: Performance Results

| | |
|--|---------|
| Database I/O | |
| Database Disks Transfers/sec | 430.404 |
| Database Disks Reads/sec | 202.659 |
| Database Disks Writes/sec | 227.745 |
| Average Database Disk Read Latency (ms) | 13 |
| Average Database Disk Write Latency (ms) | 3 |
| Transaction Log I/O | |
| Log Disks Writes/sec | 137.579 |
| Average Log Disk Write Latency (ms) | 2 |

The Jetstress performance results (2-hour performance test) are available in [Appendix B - Performance Test Results](#).

Also, refer to [Appendix E - Maximum Solution IOPS Testing](#) to obtain results that characterize the maximum performance of the disk layout.

Streaming Backup/Recovery Performance

There are two tests in this section. The first test is to measure the read I/O performance metrics by running checksum on all the databases and log files. The second test is to measure the end-to-end performance when the databases are backed up to disks.

Database Read-Only Performance

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

Table 9: Database Read-Only Performance

| | |
|-------------------------------|-------|
| MB read/sec per storage group | 9.22 |
| MB read/sec total | 18.44 |

Log Read-Only performance

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

Table 10: Log Read-only Performance

| | |
|---|------|
| Average time to play one Log file (sec) | 1.08 |
|---|------|

Backup to disk performance

This test runs backup on all the database files, and stores them on disks. The following table shows an average rate at which each storage group can be backed up at.

Table 11: Backup to disk performance

| | |
|--|-------------|
| Total database size per storage group (GB) | 189.8804102 |
| Time taken to backup each storage group | 2:55:46 |
| Average MB backed up/sec per storage group | 9.22 |

Conclusion

This document is developed by storage solution providers, and reviewed by the Microsoft Exchange Product team. The test results/data presented in this document is 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.

The ESRP program is not designed to be a benchmarking program; tests are not designed to receive 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.

Contact information

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<http://EMC.com>

<http://powerlink.EMC.com>

Appendix A - Stress Test Report (24 hrs Performance Test)

Microsoft Exchange Server Jetstress
Stress Test Result Report
Test Summary

Overall Test Result **Pass**

Machine Name RTPSOL402

Test

Description

Test Start Time 7/19/2008 9:18:51 AM

Test End Time 7/20/2008 9:28:02 AM

Jetstress 08.02.0050.000

Version

Ese Version 08.01.0240.005

Operating System Microsoft Windows Server 2003 Service Pack 2
(5.2.3790.131072)

Performance Log [C:\Program Files\Exchange
Jetstress\Stress_2008_7_19_9_18_56.blg](C:\Program Files\Exchange Jetstress\Stress_2008_7_19_9_18_56.blg)
[C:\Program Files\Exchange
Jetstress\DBChecksum_2008_7_20_9_28_2.blg](C:\Program Files\Exchange Jetstress\DBChecksum_2008_7_20_9_28_2.blg)

Database Sizing and Throughput

Achieved I/O per Second 422.061

Capacity Percentage 100%

Throughput Percentage 100%

Initial database size 203886723072

Final database size 219416133632

Database files (count) 2

Jetstress System Parameters

Thread count 4 (per-storage group)

Log buffers 9000

Minimum database cache 64.0 MB

Maximum database cache 512.0 MB

Insert operations 40%

Delete operations 30%

Replace operations 5%

Read operations 25%

Lazy commits 55%

Disk Subsystem Performance

| LogicalDisk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec | Avg. Disk Bytes/Write |
|---------------|--------------------|---------------------|----------------|-----------------|-----------------------|
| Database (F:) | 0.013 | 0.004 | 104.095 | 107.443 | (n/a) |
| Database (G:) | 0.014 | 0.004 | 103.576 | 106.946 | (n/a) |
| Log (K:) | 0.002 | 0.002 | 1.016 | 64.351 | 4478.563 |
| Log (N:) | 0.002 | 0.002 | 1.008 | 64.098 | 4469.351 |

Host System Performance

| Counter | Average | Minimum | Maximum |
|---------------------------------|---------------|---------------|---------------|
| % Processor Time | 0.688 | 0.130 | 9.154 |
| Available MBytes | 6467.617 | 6452.000 | 6514.000 |
| Free System Page Table Entries | 16755186.992 | 16755164.000 | 16755187.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 66689600.000 | 65335296.000 | 67653632.000 |
| Pool Paged Bytes | 146165720.178 | 145584128.000 | 147005440.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

Test Log

7/18/2008 10:27:43 PM -- Prepare testing begins ...
7/18/2008 10:27:43 PM -- Creating F:\Jetstress1.edb.
7/18/2008 10:27:43 PM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
7/18/2008 10:27:43 PM -- Database flush thresholds: (start: 2.6 MB, stop: 5.1 MB)
7/18/2008 10:52:43 PM -- 60.0% of 94.9 GB complete (11592968 records inserted).
7/18/2008 11:32:28 PM -- 100.0% of 94.9 GB complete (20179689 records inserted).
7/18/2008 11:32:31 PM -- Duplicating 2 databases:
7/19/2008 12:22:12 AM -- 100.0% of 189.9 GB complete (189.9 GB duplicated).
7/19/2008 12:22:15 AM -- Attaching databases ...
7/19/2008 12:22:15 AM -- Prepare testing ends.
7/19/2008 9:18:50 AM -- Jetstress testing begins ...
7/19/2008 9:18:51 AM -- Prepare testing begins ...
7/19/2008 9:18:53 AM -- Attaching databases ...
7/19/2008 9:18:53 AM -- Prepare testing ends.
7/19/2008 9:18:53 AM -- Dispatching transactions begins ...

7/19/2008 9:18:53 AM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
7/19/2008 9:18:53 AM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
7/19/2008 9:18:56 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.1 seconds/read).
7/19/2008 9:18:56 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.1 seconds/write).
7/19/2008 9:18:57 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.
7/19/2008 9:18:57 AM -- Performance logging begins (interval: 15000 ms).
7/19/2008 9:18:57 AM -- Attaining prerequisites:
7/19/2008 9:27:59 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 483729400.0 (lower bound: 483183800.0, upper bound: none)
7/20/2008 9:28:00 AM -- Performance logging ends.
7/20/2008 9:28:00 AM -- JetInterop batch transaction stats: 285449, and 283979.
7/20/2008 9:28:01 AM -- Dispatching transactions ends.
7/20/2008 9:28:01 AM -- Shutting down databases ...
7/20/2008 9:28:02 AM -- Instance1588.1 (complete), and Instance1588.2 (complete)
7/20/2008 9:28:02 AM -- Performance logging begins (interval: 15000 ms).
7/20/2008 9:28:02 AM -- Verifying database checksums ...
7/20/2008 10:01:20 AM -- F: (100% processed), and G: (100% processed)
7/20/2008 10:01:21 AM -- Performance logging ends.
7/20/2008 10:01:21 AM -- <C:\Program Files\Exchange Jetstress\DBChecksum 2008 7 20 9 28 2.blg> has 133 samples.
7/20/2008 10:01:24 AM -- <C:\Program Files\Exchange Jetstress\DBChecksum 2008 7 20 9 28 2.html> is saved.
7/20/2008 10:01:24 AM -- Verifying log checksums ...
7/20/2008 10:01:24 AM -- K:\ (3 logs passed), and N:\ (2 logs passed)
7/20/2008 10:01:24 AM -- <C:\Program Files\Exchange Jetstress\Stress 2008 7 19 9 18 56.blg> has 5796 samples.
7/20/2008 10:01:24 AM -- Creating test report ...
7/20/2008 10:02:35 AM -- Volume F: has 0.0132 for Avg. Disk sec/Read.
7/20/2008 10:02:35 AM -- Volume G: has 0.0136 for Avg. Disk sec/Read.
7/20/2008 10:02:35 AM -- Volume K: has 0.0022 for Avg. Disk sec/Write.
7/20/2008 10:02:35 AM -- Volume K: has 0.0024 for Avg. Disk sec/Read.
7/20/2008 10:02:35 AM -- Volume N: has 0.0022 for Avg. Disk sec/Write.
7/20/2008 10:02:35 AM -- Volume N: has 0.0024 for Avg. Disk sec/Read.
7/20/2008 10:02:35 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
7/20/2008 10:02:35 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
7/20/2008 10:02:35 AM -- <C:\Program Files\Exchange Jetstress\Stress 2008 7 19 9 18 56.xml> has 5759 samples queried.

Microsoft Exchange Server **Jetstress**
 Stress Test Result Report
 Checksum Statistics - All

| Database | Seen pages | Bad pages | Correctable pages | Wrong page no pages | File length / seconds taken |
|--------------------------|------------|-----------|-------------------|---------------------|------------------------------|
| F:\Jetstress1.edb | 13393506 | 0 | 0 | 0 | 104636 MBytes / 1862 seconds |
| G:\Jetstress1.edb | 13390690 | 0 | 0 | 0 | 104614 MBytes / 1997 seconds |
| (Sum) | 26784196 | 0 | 0 | 0 | 209251 MBytes / 1997 seconds |

Disk Subsystem Performance (of checksum)

| LogicalDisk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec |
|-------------|--------------------|---------------------|----------------|-----------------|
| F: | 0.059 | 0.001 | 899.862 | 0.007 |
| G: | 0.061 | 0.001 | 837.344 | 0.004 |

Memory System Performance (of checksum)

| Counter | Average | Minimum | Maximum |
|--|---------------|---------------|---------------|
| % Processor Time | 8.970 | 6.745 | 11.810 |
| Available MBytes | 6990.226 | 6979.000 | 6998.000 |
| Free System Page Table Entries | 16755187.000 | 16755187.000 | 16755187.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 65888409.985 | 65642496.000 | 66387968.000 |
| Pool Paged Bytes | 147628647.940 | 147365888.000 | 147898368.000 |

Test Log

7/18/2008 10:27:43 PM -- Prepare testing begins ...
 7/18/2008 10:27:43 PM -- Creating F:\Jetstress1.edb.
 7/18/2008 10:27:43 PM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
 7/18/2008 10:27:43 PM -- Database flush thresholds: (start: 2.6 MB, stop: 5.1 MB)
 7/18/2008 10:52:43 PM -- 60.0% of 94.9 GB complete (11592968 records inserted).
 7/18/2008 11:32:28 PM -- 100.0% of 94.9 GB complete (20179689 records

inserted).

7/18/2008 11:32:31 PM -- Duplicating 2 databases:

7/19/2008 12:22:12 AM -- 100.0% of 189.9 GB complete (189.9 GB duplicated).

7/19/2008 12:22:15 AM -- Attaching databases ...

7/19/2008 12:22:15 AM -- Prepare testing ends.

7/19/2008 9:18:50 AM -- Jetstress testing begins ...

7/19/2008 9:18:51 AM -- Prepare testing begins ...

7/19/2008 9:18:53 AM -- Attaching databases ...

7/19/2008 9:18:53 AM -- Prepare testing ends.

7/19/2008 9:18:53 AM -- Dispatching transactions begins ...

7/19/2008 9:18:53 AM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)

7/19/2008 9:18:53 AM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)

7/19/2008 9:18:56 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.1 seconds/read).

7/19/2008 9:18:56 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.1 seconds/write).

7/19/2008 9:18:57 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

7/19/2008 9:18:57 AM -- Performance logging begins (interval: 15000 ms).

7/19/2008 9:18:57 AM -- Attaining prerequisites:

7/19/2008 9:27:59 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 483729400.0 (lower bound: 483183800.0, upper bound: none)

7/20/2008 9:28:00 AM -- Performance logging ends.

7/20/2008 9:28:00 AM -- JetInterop batch transaction stats: 285449, and 283979.

7/20/2008 9:28:01 AM -- Dispatching transactions ends.

7/20/2008 9:28:01 AM -- Shutting down databases ...

7/20/2008 9:28:02 AM -- Instance1588.1 (complete), and Instance1588.2 (complete)

7/20/2008 9:28:02 AM -- Performance logging begins (interval: 15000 ms).

7/20/2008 9:28:02 AM -- Verifying database checksums ...

7/20/2008 10:01:20 AM -- F: (100% processed), and G: (100% processed)

7/20/2008 10:01:21 AM -- Performance logging ends.

7/20/2008 10:01:21 AM -- [C:\Program Files\Exchange Jetstress\DBChecksum_2008_7_20_9_28_2.blg](#) has 133 samples.

Appendix B - Performance Test Results

Microsoft Exchange Server Jetstress
Performance Test Result Report
Test Summary

Overall Test Result **Pass**

Machine Name RTPSOL402

Test Description

Test Start Time 7/18/2008 7:04:33 PM

Test End Time 7/18/2008 9:14:02 PM

Jetstress Version 08.02.0050.000

Ese Version 08.01.0240.005

Operating System Microsoft Windows Server 2003 Service Pack 2
(5.2.3790.131072)

Performance Log [C:\Program Files\Exchange
Jetstress\Performance_2008_7_18_19_4_38.blg](C:\Program Files\Exchange Jetstress\Performance_2008_7_18_19_4_38.blg)
[C:\Program Files\Exchange
Jetstress\DBChecksum_2008_7_18_21_14_2.blg](C:\Program Files\Exchange Jetstress\DBChecksum_2008_7_18_21_14_2.blg)

Database Sizing and Throughput

Achieved I/O per Second 430.404

Capacity Percentage 100%

Throughput Percentage 100%

Initial database size 203886723072

Final database size 205556056064

Database files (count) 2

Jetstress System Parameters

Thread count 4 (per-storage group)
Log buffers 9000
Minimum database cache 64.0 MB
Maximum database cache 512.0 MB
Insert operations 40%
Delete operations 30%
Replace operations 5%
Read operations 25%
Lazy commits 55%

Disk Subsystem Performance

| LogicalDisk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec | Avg. Disk Bytes/Write |
|---------------|--------------------|---------------------|----------------|-----------------|-----------------------|
| Database (F:) | 0.013 | 0.003 | 100.808 | 113.823 | (n/a) |
| Database (G:) | 0.013 | 0.003 | 101.851 | 113.922 | (n/a) |
| Log (K:) | 0.002 | 0.002 | 1.102 | 68.797 | 4538.545 |
| Log (N:) | 0.002 | 0.002 | 1.104 | 68.782 | 4514.433 |

Host System Performance

| Counter | Average | Minimum | Maximum |
|---------------------------------|--------------|--------------|--------------|
| % Processor Time | 0.597 | 0.234 | 1.016 |
| Available MBytes | 6445.431 | 6441.000 | 6489.000 |
| Free System Page Table Entries | 16755187.000 | 16755187.000 | 16755187.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 65821550.933 | 64688128.000 | 66871296.000 |
| Pool Paged Bytes | 79773960.533 | 78467072.000 | 81809408.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

Test Log

7/18/2008 6:03:09 PM -- Prepare testing begins ...
 7/18/2008 6:03:09 PM -- Duplicating 2 databases:
 7/18/2008 6:53:16 PM -- 100.0% of 189.9 GB complete (189.9 GB duplicated).
 7/18/2008 6:53:18 PM -- Attaching databases ...
 7/18/2008 6:53:18 PM -- Prepare testing ends.
 7/18/2008 7:04:33 PM -- Jetstress testing begins ...
 7/18/2008 7:04:33 PM -- Prepare testing begins ...

7/18/2008 7:04:35 PM -- Attaching databases ...
 7/18/2008 7:04:35 PM -- Prepare testing ends.
 7/18/2008 7:04:35 PM -- Dispatching transactions begins ...
 7/18/2008 7:04:36 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
 7/18/2008 7:04:36 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
 7/18/2008 7:04:38 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
 7/18/2008 7:04:38 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
 7/18/2008 7:04:39 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.
 7/18/2008 7:04:39 PM -- Performance logging begins (interval: 15000 ms).
 7/18/2008 7:04:39 PM -- Attaining prerequisites:
 7/18/2008 7:14:00 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 483229700.0 (lower bound: 483183800.0, upper bound: none)
 7/18/2008 9:14:02 PM -- Performance logging ends.
 7/18/2008 9:14:02 PM -- JetInterop batch transaction stats: 27458, and 27639.
 7/18/2008 9:14:02 PM -- Dispatching transactions ends.
 7/18/2008 9:14:02 PM -- Shutting down databases ...
 7/18/2008 9:14:02 PM -- Instance3116.1 (complete), and Instance3116.2 (complete)
 7/18/2008 9:14:03 PM -- Performance logging begins (interval: 15000 ms).
 7/18/2008 9:14:03 PM -- Verifying database checksums ...
 7/18/2008 9:45:18 PM -- F: (100% processed), and G: (100% processed)
 7/18/2008 9:45:19 PM -- Performance logging ends.
 7/18/2008 9:45:19 PM -- <C:\Program Files\Exchange Jetstress\DBChecksum 2008 7 18 21 14 2.blg> has 125 samples.
 7/18/2008 9:45:21 PM -- <C:\Program Files\Exchange Jetstress\DBChecksum 2008 7 18 21 14 2.html> is saved.
 7/18/2008 9:45:21 PM -- Verifying log checksums ...
 7/18/2008 9:45:21 PM -- K:\ (2 logs passed), and N:\ (2 logs passed)
 7/18/2008 9:45:21 PM -- <C:\Program Files\Exchange Jetstress\Performance 2008 7 18 19 4 38.blg> has 517 samples.
 7/18/2008 9:45:21 PM -- Creating test report ...
 7/18/2008 9:45:26 PM -- Volume F: has 0.0134 for Avg. Disk sec/Read.
 7/18/2008 9:45:26 PM -- Volume G: has 0.0135 for Avg. Disk sec/Read.
 7/18/2008 9:45:26 PM -- Volume K: has 0.0021 for Avg. Disk sec/Write.
 7/18/2008 9:45:26 PM -- Volume K: has 0.0023 for Avg. Disk sec/Read.
 7/18/2008 9:45:26 PM -- Volume N: has 0.0021 for Avg. Disk sec/Write.
 7/18/2008 9:45:26 PM -- Volume N: has 0.0024 for Avg. Disk sec/Read.
 7/18/2008 9:45:26 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 7/18/2008 9:45:26 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

7/18/2008 9:45:26 PM -- C:\Program Files\Exchange Jetstress\Performance_2008_7_18_19_4_38.xml has 479 samples queried.

Microsoft Exchange Server **Jetstress**

Test Result Report

Checksum Statistics - All

| Database | Seen pages | Bad pages | Correctable pages | Wrong page no pages | File length / seconds taken |
|--------------------------|------------|-----------|-------------------|---------------------|------------------------------|
| F:\Jetstress1.edb | 12546658 | 0 | 0 | 0 | 98020 MBytes / 1769 seconds |
| G:\Jetstress1.edb | 12545634 | 0 | 0 | 0 | 98012 MBytes / 1874 seconds |
| (Sum) | 25092292 | 0 | 0 | 0 | 196033 MBytes / 1875 seconds |

Disk Subsystem Performance (of checksum)

| LogicalDisk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec |
|-------------|--------------------|---------------------|----------------|-----------------|
| F: | 0.059 | 0.002 | 889.068 | 0.009 |
| G: | 0.061 | 0.002 | 838.769 | 0.007 |

Memory System Performance (of checksum)

| Counter | Average | Minimum | Maximum |
|--|--------------|--------------|--------------|
| % Processor Time | 8.934 | 6.693 | 12.253 |
| Available MBytes | 6971.744 | 6961.000 | 6991.000 |
| Free System Page Table Entries | 16755187.000 | 16755187.000 | 16755187.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 65515552.768 | 65249280.000 | 66408448.000 |
| Pool Paged Bytes | 79214346.240 | 78172160.000 | 80125952.000 |

Test Log

7/18/2008 6:03:09 PM -- Prepare testing begins ...
 7/18/2008 6:03:09 PM -- Duplicating 2 databases:
 7/18/2008 6:53:16 PM -- 100.0% of 189.9 GB complete (189.9 GB duplicated).
 7/18/2008 6:53:18 PM -- Attaching databases ...

7/18/2008 6:53:18 PM -- Prepare testing ends.
7/18/2008 7:04:33 PM -- Jetstress testing begins ...
7/18/2008 7:04:33 PM -- Prepare testing begins ...
7/18/2008 7:04:35 PM -- Attaching databases ...
7/18/2008 7:04:35 PM -- Prepare testing ends.
7/18/2008 7:04:35 PM -- Dispatching transactions begins ...
7/18/2008 7:04:36 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
7/18/2008 7:04:36 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
7/18/2008 7:04:38 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
7/18/2008 7:04:38 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
7/18/2008 7:04:39 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.
7/18/2008 7:04:39 PM -- Performance logging begins (interval: 15000 ms).
7/18/2008 7:04:39 PM -- Attaining prerequisites:
7/18/2008 7:14:00 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 483229700.0 (lower bound: 483183800.0, upper bound: none)
7/18/2008 9:14:02 PM -- Performance logging ends.
7/18/2008 9:14:02 PM -- JetInterop batch transaction stats: 27458, and 27639.
7/18/2008 9:14:02 PM -- Dispatching transactions ends.
7/18/2008 9:14:02 PM -- Shutting down databases ...
7/18/2008 9:14:02 PM -- Instance3116.1 (complete), and Instance3116.2 (complete)
7/18/2008 9:14:03 PM -- Performance logging begins (interval: 15000 ms).
7/18/2008 9:14:03 PM -- Verifying database checksums ...
7/18/2008 9:45:18 PM -- F: (100% processed), and G: (100% processed)
7/18/2008 9:45:19 PM -- Performance logging ends.
7/18/2008 9:45:19 PM -- [C:\Program Files\Exchange Jetstress\DBChecksum 2008 7 18 21 14 2.blg](#) has 125 samples.

Appendix C - Soft Recovery Test Results

Microsoft Exchange Server **Jetstress**
SoftRecovery Test Result Report
Test Summary

Overall Test Result **Pass**

Machine Name RTPSOL402

Test Description

Test Start Time 7/20/2008 10:07:26 PM

Test End Time 7/20/2008 11:09:26 PM

Jetstress Version 08.02.0050.000

Version

Ese Version 08.01.0240.005

Operating System Microsoft Windows Server 2003 Service Pack 2
(5.2.3790.131072)

Performance Log C:\Program Files\Exchange\Jetstress\Performance_2008_7_20_22_7_32.blg

Database Sizing and Throughput

Achieved I/O per Second 426.905

Capacity Percentage 100%

Throughput Percentage 100%

Initial database size 203886723072

Final database size 204681543680

Database files (count) 2

Jetstress System Parameters

Thread count 4 (per-storage group)

Log buffers 9000

Minimum database cache 64.0 MB

Maximum database cache 512.0 MB

Insert operations 40%

Delete operations 30%

Replace operations 5%

Read operations 25%

Lazy commits 55%

Disk Subsystem Performance

| LogicalDisk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec | Avg. Disk Bytes/Write |
|---------------|--------------------|---------------------|----------------|-----------------|-----------------------|
| Database (F:) | 0.013 | 0.004 | 100.816 | 113.499 | (n/a) |
| Database (G:) | 0.013 | 0.004 | 100.448 | 112.142 | (n/a) |
| Log (K:) | 0.003 | 0.002 | 1.127 | 68.268 | 4598.270 |
| Log (N:) | 0.002 | 0.002 | 1.136 | 67.772 | 4602.676 |

Host System Performance

| Counter | Average | Minimum | Maximum |
|---------------------------------|---------------|---------------|---------------|
| % Processor Time | 0.675 | 0.286 | 1.094 |
| Available MBytes | 6507.749 | 6461.000 | 6963.000 |
| Free System Page Table Entries | 16755179.955 | 16755177.000 | 16755187.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 66688501.636 | 65712128.000 | 67592192.000 |
| Pool Paged Bytes | 152305465.004 | 148529152.000 | 155410432.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

Test Log

7/20/2008 8:13:54 PM -- Prepare testing begins ...
 7/20/2008 8:13:54 PM -- Duplicating 2 databases:
 7/20/2008 9:10:57 PM -- 100.0% of 189.9 GB complete (189.9 GB duplicated).
 7/20/2008 9:10:59 PM -- Attaching databases ...
 7/20/2008 9:10:59 PM -- Prepare testing ends.
 7/20/2008 10:07:26 PM -- Jetstress testing begins ...
 7/20/2008 10:07:26 PM -- Prepare testing begins ...
 7/20/2008 10:07:29 PM -- Attaching databases ...
 7/20/2008 10:07:29 PM -- Prepare testing ends.
 7/20/2008 10:07:29 PM -- Dispatching transactions begins ...
 7/20/2008 10:07:29 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
 7/20/2008 10:07:29 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
 7/20/2008 10:07:32 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
 7/20/2008 10:07:32 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
 7/20/2008 10:07:33 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.

7/20/2008 10:07:33 PM -- Performance logging begins (interval: 15000 ms).
 7/20/2008 10:07:33 PM -- Generating log files ...
 7/20/2008 11:09:24 PM -- K:\ (101.4% generated), and N:\ (100.2% generated)
 7/20/2008 11:09:25 PM -- Performance logging ends.
 7/20/2008 11:09:25 PM -- JetInterop batch transaction stats: 13133, and 13068.
 7/20/2008 11:09:25 PM -- Dispatching transactions ends.
 7/20/2008 11:09:25 PM -- Shutting down databases ...
 7/20/2008 11:09:26 PM -- Instance2456.1 (complete), and Instance2456.2 (complete)
 7/20/2008 11:09:26 PM -- [C:\Program Files\Exchange Jetstress\Performance_2008_7_20_22_7_32.blg](#) has 247 samples.
 7/20/2008 11:09:26 PM -- Creating test report ...
 7/20/2008 11:09:27 PM -- Volume F: has 0.0133 for Avg. Disk sec/Read.
 7/20/2008 11:09:27 PM -- Volume G: has 0.0135 for Avg. Disk sec/Read.
 7/20/2008 11:09:27 PM -- Volume K: has 0.0022 for Avg. Disk sec/Write.
 7/20/2008 11:09:27 PM -- Volume K: has 0.0026 for Avg. Disk sec/Read.
 7/20/2008 11:09:27 PM -- Volume N: has 0.0022 for Avg. Disk sec/Write.
 7/20/2008 11:09:27 PM -- Volume N: has 0.0025 for Avg. Disk sec/Read.
 7/20/2008 11:09:28 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 7/20/2008 11:09:28 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 7/20/2008 11:09:28 PM -- [C:\Program Files\Exchange Jetstress\Performance_2008_7_20_22_7_32.xml](#) has 246 samples queried.

Microsoft Exchange Server **Jetstress**

SoftRecovery Test Result Report

Soft-Recovery Statistics - All

| Database Instance | Log files replayed | Elapsed seconds |
|-----------------------|--------------------|-----------------|
| Instance2456.1 | 506 | 549.1875 |
| Instance2456.2 | 500 | 544.1875 |

Disk Subsystem Performance

| LogicalDisk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec | Avg. Disk Bytes/Write |
|----------------------|--------------------|---------------------|----------------|-----------------|-----------------------|
| Database (F:) | 0.173 | 0.044 | 421.532 | 8.815 | (n/a) |
| Database (G:) | 0.167 | 0.041 | 414.119 | 8.847 | (n/a) |
| Log (K:) | 0.008 | 0.029 | 30.343 | 1.106 | 2373.705 |
| Log (N:) | 0.007 | 0.008 | 30.232 | 1.152 | 2589.257 |

Host System Performance

| Counter | Average | Minimum | Maximum |
|---------------------------------|---------------|---------------|---------------|
| % Processor Time | 1.818 | 0.879 | 4.199 |
| Available MBytes | 6663.420 | 6453.000 | 7098.000 |
| Free System Page Table Entries | 16755177.000 | 16755177.000 | 16755177.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 67120015.883 | 66150400.000 | 68501504.000 |
| Pool Paged Bytes | 152861793.168 | 149020672.000 | 216129536.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

Test Log

7/20/2008 8:13:54 PM -- Prepare testing begins ...
7/20/2008 8:13:54 PM -- Duplicating 2 databases:
7/20/2008 9:10:57 PM -- 100.0% of 189.9 GB complete (189.9 GB duplicated).
7/20/2008 9:10:59 PM -- Attaching databases ...
7/20/2008 9:10:59 PM -- Prepare testing ends.
7/20/2008 10:07:26 PM -- Jetstress testing begins ...
7/20/2008 10:07:26 PM -- Prepare testing begins ...
7/20/2008 10:07:29 PM -- Attaching databases ...
7/20/2008 10:07:29 PM -- Prepare testing ends.
7/20/2008 10:07:29 PM -- Dispatching transactions begins ...
7/20/2008 10:07:29 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
7/20/2008 10:07:29 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
7/20/2008 10:07:32 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
7/20/2008 10:07:32 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
7/20/2008 10:07:33 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.
7/20/2008 10:07:33 PM -- Performance logging begins (interval: 15000 ms).
7/20/2008 10:07:33 PM -- Generating log files ...
7/20/2008 11:09:24 PM -- K:\ (101.4% generated), and N:\ (100.2% generated)
7/20/2008 11:09:25 PM -- Performance logging ends.
7/20/2008 11:09:25 PM -- JetInterop batch transaction stats: 13133, and 13068.
7/20/2008 11:09:25 PM -- Dispatching transactions ends.
7/20/2008 11:09:25 PM -- Shutting down databases ...
7/20/2008 11:09:26 PM -- Instance2456.1 (complete), and Instance2456.2 (complete)
7/20/2008 11:09:26 PM -- [C:\Program Files\Exchange](#)

[Jetstress\Performance_2008_7_20_22_7_32.blg](#) has 247 samples.
7/20/2008 11:09:26 PM -- Creating test report ...
7/20/2008 11:09:27 PM -- Volume F: has 0.0133 for Avg. Disk sec/Read.
7/20/2008 11:09:27 PM -- Volume G: has 0.0135 for Avg. Disk sec/Read.
7/20/2008 11:09:27 PM -- Volume K: has 0.0022 for Avg. Disk sec/Write.
7/20/2008 11:09:27 PM -- Volume K: has 0.0026 for Avg. Disk sec/Read.
7/20/2008 11:09:27 PM -- Volume N: has 0.0022 for Avg. Disk sec/Write.
7/20/2008 11:09:27 PM -- Volume N: has 0.0025 for Avg. Disk sec/Read.
7/20/2008 11:09:28 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
7/20/2008 11:09:28 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
7/20/2008 11:09:28 PM -- [C:\Program Files\Exchange](#)
[Jetstress\Performance_2008_7_20_22_7_32.xml](#) has 246 samples queried.
7/20/2008 11:09:28 PM -- [C:\Program Files\Exchange](#)
[Jetstress\Performance_2008_7_20_22_7_32.html](#) is saved.
7/20/2008 11:09:29 PM -- Performance logging begins (interval: 2000 ms).
7/20/2008 11:09:29 PM -- Recovering databases ...
7/20/2008 11:18:39 PM -- Performance logging ends.
7/20/2008 11:18:39 PM -- Instance2456.1 (549.1875), and Instance2456.2 (544.1875)
7/20/2008 11:18:39 PM -- [C:\Program Files\Exchange](#)
[Jetstress\SoftRecovery_2008_7_20_23_9_28.blg](#) has 274 samples.
7/20/2008 11:18:39 PM -- Creating test report ...

Appendix D - Streaming Backup Test Results

Microsoft Exchange Server **Jetstress**
 Streaming backup Test Result Report
 Streaming Backup Statistics - All

| Database Instance | Database Size (MBytes) | Elapsed Backup Time | MBytes Transferred/sec |
|-----------------------|------------------------|---------------------|------------------------|
| Instance3232.1 | 97218.77 | 02:54:14 | 9.30 |
| Instance3232.2 | 97218.77 | 02:57:18 | 9.14 |

Jetstress System Parameters

| | |
|-------------------------------|-----------------------|
| Thread count | 4 (per-storage group) |
| Log buffers | 9000 |
| Minimum database cache | 64.0 MB |
| Maximum database cache | 512.0 MB |
| Insert operations | 40% |
| Delete operations | 30% |
| Replace operations | 5% |
| Read operations | 25% |
| Lazy commits | 55% |

Disk Subsystem Performance

| Logical Disk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec | Avg. Disk Bytes/Write |
|----------------------|----------------------|----------------------|----------------|-----------------|-----------------------|
| Database (F:) | 0.004 | 0.000 | 73.151 | 0.008 | (n/a) |
| Database (G:) | 0.004 | 8.55138152506574E-05 | 73.082 | 0.003 | (n/a) |
| Log (K:) | 6.49141043877886E-06 | 0.000 | 0.002 | 0.006 | 60.692 |
| Log (N:) | 9.19137761243024E-07 | 6.90066382171645E-05 | 0.001 | 0.003 | 29.132 |

Host System Performance

| Counter | Average | Minimum | Maximum |
|---------------------------------------|--------------|--------------|--------------|
| % Processor Time | 31.269 | 7.575 | 55.463 |
| Available MBytes | 6797.801 | 6596.000 | 7017.000 |
| Free System Page Table Entries | 16754987.000 | 16754987.000 | 16754987.000 |

| | | | |
|--|---------------|--------------|---------------|
| Transition Pages RePurposed/sec | 4545.783 | 0.000 | 12785.646 |
| Pool Nonpaged Bytes | 73173166.545 | 68460544.000 | 76075008.000 |
| Pool Paged Bytes | 323263738.182 | 69500928.000 | 530587648.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

Test Log

7/21/2008 2:03:43 PM -- Prepare testing begins ...
7/21/2008 2:03:43 PM -- Duplicating 2 databases:
7/21/2008 2:59:48 PM -- 100.0% of 189.9 GB complete (189.9 GB duplicated).
7/21/2008 2:59:50 PM -- Attaching databases ...
7/21/2008 2:59:50 PM -- Prepare testing ends.
7/21/2008 3:00:44 PM -- Jetstress testing begins ...
7/21/2008 3:00:44 PM -- Prepare testing begins ...
7/21/2008 3:00:47 PM -- Attaching databases ...
7/21/2008 3:00:47 PM -- Prepare testing ends.
7/21/2008 3:00:50 PM -- Performance logging begins (interval: 15000 ms).
7/21/2008 3:00:50 PM -- Streaming backup databases ...
7/21/2008 5:58:09 PM -- Performance logging ends.
7/21/2008 5:58:09 PM -- Instance3232.1 (100% processed), and Instance3232.2 (100% processed)
7/21/2008 5:58:09 PM -- [C:\Program Files\Exchange Jetstress\StreamingBackup_2008_7_21_15_0_47.blg](#) has 704 samples.
7/21/2008 5:58:10 PM -- Creating test report ...

Appendix E - Maximum Solution IOPS Testing

The building block described in this section is the EMC recommended configuration for 800 Exchange user workload at 0.5 IOPS per user. The result shown in [Appendix A - Stress Test Report \(24 hrs Performance Test\)](#) illustrates that this 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 or 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.

After ensuring that the building block could easily satisfy the ESRP criteria, subsequent tests were run to determine the upper limits of the configuration. The number of Jetstress threads increased from 4 to 9 without modifying any of the other components. The achieved IOPS increased from 430 to 729, at 69.4 percent increase. While this workload is not recommended for customers, as it is close to the maximum acceptable latency for ESRP, it highlights the headroom in the recommended building block.

Maximum Performance Test Report

Microsoft Exchange Server **Jetstress**
Performance Test Result Report
Test Summary

Overall Test Result **Pass**

Machine Name RTPSOL402

Test

Description

Test Start Time 7/12/2008 9:36:38 PM

Test End Time 7/12/2008 11:42:31 PM

Jetstress Version 08.02.0050.000

Ese Version

08.01.0240.005

Operating System

Microsoft Windows Server 2003 Service Pack 2
(5.2.3790.131072)

Performance Log

[C:\Program Files\Exchange
Jetstress\Performance_2008_7_12_21_36_44.blg](#)
[C:\Program Files\Exchange
Jetstress\DBChecksum_2008_7_12_23_42_31.blg](#)

Database Sizing and Throughput

Achieved I/O per Second 729.643
Capacity Percentage 100%
Throughput Percentage 100%
Initial database size 200829075456
Final database size 203280646144
Database files (count) 2

Jetstress System Parameters

Thread count 9 (per-storage group)
Log buffers 9000
Minimum database cache 64.0 MB
Maximum database cache 512.0 MB
Insert operations 40%
Delete operations 30%
Replace operations 5%
Read operations 25%
Lazy commits 55%

Disk Subsystem Performance

| LogicalDisk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec | Avg. Disk Bytes/Write |
|---------------|--------------------|---------------------|----------------|-----------------|-----------------------|
| Database (F:) | 0.019 | 0.003 | 160.430 | 206.391 | (n/a) |
| Database (G:) | 0.018 | 0.003 | 159.898 | 202.924 | (n/a) |
| Log (K:) | 0.003 | 0.002 | 1.765 | 107.687 | 4651.650 |
| Log (U:) | 0.002 | 0.002 | 1.764 | 107.101 | 4626.303 |

Host System Performance

| Counter | Average | Minimum | Maximum |
|---------------------------------|---------------|---------------|---------------|
| % Processor Time | 1.140 | 0.676 | 1.771 |
| Available MBytes | 6376.671 | 6373.000 | 6427.000 |
| Free System Page Table Entries | 16754467.000 | 16754467.000 | 16754467.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 74699810.133 | 73789440.000 | 75575296.000 |
| Pool Paged Bytes | 272105907.200 | 271851520.000 | 272580608.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

Test Log

7/12/2008 7:53:25 PM -- Prepare testing begins ...
7/12/2008 7:53:25 PM -- Creating F:\Jetstress1.edb.
7/12/2008 7:53:25 PM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
7/12/2008 7:53:25 PM -- Database flush thresholds: (start: 2.6 MB, stop: 5.1 MB)
7/12/2008 8:20:13 PM -- 60.0% of 93.5 GB complete (11418493 records inserted).
7/12/2008 8:52:57 PM -- 100.0% of 93.5 GB complete (17767685 records inserted).
7/12/2008 8:53:02 PM -- Duplicating 1 databases:
7/12/2008 9:30:40 PM -- 100.0% of 93.5 GB complete (93.5 GB duplicated).
7/12/2008 9:30:42 PM -- Attaching databases ...
7/12/2008 9:30:42 PM -- Prepare testing ends.
7/12/2008 9:36:38 PM -- Jetstress testing begins ...
7/12/2008 9:36:38 PM -- Prepare testing begins ...
7/12/2008 9:36:41 PM -- Attaching databases ...
7/12/2008 9:36:41 PM -- Prepare testing ends.
7/12/2008 9:36:41 PM -- Dispatching transactions begins ...
7/12/2008 9:36:41 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
7/12/2008 9:36:41 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
7/12/2008 9:36:44 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
7/12/2008 9:36:44 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
7/12/2008 9:36:44 PM -- Operation mix: Sessions 9, Inserts 40%, Deletes 30%, Replaces 5%, Reads 25%, Lazy Commits 55%.
7/12/2008 9:36:44 PM -- Performance logging begins (interval: 15000 ms).
7/12/2008 9:36:44 PM -- Attaining prerequisites:
7/12/2008 9:42:28 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 484335600.0 (lower bound: 483183800.0, upper bound: none)
7/12/2008 11:42:30 PM -- Performance logging ends.
7/12/2008 11:42:30 PM -- JetInterop batch transaction stats: 46268, and 45973.
7/12/2008 11:42:30 PM -- Dispatching transactions ends.
7/12/2008 11:42:30 PM -- Shutting down databases ...
7/12/2008 11:42:31 PM -- Instance728.1 (complete), and Instance728.2 (complete)
7/12/2008 11:42:31 PM -- Performance logging begins (interval: 15000 ms).
7/12/2008 11:42:31 PM -- Verifying database checksums ...
7/13/2008 12:12:54 AM -- F: (100% processed), and G: (100% processed)
7/13/2008 12:12:55 AM -- Performance logging ends.
7/13/2008 12:12:55 AM -- <C:\Program Files\Exchange>

[Jetstress\DBChecksum_2008_7_12_23_42_31.blg](#) has 121 samples.
 7/13/2008 12:12:58 AM -- [C:\Program Files\Exchange](#)
[Jetstress\DBChecksum_2008_7_12_23_42_31.html](#) is saved.
 7/13/2008 12:12:58 AM -- Verifying log checksums ...
 7/13/2008 12:12:58 AM -- K:\ (2 logs passed), and U:\ (2 logs passed)
 7/13/2008 12:12:58 AM -- [C:\Program Files\Exchange](#)
[Jetstress\Performance_2008_7_12_21_36_44.blg](#) has 502 samples.
 7/13/2008 12:12:58 AM -- Creating test report ...
 7/13/2008 12:13:03 AM -- Volume F: has 0.0187 for Avg. Disk sec/Read.
 7/13/2008 12:13:03 AM -- Volume G: has 0.0182 for Avg. Disk sec/Read.
 7/13/2008 12:13:03 AM -- Volume K: has 0.0021 for Avg. Disk sec/Write.
 7/13/2008 12:13:03 AM -- Volume K: has 0.0025 for Avg. Disk sec/Read.
 7/13/2008 12:13:03 AM -- Volume U: has 0.0021 for Avg. Disk sec/Write.
 7/13/2008 12:13:03 AM -- Volume U: has 0.0024 for Avg. Disk sec/Read.
 7/13/2008 12:13:03 AM -- Test has 0 Maximum Database Page Fault
 Stalls/sec.
 7/13/2008 12:13:03 AM -- Test has 0 Database Page Fault Stalls/sec
 samples higher than 0.
 7/13/2008 12:13:03 AM -- [C:\Program Files\Exchange](#)
[Jetstress\Performance_2008_7_12_21_36_44.xml](#) has 479 samples queried.

Microsoft Exchange Server **Jetstress**

Test Result Report

Checksum Statistics - All

| Database | Seen pages | Bad pages | Correctable pages | Wrong page no pages | File length / seconds taken |
|--------------------------|------------|-----------|-------------------|---------------------|------------------------------|
| F:\Jetstress1.edb | 12407906 | 0 | 0 | 0 | 96936 MBytes / 1739 seconds |
| G:\Jetstress1.edb | 12406626 | 0 | 0 | 0 | 96926 MBytes / 1822 seconds |
| (Sum) | 24814532 | 0 | 0 | 0 | 193863 MBytes / 1823 seconds |

Disk Subsystem Performance (of checksum)

| LogicalDisk | Avg. Disk sec/Read | Avg. Disk sec/Write | Disk Reads/sec | Disk Writes/sec |
|-------------|--------------------|---------------------|----------------|-----------------|
| F: | 0.059 | 0.001 | 891.208 | 0.007 |
| G: | 0.061 | 0.001 | 845.287 | 0.006 |

Memory System Performance (of checksum)

| Counter | Average | Minimum | Maximum |
|-------------------------|---------|---------|---------|
| % Processor Time | 9.353 | 6.862 | 12.461 |

| | | | |
|--|---------------|---------------|---------------|
| Available MBytes | 6900.694 | 6893.000 | 6911.000 |
| Free System Page Table Entries | 16754467.000 | 16754467.000 | 16754467.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 73291386.711 | 73093120.000 | 74309632.000 |
| Pool Paged Bytes | 272271173.818 | 271720448.000 | 272711680.000 |

Test Log

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7/12/2008 7:53:25 PM -- Creating F:\Jetstress1.edb.
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(complete)
7/12/2008 11:42:31 PM -- Performance logging begins (interval: 15000 ms).
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7/13/2008 12:12:55 AM -- Performance logging ends.
7/13/2008 12:12:55 AM -- [C:\Program Files\Exchange
Jetstress\DBChecksum_2008_7_12_23_42_31.blg](#) has 121 samples.