

ESRP Storage Program
EMC CX-3-20 (1300 User) iSCSI Storage Solution for
Microsoft Exchange Server 2007

Tested with: ESRP – Storage Version 2.0
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Overview

This document provides information on EMC CX3-20 (1300 User) iSCSI Storage Solution for Microsoft Exchange Server 2007, based on the *Microsoft Exchange Solution Reviewed Program (ESRP) – Storage* program*. For any questions or comments regarding the contents of this document, see the section [Contact Information](#).

*The *ESRP – Storage* program was developed by Microsoft Corporation to provide a common storage testing framework for EMC to provide information on its storage solutions for the Microsoft Exchange Server software. For more details on the *Microsoft ESRP – Storage* program, please visit:

<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 Exchange solutions around EMC's CLARiiON CX3-20 storage systems. Built on the innovative EMC CLARiiON CX3 UltraScale architecture, the EMC CX-3-20 offers exceptional performance, ease-of-use, and unmatched reliability. It meets the storage needs of a wide range of applications including:

- Mail/Messaging
- Databases
- File, Print and Web Services
- Distributed Applications
- Remote Replication

In addition, the CX3-20 supports a wide range of server operating environments such as: Microsoft Windows, Linux, Solaris, AIX, HP-UX, and VMware ESX Server.

The CLARiiON CX3-20 Fibre Channel (FC)/iSCSI array offers both 4 Gb/s FC and 1 Gb/s iSCSI ports fully integrated in the same array, enabling the customers to leverage their networked storage investments over a broader range of servers and applications with complete flexibility and without additional hardware. A total of 8 iSCSI ports (4 per SP) and 4 Fibre Channel ports (2 per SP) are available on each CX3-20 array.

The CLARiiON CX3-20 Fibre Channel (FC)/iSCSI array gives customers an advantage, irrespective of whether or not they currently have iSCSI or FC deployed. For customers who are implementing networked storage for the first time and are considering iSCSI, the CLARiiON CX3-20 Fibre Channel(FC)/iSCSI

array provides scalable iSCSI storage as well as the flexibility and investment protection of integrated FC support, should the customers' business and application needs grow. For customers with existing FC deployments, the CLARiiON CX3-20 Fibre Channel (FC)/iSCSI array offers the opportunity to expand the reach of their networked storage environment economically with iSCSI, while maintaining complete flexibility with regard to how the incremental capacity is shared across server platforms and interconnects.

With the EMC CX3-20, you can choose the drive options that meet your specific needs, thereby providing the flexibility to offer multiple levels of performance in one system. The CX3-20 supports both high-performance and high-capacity disk drives in the same system, can scale from 365 GB to 59TB, and supports 128 high-availability hosts. It supports 4 Gb/s (15kRPM) FC drives for demanding applications requiring maximum performance.

2 Gb/s FC (10k RPM) serves applications that require a balance between performance and costs. Alternatively, low-cost 2 Gb/s FC drives (7.2k RPM) can be chosen for Tier 2 applications such as disk-based backup, requiring high capacities and low cost.

The CX3-20 delivers tiered storage that enables you to provide the right level of performance to the right applications. The system also delivers exceptional 4 Gb/s performance throughout the entire system without compromises or bottlenecks. Performance boosting features include four front-end and two backend 4 Gb/s ports, along with the state-of-the art low latency, high bandwidth I/O interconnect technologies.

The performance results and best practices discussed in this document provide tested guidelines for configuring the EMC CX3-20 for a high-performance Exchange environment. For this solution, a CX3-20 *EMC CLARiiON CX3-20 Storage Solution for Microsoft Exchange Server* storage system was used and configured for 1300 Exchange 2007 users. The server was connected to the CX3-20 through iSCSI using dedicated NICs used for iSCSI with the Microsoft iSCSI software initiator (V2.0.4), and an iSCSI VLAN. Each of the 1300 users is profiled using a value of 1 IOPS per user and a 200 MB mailbox requirement.

Solution Description

The solution described is for utilizing a single CX3-20 and a single disk enclosure (DEA), utilizing 17:146 GB 15,000 RPM FC drives, thus giving the customer the most performance and fault tolerance utilizing Raid 10 for the Exchange Databases and Log files and Raid 5 for backup to disk volumes.

Log files are placed on the first four drives 0_0-0_3 in a Raid 1_0 configuration, and Backup to Disk are placed on drives 0_5-0_9. Database Drives are then placed on drives 0_10-0_13, 1_10-1_13 with drive 0_14, and 1_14 left for hot spares.

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.

The method described in this ESRP submission is the building block method. The building block method is used to simplify the sizing and configuration when using low number of disks to ensure the highest performance while staying fault tolerant.

This unit of measure (or Building Block) is designed to be scalable based on IO and latency requirements of the customer. The building blocks are designed around the Exchange Database drives in 4 drive increments using Raid 1_0, and the Exchange log files are placed onto a 4 drive Raid 1_0 configuration which is capable of holding multiple building blocks SG log files.

The building block is designed with the ability to grow and expand into larger building block deployment models detailed in the EMC ESRP submissions for greater than 4000 users.

http://www.emc.com/techlib/pdf/20084_CX3-20c_iSCSI_4000_Users_Storage_Solution_for_Microsoft_Exchange_Server.pdf

The building blocks help to simplify the design and configuration of a highly available, high performance configuration as a company grows and email requirements increase.

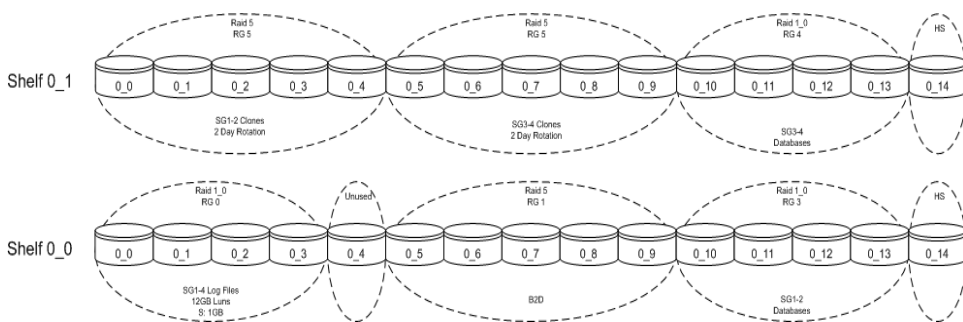


Figure 1 – Building Block 2

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 which affect the server scalability are:

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

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 deployments.

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

Targeted Customer Profile

This solution is intended for small and medium businesses hosting 1300 Exchange mailboxes. The configuration used for testing is as below:

- Number of mailbox servers presented to the storage array — 1
- User IO profile for testing — 0.42
- User mailbox size for testing — 200 MB
- Backup strategy for testing — Streaming Backup to Disk
- Time for Restore — 2.5 hours per SG, Tested 100 GB database per SG

Tested Deployment

The following tables summarize the testing environment:

Simulated Exchange Configuration

Number of Exchange mailboxes simulated	1300
Number of hosts	1
Number of mailboxes/host	1300
Number of storage groups/host	2
Number of mailbox stores/storage group	1
Number of mailboxes/mailbox store	200
Number of mailbox store LUNs/storage group	1
Simulated profile: I/O's per second per mailbox (IOPS, include 20% headroom)	0.5
Database LUN size	120 GB
Log LUN size	12 GB
Backup LUN size/storage group	547 GB
Total database size for performance testing	100 GB
% Storage capacity used by Exchange database**	83%

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

Primary Storage Hardware

Storage Connectivity (Fibre Channel, SAS, SATA, iSCSI)	iSCSI
Storage model and OS/firmware revision	CX3-20 Flare .24
Storage cache	1 GB
Number of storage controllers	2
Number of storage ports	4 Tested – 8 possible
Maximum bandwidth of storage connectivity to host	4*1Gb per SP
Switch type/model/firmware revision	Dell 5324 Version 2.21 Build No. 3.04

HBA model and firmware	Intel(R) PRO/1000 MT Dual Port Server Adapter
Number of HBA's/host	2
Host server type	Dell PowerEdge 2950 2: Dual Core [01]: EM64T Family 6 Model 15 Stepping 6 GenuineIntel ~2328 Mhz [02]: EM64T Family 6 Model 15 Stepping 6 GenuineIntel ~2328 Mhz [03]: EM64T Family 6 Model 15 Stepping 6 GenuineIntel ~2328 Mhz [04]: EM64T Family 6 Model 15 Stepping 6 GenuineIntel ~2328 Mhz
Total number of disks tested in solution	14 (with HotSpare)
Maximum number of spindles that can be hosted in the storage	15

Primary Storage Software

HBA driver	c:\windows\system32\drivers\le1g5132e.sys (8.4.21.0 built by: WinDDK, 220.25 KB (225,536 bytes), 3/14/2007 6:00 PM)
HBA QueueTarget Setting	Not Applicable
HBA QueueDepth Setting	Not Applicable
Multi-Pathing	Microsoft iSCSI Initiator v 2.0.4, PowerPath 4.6
Host OS	Microsoft® Windows® Server 2003, Enterprise Edition *64 SP1 5.2.3790 Service Pack 1 Build 3790
ESE.dll file version	08.00.0685.024
Replication solution name/version	Not Applicable

Primary Storage Disk Configuration (Mailbox Store Disks)

Disk type, speed and firmware revision	4 Gbps FC SCSI 15,000 RPM – 60AC
Raw capacity per disk (GB)	146 GB
Number of physical disks in test	8
total raw storage capacity (GB)	584 GB
Disk slice size (GB)	Not Applicable
Number of slices per LUN or number of disks per LUN	Not Applicable
Number of Luns Per Raid Group	2
LUN Size in GB	120
Raid level	Raid 1_0
Total formatted capacity	480 GB
Storage capacity utilization	46%
Database capacity utilization	83 GB

Primary Storage Disk Configuration (Transactional Log Disks)

Disk type, speed and firmware revision	4Gbps FC SCSI 15,000 RPM – 60AC
Raw capacity per disk (GB)	146 GB
Number of spindles in test	4
total raw storage capacity (GB)	584 GB

Disk slice size (GB)	Not Applicable
Number of slices per LUN or number of disks per LUN	Not Applicable
Number of Luns per Raid Group	4
LUN Size in GB	12
Raid level	Raid 1_0
Total formatted capacity	48 GB

Streaming Backup

Disk Configuration (Streaming Backup to disk)

Disk type, speed and firmware revision	4Gbps FC SCSI 15,000 RPM – 60AC
Raw capacity per disk (GB)	146GB
Number of spindles in test	5
Total raw storage capacity (GB)	730GB
Disk slice size (GB)	Not Applicable
Number of slices per LUN or number of disks per LUN	Not Applicable
Number of Luns per Raid Group	1
Raid level	Raid 5
Total formatted capacity	532 GB

Best Practices

Microsoft Exchange server is a disk-intensive application. Based on the testing run using the ESRP framework, EMC would recommend the Exchange 2007 best practices to improve the storage performance.

For Exchange 2007 best practices on storage design, please visit <http://technet.microsoft.com/en-us/library/bb124518.aspx>

Core Storage/Replication

1. Use diskpart (in Microsoft Windows 2003 SP1*64) to align all disks used with Microsoft Exchange, using a value of 64 for CLARiiON. This aligns all of the Exchange related NTFS partitions on a 64KB boundary.
2. Isolate the Microsoft Exchange Database workload from other I/O intensive applications or workloads. This ensures the highest levels of performance from Microsoft Exchange and makes troubleshooting efforts easier in the event of a disk related Microsoft Exchange performance issue.
3. TcpAckFrequency = 1 for each iSCSI connection. Refer <http://support.microsoft.com/kb/328890> to improve iSCSI performance
4. Size and configure the environment for spindle performance as a primary consideration, with storage capacity secondary.
5. iSCSI configuration using PowerPath 4.6 utilizing a balanced path approach. Logging in with NIC0 into the A0(Spa) and B3(Spb), and NIC1 into B0(Spb) and A3(Spa).
6. Tuning the CX3-20 storage system parameters is important in obtaining best performance. The following list details the optimal parameters for Exchange:
 - Cache page size of 8KB
 - Balance read and write caching
 - Read and write cache enabled for all LUNs
 - Read cache minimum of 50-100MB for prefetch

See the following Microsoft documentation for storage based replication best practices and support criteria:

Deployment Guidelines for Data Replication

<http://www.microsoft.com/technet/prodtechnol/exchange/guides/E2k3DataRepl/bedf62a9-dff7-49a8-bd27-b2f1c46d5651.mspx>

Multi-site data replication support for Exchange

<http://support.microsoft.com/?kbid=895847>

Backup strategy

This solution utilized Raid 5 for the backup to disk LUNs to maximize space, and then, using EMC Networker or NTBackup for backup to CDL or Tape, for long term storage of databases.

Test Result Summary

This section provides a high level summary of the test data from ESRP. The Appendix section has the detailed html reports that are generated by the ESRP testing framework.

Reliability

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

The following list provides an overview:

- Any errors reported in the saved eventlog file? None
- Any errors reported in during the database and log checksum process? None
- If backup to disk test is done, any errors reported during the process? None
- Any errors during database checksum on the remote storage database? None

Primary Storage Performance Results

The Primary Storage performance testing is designed to exercise the storage with maximum sustainable Exchange type of IO for two hours. The test is to show how long it takes for the storage to respond to an IO under load. The data below is the sum of all the logical disk I/O's, and average of all the logical disks I/O latency in the 2 hours test duration. Each server is listed separately and the aggregate numbers across all servers is listed as well.

Individual Server Metrics

The sum of I/O's across Storage Groups and the average latency across all Storage Groups on a per server basis.

Database I/O	
Average Database Disk Transfers/sec	692.494
Average Database Disk Reads/sec	365.482
Average Database Disk Writes/sec	327.012

Average Database Disk Read Latency (ms)	10.25
Average Database Disk Write Latency (ms)	5
Transaction Log I/O	
Average Log Disk Writes/sec	200.7
Average Log Disk Write Latency (ms)	2

Streaming Backup Performance

For the Version 1.0 release, only streaming backup type is supported for testing in the framework. There are two tests in this section. The first one is to measure the read IO 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.

MB read/sec per storage group	10.17
MB read/sec total	20.34
File size/sec taken	241.2853703

Log Read-only Performance

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

Average time to play one log file (sec)	0.461034646
---	-------------

Backup to Disk Performance

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

Total database size per storage group (GB)	394.78308
Time taken to backup each storage group	10:54:28
Average MB backed up/sec per storage group	10.17

Conclusion

This document is developed by storage solution providers, and reviewed by Microsoft Exchange Product team. The test results/data presented in this document is based on the tests introduced in the ESRP test framework. Customer should not quote the data directly for his/her 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 getting the maximum throughput for a given solution. Rather, it is focused on producing recommendations from EMC for Exchange application. So, the data presented in this document should not be used for direct comparisons among the solutions.

Contact Information

EMC recommends that you consult with EMC Professional Services to assist with the design and deployment of a similar solution. For information regarding this or any other EMC Solution, please 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, please refer to:

<http://EMC.com> or <http://powerlink.EMC.com>

Appendix A: Stress Testing

Stress Test Result Report

Test Summary

Overall Test Result	Pass
Machine Name	82D77C1
Test Description	
Test Start Time	4/1/2007 6:11:35 PM
Test End Time	4/2/2007 6:19:22 PM
Jetstress Version	08.01.0075.000
Ese Version	08.00.0685.024
Operating System	Microsoft Windows Server 2003 Service Pack 1 (5.2.3790.65536)
Performance Log	C:\Jetstress\3thread\stress3t\Stress_2007_4_1_18_11_37.blg C:\Jetstress\3thread\stress3t\DBChecksum_2007_4_2_18_19_22.blg

Database Sizing and Throughput

Achieved I/O per Second	670.535
Capacity Percentage	100%
Throughput Percentage	100%
Initial database size	412303294464
Final database size	479718866944
Database files (count)	4

Jetstress System Parameters

Thread count	3 (per-storage group)
Log buffers	9000
Minimum database cache	128.0 MB
Maximum database cache	1024.0 MB
Insert operations	25%
Delete operations	10%

Replace operations	50%
Read operations	15%
Lazy commits	80%

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (c:\sg1db)	0.011	0.005	88.267	79.427	(n/a)
Database (c:\sg2db)	0.011	0.005	88.204	79.335	(n/a)
Database (c:\sg3db)	0.011	0.005	87.977	79.292	(n/a)
Database (c:\sg4db)	0.011	0.005	88.634	79.399	(n/a)
Log (c:\sg1lg)	0.000	0.002	0.000	47.767	11005.852
Log (c:\sg2lg)	0.000	0.002	0.000	47.800	11035.178
Log (c:\sg3lg)	0.000	0.002	0.000	47.723	11057.406
Log (c:\sg4lg)	0.000	0.002	0.000	47.859	11018.685

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.640	0.649	7.368
Available MBytes	14386.631	14316.000	15259.000
Free System Page Table Entries	16758038.431	16757726.000	16758296.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	54945868.800	54935552.000	55070720.000
Pool Paged Bytes	56932405.760	53837824.000	63160320.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

4/1/2007 6:11:35 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\Jetstress\3thread\stress3t\stress3t.xml"

4/1/2007 6:11:35 PM -- Jetstress testing begins ...

4/1/2007 6:11:35 PM -- Prepare testing begins ...

4/1/2007 6:11:36 PM -- Attaching databases ...

4/1/2007 6:11:36 PM -- Prepare testing ends.

4/1/2007 6:11:36 PM -- Dispatching transactions begins ...

4/1/2007 6:11:36 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)

4/1/2007 6:11:36 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

4/1/2007 6:11:37 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.1 seconds/read).

4/1/2007 6:11:37 PM -- Log write latency thresholds: (average: 0.01 seconds/write,

maximum: 0.1 seconds/write).

4/1/2007 6:11:38 PM -- Operation mix: Sessions 3, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

4/1/2007 6:11:38 PM -- Performance logging begins (interval: 15000 ms).

4/1/2007 6:11:38 PM -- Attaining prerequisites:

4/1/2007 6:19:17 PM -- \Database(JetstressCmd)\Database Cache Size, Last: 966402000.0 (lower bound: 966367600.0, upper bound: none)

4/2/2007 6:19:18 PM -- Performance logging ends.

4/2/2007 6:19:18 PM -- JetInterop batch transaction stats: 410466, 410211, 409352, and 410559.

4/2/2007 6:19:19 PM -- Dispatching transactions ends.

4/2/2007 6:19:19 PM -- Shutting down databases ...

4/2/2007 6:19:22 PM -- Instance984.1 (complete), Instance984.2 (complete), Instance984.3 (complete), and Instance984.4 (complete)

4/2/2007 6:19:22 PM -- Performance logging begins (interval: 15000 ms).

4/2/2007 6:19:22 PM -- Verifying database checksums ...

4/2/2007 6:57:23 PM -- c:\sg1db (100% processed), c:\sg2db (100% processed), c:\sg3db (100% processed), and c:\sg4db (100% processed)

4/2/2007 6:57:24 PM -- Performance logging ends.

4/2/2007 6:57:24 PM -- C:\Jetstress\3thread\stress3t\DBChecksum_2007_4_2_18_19_22.blg has 152 samples.

4/2/2007 6:57:26 PM -- C:\Jetstress\3thread\stress3t\DBChecksum_2007_4_2_18_19_22.html is saved.

4/2/2007 6:57:26 PM -- Verifying log checksums ...

4/2/2007 6:57:31 PM -- c:\sg1lg (22 logs passed), c:\sg2lg (22 logs passed), c:\sg3lg (22 logs passed), and c:\sg4lg (22 logs passed)

4/2/2007 6:57:31 PM -- C:\Jetstress\3thread\stress3t\Stress_2007_4_1_18_11_37.blg has 5790 samples.

4/2/2007 6:57:31 PM -- Creating test report ...

4/2/2007 6:58:14 PM -- Volume c:\sg1db has 0.0106 for Avg. Disk sec/Read.

4/2/2007 6:58:14 PM -- Volume c:\sg2db has 0.0108 for Avg. Disk sec/Read.

4/2/2007 6:58:14 PM -- Volume c:\sg3db has 0.0105 for Avg. Disk sec/Read.

4/2/2007 6:58:14 PM -- Volume c:\sg4db has 0.0107 for Avg. Disk sec/Read.

4/2/2007 6:58:14 PM -- Volume c:\sg1lg has 0.0017 for Avg. Disk sec/Write.

4/2/2007 6:58:14 PM -- Volume c:\sg1lg has 0.0000 for Avg. Disk sec/Read.

4/2/2007 6:58:14 PM -- Volume c:\sg2lg has 0.0017 for Avg. Disk sec/Write.

4/2/2007 6:58:14 PM -- Volume c:\sg2lg has 0.0000 for Avg. Disk sec/Read.

4/2/2007 6:58:14 PM -- Volume c:\sg3lg has 0.0017 for Avg. Disk sec/Write.

4/2/2007 6:58:14 PM -- Volume c:\sg3lg has 0.0000 for Avg. Disk sec/Read.

4/2/2007 6:58:14 PM -- Volume c:\sg4lg has 0.0017 for Avg. Disk sec/Write.

4/2/2007 6:58:14 PM -- Volume c:\sg4lg has 0.0000 for Avg. Disk sec/Read.

4/2/2007 6:58:14 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

4/2/2007 6:58:14 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

Database Checksum Results

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page no pages	File length / seconds taken
c:\sg1db\Jetstress1.edb	14632050	0	0	0	3720 MBytes / 2280 seconds
c:\sg2db\Jetstress1.edb	14647666	0	0	0	3842 MBytes / 2260 seconds

c:\sg3db\Jetstress1.edb	14651506	0	0	0	3872 MBytes / 2279 seconds
c:\sg4db\Jetstress1.edb	14628210	0	0	0	3690 MBytes / 2217 seconds
(Sum)	58559432	0	0	0	2839 MBytes / 9038 seconds

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec
c:\sg1db	0.117	0.000	802.088	0.000
c:\sg2db	0.115	0.001	805.100	0.003
c:\sg3db	0.113	0.000	805.203	0.001
c:\sg4db	0.113	0.001	804.346	0.001

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	21.726	14.920	28.124
Available MBytes	15161.250	15148.000	15344.000
Free System Page Table Entries	16757493.993	16757493.000	16757494.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	65734871.579	64204800.000	66539520.000
Pool Paged Bytes	64705482.105	63455232.000	65331200.000

Test Log

4/1/2007 6:11:35 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\Jetstress\3thread\stress3t\stress3t.xml"

4/1/2007 6:11:35 PM -- Jetstress testing begins ...

4/1/2007 6:11:35 PM -- Prepare testing begins ...

4/1/2007 6:11:36 PM -- Attaching databases ...

4/1/2007 6:11:36 PM -- Prepare testing ends.

4/1/2007 6:11:36 PM -- Dispatching transactions begins ...

4/1/2007 6:11:36 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)

4/1/2007 6:11:36 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

4/1/2007 6:11:37 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.1 seconds/read).

4/1/2007 6:11:37 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.1 seconds/write).

4/1/2007 6:11:38 PM -- Operation mix: Sessions 3, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

4/1/2007 6:11:38 PM -- Performance logging begins (interval: 15000 ms).

4/1/2007 6:11:38 PM -- Attaining prerequisites:

4/1/2007 6:19:17 PM -- \Database(JetstressCmd)\Database Cache Size, Last: 966402000.0 (lower bound: 966367600.0, upper bound: none)

4/2/2007 6:19:18 PM -- Performance logging ends.

4/2/2007 6:19:18 PM -- JetInterop batch transaction stats: 410466, 410211, 409352, and 410559.

4/2/2007 6:19:19 PM -- Dispatching transactions ends.
4/2/2007 6:19:19 PM -- Shutting down databases ...
4/2/2007 6:19:22 PM -- Instance984.1 (complete), Instance984.2 (complete), Instance984.3 (complete), and Instance984.4 (complete)
4/2/2007 6:19:22 PM -- Performance logging begins (interval: 15000 ms).
4/2/2007 6:19:22 PM -- Verifying database checksums ...
4/2/2007 6:57:23 PM -- c:\sg1db (100% processed), c:\sg2db (100% processed), c:\sg3db (100% processed), and c:\sg4db (100% processed)
4/2/2007 6:57:24 PM -- Performance logging ends.
4/2/2007 6:57:24 PM -- [C:\Jetstress\3thread\stress3t\DBChecksum_2007_4_2_18_19_22.blg](#) has 152 samples.

Appendix B: Performance Testing

Performance Test Result Report

Test Summary

Overall Test Result	Pass
Machine Name	82D77C1
Test Description	
Test Start Time	3/29/2007 6:05:04 PM
Test End Time	3/29/2007 8:12:59 PM
Jetstress Version	08.01.0075.000
Ese Version	08.00.0685.024
Operating System	Microsoft Windows Server 2003 Service Pack 1 (5.2.3790.65536)
Performance Log	C:\Jetstress\Perf3t - Direct Connect\Performance_2007_3_29_18_5_7.blg C:\Jetstress\Perf3t - Direct Connect\DBChecksum_2007_3_29_20_12_59.blg

Database Sizing and Throughput

Achieved I/O per Second	692.496
Capacity Percentage	100%
Throughput Percentage	100%
Initial database size	425450340352
Final database size	431513206784
Database files (count)	4

Jetstress System Parameters

Thread count	3 (per-storage group)
Log buffers	9000
Minimum database cache	128.0 MB
Maximum database cache	1024.0 MB
Insert operations	25%
Delete operations	10%
Replace operations	50%
Read operations	15%
Lazy commits	80%

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (c:\sg1db)	0.010	0.005	91.711	82.294	(n/a)
Database (c:\sg2db)	0.010	0.005	89.880	80.672	(n/a)
Database (c:\sg3db)	0.010	0.005	92.670	82.274	(n/a)
Database (c:\sg4db)	0.011	0.005	91.221	81.772	(n/a)
Log (c:\sg1lg)	0.000	0.002	0.000	50.348	11072.162
Log (c:\sg2lg)	0	0.002	0.000	49.730	11033.833
Log (c:\sg3lg)	0	0.002	0.000	50.312	11102.488
Log (c:\sg4lg)	0	0.002	0.000	50.310	11021.046

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.402	0.571	5.940
Available MBytes	14474.061	14410.000	15322.000
Free System Page Table Entries	16758366.000	16758366.000	16758366.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	47538672.971	45076480.000	47681536.000
Pool Paged Bytes	55416699.742	53862400.000	58077184.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

3/29/2007 6:05:04 PM -- Command Line: C:\PROGRA~1\EXCHAN~1\jetstresscmd /c "C:\Jetstress\Perf3t - Direct Connect\Perf3t.xml"

3/29/2007 6:05:04 PM -- Jetstress testing begins ...

3/29/2007 6:05:04 PM -- Prepare testing begins ...

3/29/2007 6:05:06 PM -- Attaching databases ...

3/29/2007 6:05:06 PM -- Prepare testing ends.

3/29/2007 6:05:06 PM -- Dispatching transactions begins ...

3/29/2007 6:05:06 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)

3/29/2007 6:05:06 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

3/29/2007 6:05:07 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

3/29/2007 6:05:07 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

3/29/2007 6:05:07 PM -- Operation mix: Sessions 3, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

3/29/2007 6:05:07 PM -- Performance logging begins (interval: 15000 ms).

3/29/2007 6:05:07 PM -- Attaining prerequisites:

3/29/2007 6:12:52 PM -- \Database(JetstressCmd)\Database Cache Size, Last: 967122900.0

(lower bound: 966367600.0, upper bound: none)
 3/29/2007 8:12:54 PM -- Performance logging ends.
 3/29/2007 8:12:54 PM -- JetInterop batch transaction stats: 37606, 37021, 37611, and 37324.
 3/29/2007 8:12:54 PM -- Dispatching transactions ends.
 3/29/2007 8:12:54 PM -- Shutting down databases ...
 3/29/2007 8:12:59 PM -- Instance2552.1 (complete), Instance2552.2 (complete), Instance2552.3 (complete), and Instance2552.4 (complete)
 3/29/2007 8:13:00 PM -- Performance logging begins (interval: 15000 ms).
 3/29/2007 8:13:00 PM -- Verifying database checksums ...
 3/29/2007 8:47:21 PM -- c:\sg1db (100% processed), c:\sg2db (100% processed), c:\sg3db (100% processed), and c:\sg4db (100% processed)
 3/29/2007 8:47:22 PM -- Performance logging ends.
 3/29/2007 8:47:22 PM -- [C:\Jetstress\Perf3t - Direct Connect\DBChecksum_2007_3_29_20_12_59.blg](#) has 137 samples.
 3/29/2007 8:47:23 PM -- [C:\Jetstress\Perf3t - Direct Connect\DBChecksum_2007_3_29_20_12_59.html](#) is saved.
 3/29/2007 8:47:23 PM -- Verifying log checksums ...
 3/29/2007 8:47:28 PM -- c:\sg1lg (22 logs passed), c:\sg2lg (21 logs passed), c:\sg3lg (21 logs passed), and c:\sg4lg (21 logs passed)
 3/29/2007 8:47:28 PM -- [C:\Jetstress\Perf3t - Direct Connect\Performance_2007_3_29_18_5_7.blg](#) has 511 samples.
 3/29/2007 8:47:28 PM -- Creating test report ...
 3/29/2007 8:47:31 PM -- Volume c:\sg1db has 0.0103 for Avg. Disk sec/Read.
 3/29/2007 8:47:31 PM -- Volume c:\sg2db has 0.0101 for Avg. Disk sec/Read.
 3/29/2007 8:47:31 PM -- Volume c:\sg3db has 0.0102 for Avg. Disk sec/Read.
 3/29/2007 8:47:31 PM -- Volume c:\sg4db has 0.0105 for Avg. Disk sec/Read.
 3/29/2007 8:47:31 PM -- Volume c:\sg1lg has 0.0016 for Avg. Disk sec/Write.
 3/29/2007 8:47:31 PM -- Volume c:\sg1lg has 0.0000 for Avg. Disk sec/Read.
 3/29/2007 8:47:31 PM -- Volume c:\sg2lg has 0.0016 for Avg. Disk sec/Write.
 3/29/2007 8:47:31 PM -- Volume c:\sg2lg has 0.0000 for Avg. Disk sec/Read.
 3/29/2007 8:47:31 PM -- Volume c:\sg3lg has 0.0016 for Avg. Disk sec/Write.
 3/29/2007 8:47:31 PM -- Volume c:\sg3lg has 0.0000 for Avg. Disk sec/Read.
 3/29/2007 8:47:31 PM -- Volume c:\sg4lg has 0.0016 for Avg. Disk sec/Write.
 3/29/2007 8:47:31 PM -- Volume c:\sg4lg has 0.0000 for Avg. Disk sec/Read.
 3/29/2007 8:47:31 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 3/29/2007 8:47:31 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

Database Checksum Results

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page no pages	File length / seconds taken
c:\sg1db\Jetstress1.edb	13166178	0	0	0	460 MBytes / 1996 seconds
c:\sg2db\Jetstress1.edb	13170274	0	0	0	492 MBytes / 2060 seconds
c:\sg3db\Jetstress1.edb	13165666	0	0	0	456 MBytes / 2033 seconds
c:\sg4db\Jetstress1.edb	13172834	0	0	0	512 MBytes / 2060 seconds
(Sum)	52674952	0	0	0	1923 MBytes / 8150 seconds

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec
c:\sg1db	0.110	0.001	801.500	0.002
c:\sg2db	0.116	0.001	798.372	0.005
c:\sg3db	0.109	0.000	802.635	0.002
c:\sg4db	0.115	0.000	799.659	0.002

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	20.780	13.411	23.153
Available MBytes	15208.533	15196.000	15334.000
Free System Page Table Entries	16758139.504	16758136.000	16758296.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	63186869.255	62185472.000	64741376.000
Pool Paged Bytes	55276775.708	55246848.000	55803904.000

Test Log

3/29/2007 6:05:04 PM -- Command Line: C:\PROGRA~1\EXCHAN~1\jetstresscmd /c "C:\Jetstress\Perf3t - Direct Connect\Perf3t.xml"

3/29/2007 6:05:04 PM -- Jetstress testing begins ...

3/29/2007 6:05:04 PM -- Prepare testing begins ...

3/29/2007 6:05:06 PM -- Attaching databases ...

3/29/2007 6:05:06 PM -- Prepare testing ends.

3/29/2007 6:05:06 PM -- Dispatching transactions begins ...

3/29/2007 6:05:06 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)

3/29/2007 6:05:06 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

3/29/2007 6:05:07 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

3/29/2007 6:05:07 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

3/29/2007 6:05:07 PM -- Operation mix: Sessions 3, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

3/29/2007 6:05:07 PM -- Performance logging begins (interval: 15000 ms).

3/29/2007 6:05:07 PM -- Attaining prerequisites:

3/29/2007 6:12:52 PM -- \Database(JetstressCmd)\Database Cache Size, Last: 967122900.0 (lower bound: 966367600.0, upper bound: none)

3/29/2007 8:12:54 PM -- Performance logging ends.

3/29/2007 8:12:54 PM -- JetInterop batch transaction stats: 37606, 37021, 37611, and 37324.

3/29/2007 8:12:54 PM -- Dispatching transactions ends.
3/29/2007 8:12:54 PM -- Shutting down databases ...
3/29/2007 8:12:59 PM -- Instance2552.1 (complete), Instance2552.2 (complete),
Instance2552.3 (complete), and Instance2552.4 (complete)
3/29/2007 8:13:00 PM -- Performance logging begins (interval: 15000 ms).
3/29/2007 8:13:00 PM -- Verifying database checksums ...
3/29/2007 8:47:21 PM -- c:\sg1db (100% processed), c:\sg2db (100% processed), c:\sg3db
(100% processed), and c:\sg4db (100% processed)
3/29/2007 8:47:22 PM -- Performance logging ends.
3/29/2007 8:47:22 PM -- [C:\Jetstress\Perf3t - Direct
Connect\DBChecksum 2007_3_29_20_12_59.blg](#) has 137 samples.

Appendix C: Streaming Backup Testing

Streaming backup Test Result Report

Streaming Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance920.1	98680.77	02:31:16	10.87
Instance920.2	98696.77	03:02:52	8.99
Instance920.3	98724.77	02:21:53	11.60
Instance920.4	98680.77	02:58:27	9.22

Jetstress System Parameters

Thread count	3 (per-storage group)
Log buffers	9000
Minimum database cache	128.0 MB
Maximum database cache	1024.0 MB
Insert operations	25%
Delete operations	10%
Replace operations	50%
Read operations	15%
Lazy commits	80%

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (c:\sg1db)	0.004	0.000	72.214	0.030	(n/a)
Database (c:\sg2db)	0.007	0.000	72.345	0.024	(n/a)
Database (c:\sg3db)	0.004	0.000	72.313	0.029	(n/a)
Database (c:\sg4db)	0.006	0.000	72.390	0.029	(n/a)
Log (c:\sg1lg)	0.000	0.001	0.000	0.031	323.677
Log (c:\sg2lg)	0.000	0.000	0.000	0.023	232.498
Log (c:\sg3lg)	0.000	0.000	0.000	0.028	286.679
Log (c:\sg4lg)	0.000	0.000	0.000	0.029	298.304

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	60.248	23.313	94.878
Available MBytes	14860.898	14588.000	15310.000
Free System Page Table Entries	16755895.861	16755876.000	16755896.000
Transition Pages RePurposed/sec	8975.660	0.000	22147.031
Pool Nonpaged Bytes	65586490.748	58470400.000	71376896.000
Pool Paged Bytes	551309312.000	100601856.000	821923840.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

3/30/2007 3:21:29 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\Jetstress\3thread\b2d3t\b2d3t.xml"
3/30/2007 3:21:29 PM -- Jetstress testing begins ...
3/30/2007 3:21:29 PM -- Prepare testing begins ...
3/30/2007 3:21:30 PM -- Attaching databases ...
3/30/2007 3:21:30 PM -- Prepare testing ends.
3/30/2007 3:21:31 PM -- Performance logging begins (interval: 15000 ms).
3/30/2007 3:21:31 PM -- Streaming backup databases ...
3/30/2007 6:24:26 PM -- Performance logging ends.
3/30/2007 6:24:26 PM -- Instance920.1 (100% processed), Instance920.2 (100% processed), Instance920.3 (100% processed), and Instance920.4 (100% processed)
3/30/2007 6:24:26 PM --
[C:\Jetstress\3thread\b2d3t\StreamingBackup_2007_3_30_15_21_30.blg](#) has 719 samples.
3/30/2007 6:24:26 PM -- Creating test report ...

Appendix D: Soft Recovery Testing

SoftRecovery Test Result Report

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance2024.1	500	210.4866928
Instance2024.2	502	210.9866736
Instance2024.3	503	206.236856
Instance2024.4	511	209.4867312

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (s:\sg1db)	0.075	0.022	567.260	9.591	(n/a)
Database (s:\sg2db)	0.073	0.021	594.961	9.636	(n/a)
Database (s:\sg3db)	0.069	0.020	568.267	9.852	(n/a)
Database (s:\sg4db)	0.070	0.020	570.546	10.000	(n/a)
Log (s:\sg1lg)	0.001	0.001	78.691	2.727	3996.648
Log (s:\sg2lg)	0.001	0.001	79.174	2.693	4962.268
Log (s:\sg3lg)	0.001	0.001	79.491	2.905	3885.060
Log (s:\sg4lg)	0.001	0.001	80.757	2.919	4448.791

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	10.028	5.265	18.552
Available MBytes	14534.533	14345.000	15389.000
Free System Page Table Entries	16759068.000	16759068.000	16759068.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	57006489.600	56352768.000	59138048.000
Pool Paged Bytes	43574184.229	42799104.000	43970560.000
Database Page Fault Stalls/sec	0.010	0.000	1.000

Test Log

4/18/2007 6:50:42 AM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\Jetstress_Results\4SG\3t\soft\soft.xml"
4/18/2007 6:50:42 AM -- Jetstress testing begins ...
4/18/2007 6:50:43 AM -- Prepare testing begins ...
4/18/2007 6:50:43 AM -- Attaching databases ...
4/18/2007 6:50:43 AM -- Prepare testing ends.
4/18/2007 6:50:43 AM -- Dispatching transactions begins ...
4/18/2007 6:50:43 AM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
4/18/2007 6:50:43 AM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
4/18/2007 6:50:44 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
4/18/2007 6:50:44 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
4/18/2007 6:50:44 AM -- Operation mix: Sessions 3, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.
4/18/2007 6:50:44 AM -- Performance logging begins (interval: 15000 ms).
4/18/2007 6:50:44 AM -- Generating log files ...
4/18/2007 7:18:43 AM -- s:\sg1lg (100.2% generated), s:\sg2lg (100.4% generated), s:\sg3lg (100.8% generated), and s:\sg4lg (102.4% generated)
4/18/2007 7:18:44 AM -- Performance logging ends.
4/18/2007 7:18:44 AM -- JetInterop batch transaction stats: 9619, 9684, 9648, and 9699.
4/18/2007 7:18:44 AM -- Dispatching transactions ends.
4/18/2007 7:18:44 AM -- Shutting down databases ...
4/18/2007 7:18:47 AM -- Instance2024.1 (complete), Instance2024.2 (complete), Instance2024.3 (complete), and Instance2024.4 (complete)
4/18/2007 7:18:48 AM -- Performance logging begins (interval: 15000 ms).
4/18/2007 7:18:48 AM -- Verifying database checksums ...
4/18/2007 7:52:46 AM -- s:\sg1db (100% processed), s:\sg2db (100% processed), s:\sg3db (100% processed), and s:\sg4db (100% processed)
4/18/2007 7:52:47 AM -- Performance logging ends.
4/18/2007 7:52:47 AM --
[C:\Jetstress_Results\4SG\3t\soft\DBChecksum_2007_4_18_7_18_47.blg](#) has 135 samples.
4/18/2007 7:52:49 AM --
[C:\Jetstress_Results\4SG\3t\soft\DBChecksum_2007_4_18_7_18_47.html](#) is saved.
4/18/2007 7:52:49 AM -- Verifying log checksums ...
4/18/2007 7:53:11 AM -- s:\sg1lg (100 logs passed), s:\sg2lg (100 logs passed), s:\sg3lg (100 logs passed), and s:\sg4lg (100 logs passed)
4/18/2007 7:53:11 AM --
[C:\Jetstress_Results\4SG\3t\soft\Performance_2007_4_18_6_50_44.blg](#) has 111 samples.
4/18/2007 7:53:11 AM -- Creating test report ...
4/18/2007 7:53:11 AM -- Volume s:\sg1db has 0.0101 for Avg. Disk sec/Read.
4/18/2007 7:53:11 AM -- Volume s:\sg2db has 0.0101 for Avg. Disk sec/Read.
4/18/2007 7:53:11 AM -- Volume s:\sg3db has 0.0098 for Avg. Disk sec/Read.
4/18/2007 7:53:11 AM -- Volume s:\sg4db has 0.0099 for Avg. Disk sec/Read.
4/18/2007 7:53:11 AM -- Volume s:\sg1lg has 0.0017 for Avg. Disk sec/Write.
4/18/2007 7:53:11 AM -- Volume s:\sg1lg has 0.0007 for Avg. Disk sec/Read.
4/18/2007 7:53:11 AM -- Volume s:\sg2lg has 0.0017 for Avg. Disk sec/Write.
4/18/2007 7:53:11 AM -- Volume s:\sg2lg has 0.0006 for Avg. Disk sec/Read.
4/18/2007 7:53:11 AM -- Volume s:\sg3lg has 0.0017 for Avg. Disk sec/Write.
4/18/2007 7:53:11 AM -- Volume s:\sg3lg has 0.0011 for Avg. Disk sec/Read.
4/18/2007 7:53:11 AM -- Volume s:\sg4lg has 0.0017 for Avg. Disk sec/Write.
4/18/2007 7:53:11 AM -- Volume s:\sg4lg has 0.0015 for Avg. Disk sec/Read.
4/18/2007 7:53:11 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/18/2007 7:53:11 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/18/2007 7:53:11 AM --
[C:\Jetstress_Results\4SG\3t\soft\Performance_2007_4_18_6_50_44.html](#) is saved.

4/18/2007 7:53:12 AM -- Performance logging begins (interval: 2000 ms).
 4/18/2007 7:53:12 AM -- Recovering databases ...
 4/18/2007 7:56:44 AM -- Performance logging ends.
 4/18/2007 7:56:44 AM -- Instance2024.1 (210.4866928), Instance2024.2 (210.9866736),
 Instance2024.3 (206.236856), and Instance2024.4 (209.4867312)
 4/18/2007 7:56:44 AM --
C:\Jetstress_Results\4SG\3t\soft\SoftRecovery_2007_4_18_7_53_11.blg has 105 samples.
 4/18/2007 7:56:44 AM -- Creating test report ...

Performance Test Result Report

Test Summary

Overall Test Result	Pass
Machine Name	72D77C1
Test Description	
Test Start Time	4/18/2007 6:50:43 AM
Test End Time	4/18/2007 7:18:47 AM
Jetstress Version	08.01.0075.000
Ese Version	08.00.0685.024
Operating System	Microsoft Windows Server 2003 Service Pack 1 (5.2.3790.65536)
Performance Log	C:\Jetstress_Results\4SG\3t\soft\Performance_2007_4_18_6_50_44.blg C:\Jetstress_Results\4SG\3t\soft\DBChecksum_2007_4_18_7_18_47.blg

Database Sizing and Throughput

Achieved I/O per Second	713.03
Capacity Percentage	100%
Throughput Percentage	100%
Initial database size	412311683072
Final database size	413970530304
Database files (count)	4

Jetstress System Parameters

Thread count	3 (per-storage group)
Log buffers	9000
Minimum database cache	128.0 MB
Maximum database cache	1024.0 MB

Insert operations	25%
Delete operations	10%
Replace operations	50%
Read operations	15%
Lazy commits	80%

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (s:\sg1db)	0.010	0.005	89.059	87.065	(n/a)
Database (s:\sg2db)	0.010	0.005	94.029	88.325	(n/a)
Database (s:\sg3db)	0.010	0.005	88.650	87.285	(n/a)
Database (s:\sg4db)	0.010	0.005	89.857	88.760	(n/a)
Log (s:\sg1lg)	0.001	0.002	0.075	58.737	11306.350
Log (s:\sg2lg)	0.001	0.002	0.075	60.169	11110.829
Log (s:\sg3lg)	0.001	0.002	0.075	58.961	11346.467
Log (s:\sg4lg)	0.001	0.002	0.076	60.079	11364.656

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	3.702	1.903	12.344
Available MBytes	14511.198	14369.000	15361.000
Free System Page Table Entries	16759256.559	16759238.000	16759508.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	47553120.865	44331008.000	47702016.000
Pool Paged Bytes	41044170.955	40488960.000	41086976.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

4/18/2007 6:50:42 AM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c
"C:\Jetstress_Results\4SG\3t\soft\soft.xml"
4/18/2007 6:50:42 AM -- Jetstress testing begins ...
4/18/2007 6:50:43 AM -- Prepare testing begins ...
4/18/2007 6:50:43 AM -- Attaching databases ...
4/18/2007 6:50:43 AM -- Prepare testing ends.
4/18/2007 6:50:43 AM -- Dispatching transactions begins ...
4/18/2007 6:50:43 AM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
4/18/2007 6:50:43 AM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

```

4/18/2007 6:50:44 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

4/18/2007 6:50:44 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

4/18/2007 6:50:44 AM -- Operation mix: Sessions 3, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

4/18/2007 6:50:44 AM -- Performance logging begins (interval: 15000 ms).

4/18/2007 6:50:44 AM -- Generating log files ...

4/18/2007 7:18:43 AM -- s:\sg1lg (100.2% generated), s:\sg2lg (100.4% generated), s:\sg3lg (100.8% generated), and s:\sg4lg (102.4% generated)

4/18/2007 7:18:44 AM -- Performance logging ends.

4/18/2007 7:18:44 AM -- JetInterop batch transaction stats: 9619, 9684, 9648, and 9699.

4/18/2007 7:18:44 AM -- Dispatching transactions ends.

4/18/2007 7:18:44 AM -- Shutting down databases ...

4/18/2007 7:18:47 AM -- Instance2024.1 (complete), Instance2024.2 (complete), Instance2024.3 (complete), and Instance2024.4 (complete)

4/18/2007 7:18:48 AM -- Performance logging begins (interval: 15000 ms).

4/18/2007 7:18:48 AM -- Verifying database checksums ...

4/18/2007 7:52:46 AM -- s:\sg1db (100% processed), s:\sg2db (100% processed), s:\sg3db (100% processed), and s:\sg4db (100% processed)

4/18/2007 7:52:47 AM -- Performance logging ends.

4/18/2007 7:52:47 AM --

C:\Jetstress_Results\4SG\3t\soft\DBChecksum_2007_4_18_7_18_47.blg has 135 samples.

4/18/2007 7:52:49 AM --

C:\Jetstress_Results\4SG\3t\soft\DBChecksum_2007_4_18_7_18_47.html is saved.

4/18/2007 7:52:49 AM -- Verifying log checksums ...

4/18/2007 7:53:11 AM -- s:\sg1lg (100 logs passed), s:\sg2lg (100 logs passed), s:\sg3lg (100 logs passed), and s:\sg4lg (100 logs passed)

4/18/2007 7:53:11 AM --

C:\Jetstress_Results\4SG\3t\soft\Performance_2007_4_18_6_50_44.blg has 111 samples.

4/18/2007 7:53:11 AM -- Creating test report ...

4/18/2007 7:53:11 AM -- Volume s:\sg1db has 0.0101 for Avg. Disk sec/Read.

4/18/2007 7:53:11 AM -- Volume s:\sg2db has 0.0101 for Avg. Disk sec/Read.

4/18/2007 7:53:11 AM -- Volume s:\sg3db has 0.0098 for Avg. Disk sec/Read.

4/18/2007 7:53:11 AM -- Volume s:\sg4db has 0.0099 for Avg. Disk sec/Read.

4/18/2007 7:53:11 AM -- Volume s:\sg1lg has 0.0017 for Avg. Disk sec/Write.

4/18/2007 7:53:11 AM -- Volume s:\sg1lg has 0.0007 for Avg. Disk sec/Read.

4/18/2007 7:53:11 AM -- Volume s:\sg2lg has 0.0017 for Avg. Disk sec/Write.

4/18/2007 7:53:11 AM -- Volume s:\sg2lg has 0.0006 for Avg. Disk sec/Read.

4/18/2007 7:53:11 AM -- Volume s:\sg3lg has 0.0017 for Avg. Disk sec/Write.

4/18/2007 7:53:11 AM -- Volume s:\sg3lg has 0.0011 for Avg. Disk sec/Read.

4/18/2007 7:53:11 AM -- Volume s:\sg4lg has 0.0017 for Avg. Disk sec/Write.

4/18/2007 7:53:11 AM -- Volume s:\sg4lg has 0.0015 for Avg. Disk sec/Read.

4/18/2007 7:53:11 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.

4/18/2007 7:53:11 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

Database Checksum Results

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page no pages	File length / seconds taken
s:\sg1db\Jetstress1.edb	12633954	0	0	0	398 MBytes / 2038 seconds
s:\sg2db\Jetstress1.edb	12630370	0	0	0	370 MBytes / 1981 seconds
s:\sg3db\Jetstress1.edb	12633954	0	0	0	398 MBytes / 2021 seconds
s:\sg4db\Jetstress1.edb	12635234	0	0	0	408 MBytes / 1957 seconds
(Sum)	50533512	0	0	0	1577 MBytes / 7998 seconds

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec
s:\sg1db	0.094	0.001	766.904	0.005
s:\sg2db	0.091	0.000	780.581	0.003
s:\sg3db	0.093	0.001	780.642	0.003
s:\sg4db	0.089	0.000	781.149	0.004

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	23.188	15.878	26.224
Available MBytes	15216.370	15188.000	15425.000
Free System Page Table Entries	16759068.000	16759068.000	16759068.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	63888467.437	62119936.000	64806912.000
Pool Paged Bytes	41329398.519	40849408.000	42467328.000

Test Log

4/18/2007 6:50:42 AM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\Jetstress_Results\4SG\3t\soft\soft.xml"
 4/18/2007 6:50:42 AM -- Jetstress testing begins ...
 4/18/2007 6:50:43 AM -- Prepare testing begins ...
 4/18/2007 6:50:43 AM -- Attaching databases ...
 4/18/2007 6:50:43 AM -- Prepare testing ends.
 4/18/2007 6:50:43 AM -- Dispatching transactions begins ...

4/18/2007 6:50:43 AM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
4/18/2007 6:50:43 AM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
4/18/2007 6:50:44 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
4/18/2007 6:50:44 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
4/18/2007 6:50:44 AM -- Operation mix: Sessions 3, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.
4/18/2007 6:50:44 AM -- Performance logging begins (interval: 15000 ms).
4/18/2007 6:50:44 AM -- Generating log files ...
4/18/2007 7:18:43 AM -- s:\sg1lg (100.2% generated), s:\sg2lg (100.4% generated), s:\sg3lg (100.8% generated), and s:\sg4lg (102.4% generated)
4/18/2007 7:18:44 AM -- Performance logging ends.
4/18/2007 7:18:44 AM -- JetInterop batch transaction stats: 9619, 9684, 9648, and 9699.
4/18/2007 7:18:44 AM -- Dispatching transactions ends.
4/18/2007 7:18:44 AM -- Shutting down databases ...
4/18/2007 7:18:47 AM -- Instance2024.1 (complete), Instance2024.2 (complete), Instance2024.3 (complete), and Instance2024.4 (complete)
4/18/2007 7:18:48 AM -- Performance logging begins (interval: 15000 ms).
4/18/2007 7:18:48 AM -- Verifying database checksums ...
4/18/2007 7:52:46 AM -- s:\sg1db (100% processed), s:\sg2db (100% processed), s:\sg3db (100% processed), and s:\sg4db (100% processed)
4/18/2007 7:52:47 AM -- Performance logging ends.
4/18/2007 7:52:47 AM --
C:\Jetstress_Results\4SG\3t\soft\DBChecksum_2007_4_18_7_18_47.blg has 135 samples.

Appendix E: Maximum Solution IOPS Testing

The purpose of this test is to verify the storage configuration which the customer is planning to deploy. The test run has been successful, which means that the database read latency and log write latency are below 20ms; Database page fault stalls/sec is 0. However, Microsoft strongly recommends that you perform further validation of this storage solution (additional task listed below).

You should refer to the table below to determine if the actual disk IO (achieved IO) has exceeded the targeted IO (expected IO). If not, you may want to increase the thread count to increase the load, provided that the disk latency will not exceed the threshold.

Performance Test Result Report

Test Summary

Overall Test Result	Pass
Machine Name	82D77C1
Test Description	
Test Start Time	4/8/2007 8:28:19 PM
Test End Time	4/8/2007 10:31:48 PM
Jetstress Version	08.01.0075.000
Ese Version	08.00.0685.024
Operating System	Microsoft Windows Server 2003 Service Pack 1 (5.2.3790.65536)
Performance Log	C:\Jetstress\14thread\Performance_2007_4_8_20_28_20.blg C:\Jetstress\14thread\DBChecksum_2007_4_8_22_31_48.blg

Database Sizing and Throughput

Achieved I/O per Second	1379.992
Capacity Percentage	100%
Throughput Percentage	100%
Initial database size	412303294464
Final database size	425328705536
Database files (count)	4

Jetstress System Parameters

Thread count	14 (per-storage group)
Log buffers	9000
Minimum database cache	128.0 MB
Maximum database cache	1024.0 MB

Insert operations	25%
Delete operations	10%
Replace operations	50%
Read operations	15%
Lazy commits	80%

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (c:\sg1db)	0.019	0.006	180.965	163.915	(n/a)
Database (c:\sg2db)	0.020	0.006	180.347	163.916	(n/a)
Database (c:\sg3db)	0.019	0.006	180.395	164.732	(n/a)
Database (c:\sg4db)	0.019	0.006	181.330	164.392	(n/a)
Log (c:\sg1lg)	0	0.002	0.000	86.551	13789.124
Log (c:\sg2lg)	0.000	0.002	0.000	86.643	13791.966
Log (c:\sg3lg)	0	0.002	0.000	86.353	13910.067
Log (c:\sg4lg)	0	0.002	0.000	87.064	13749.507

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	6.119	4.477	11.873
Available MBytes	14351.371	14335.000	15277.000
Free System Page Table Entries	16757803.000	16757803.000	16757803.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	56173848.406	56127488.000	56295424.000
Pool Paged Bytes	51779421.988	51568640.000	52240384.000
Database Page Fault Stalls/sec	0.005	0.000	1.662

Test Log

```

4/8/2007 8:28:19 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c
"C:\Jetstress\14thread\Perf14t.xml"
4/8/2007 8:28:19 PM -- Jetstress testing begins ...
4/8/2007 8:28:19 PM -- Prepare testing begins ...
4/8/2007 8:28:20 PM -- Attaching databases ...
4/8/2007 8:28:20 PM -- Prepare testing ends.
4/8/2007 8:28:20 PM -- Dispatching transactions begins ...
4/8/2007 8:28:20 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
4/8/2007 8:28:20 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

```

4/8/2007 8:28:20 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

4/8/2007 8:28:20 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

4/8/2007 8:28:21 PM -- Operation mix: Sessions 14, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

4/8/2007 8:28:21 PM -- Performance logging begins (interval: 15000 ms).

4/8/2007 8:28:21 PM -- Attaining prerequisites:

4/8/2007 8:31:42 PM -- \Database(JetstressCmd)\Database Cache Size, Last: 966836200.0 (lower bound: 966367600.0, upper bound: none)

4/8/2007 10:31:44 PM -- Performance logging ends.

4/8/2007 10:31:44 PM -- JetInterop batch transaction stats: 78153, 78527, 78435, and 78680.

4/8/2007 10:31:44 PM -- Dispatching transactions ends.

4/8/2007 10:31:44 PM -- Shutting down databases ...

4/8/2007 10:31:48 PM -- Instance2052.1 (complete), Instance2052.2 (complete), Instance2052.3 (complete), and Instance2052.4 (complete)

4/8/2007 10:31:48 PM -- Performance logging begins (interval: 15000 ms).

4/8/2007 10:31:48 PM -- Verifying database checksums ...

4/8/2007 11:05:35 PM -- c:\sg1db (100% processed), c:\sg2db (100% processed), c:\sg3db (100% processed), and c:\sg4db (100% processed)

4/8/2007 11:05:36 PM -- Performance logging ends.

4/8/2007 11:05:36 PM -- C:\Jetstress\14thread\DBChecksum_2007_4_8_22_31_48.blg has 135 samples.

4/8/2007 11:05:37 PM -- C:\Jetstress\14thread\DBChecksum_2007_4_8_22_31_48.html is saved.

4/8/2007 11:05:37 PM -- Verifying log checksums ...

4/8/2007 11:05:42 PM -- c:\sg1lg (22 logs passed), c:\sg2lg (22 logs passed), c:\sg3lg (22 logs passed), and c:\sg4lg (22 logs passed)

4/8/2007 11:05:42 PM -- C:\Jetstress\14thread\Performance_2007_4_8_20_28_20.blg has 493 samples.

4/8/2007 11:05:42 PM -- Creating test report ...

4/8/2007 11:05:44 PM -- Volume c:\sg1db has 0.0194 for Avg. Disk sec/Read.

4/8/2007 11:05:44 PM -- Volume c:\sg2db has 0.0196 for Avg. Disk sec/Read.

4/8/2007 11:05:44 PM -- Volume c:\sg3db has 0.0187 for Avg. Disk sec/Read.

4/8/2007 11:05:44 PM -- Volume c:\sg4db has 0.0194 for Avg. Disk sec/Read.

4/8/2007 11:05:44 PM -- Volume c:\sg1lg has 0.0024 for Avg. Disk sec/Write.

4/8/2007 11:05:44 PM -- Volume c:\sg1lg has 0.0000 for Avg. Disk sec/Read.

4/8/2007 11:05:44 PM -- Volume c:\sg2lg has 0.0024 for Avg. Disk sec/Write.

4/8/2007 11:05:44 PM -- Volume c:\sg2lg has 0.0000 for Avg. Disk sec/Read.

4/8/2007 11:05:44 PM -- Volume c:\sg3lg has 0.0024 for Avg. Disk sec/Write.

4/8/2007 11:05:44 PM -- Volume c:\sg3lg has 0.0000 for Avg. Disk sec/Read.

4/8/2007 11:05:44 PM -- Volume c:\sg4lg has 0.0024 for Avg. Disk sec/Write.

4/8/2007 11:05:44 PM -- Volume c:\sg4lg has 0.0000 for Avg. Disk sec/Read.

4/8/2007 11:05:44 PM -- Test has 1.66226282372375 Maximum Database Page Fault Stalls/sec.

4/8/2007 11:05:44 PM -- Test has 2 Database Page Fault Stalls/sec samples higher than 0.

Database Checksum Results

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page no pages	File length / seconds taken
c:\sg1db\Jetstress1.edb	12976482	0	0	0	3074 MBytes / 1985 seconds
c:\sg2db\Jetstress1.edb	12978274	0	0	0	3088 MBytes / 2026 seconds
c:\sg3db\Jetstress1.edb	12985186	0	0	0	3142 MBytes / 2025 seconds
c:\sg4db\Jetstress1.edb	12980066	0	0	0	3102 MBytes / 2006 seconds
(Sum)	51920008	0	0	0	121 MBytes / 8043 seconds

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec
c:\sg1db	0.117	0.001	800.822	0.003
c:\sg2db	0.119	0.000	802.337	0.000
c:\sg3db	0.115	0.000	802.181	0.000
c:\sg4db	0.119	0.000	803.494	0.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	25.048	16.439	27.655
Available MBytes	15169.215	15111.000	15298.000
Free System Page Table Entries	16757733.000	16757733.000	16757733.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	65954368.474	64659456.000	67342336.000
Pool Paged Bytes	51901204.859	51703808.000	53620736.000

Test Log

4/8/2007 8:28:19 PM -- Command Line: "C:\PROGRA~1\EXCHAN~1\jetstresscmd.exe" /c "C:\Jetstress\14thread\Perf14t.xml"
 4/8/2007 8:28:19 PM -- Jetstress testing begins ...
 4/8/2007 8:28:19 PM -- Prepare testing begins ...
 4/8/2007 8:28:20 PM -- Attaching databases ...
 4/8/2007 8:28:20 PM -- Prepare testing ends.
 4/8/2007 8:28:20 PM -- Dispatching transactions begins ...
 4/8/2007 8:28:20 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)

4/8/2007 8:28:20 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
4/8/2007 8:28:20 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
4/8/2007 8:28:20 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
4/8/2007 8:28:21 PM -- Operation mix: Sessions 14, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.
4/8/2007 8:28:21 PM -- Performance logging begins (interval: 15000 ms).
4/8/2007 8:28:21 PM -- Attaining prerequisites:
4/8/2007 8:31:42 PM -- \Database(JetstressCmd)\Database Cache Size, Last: 966836200.0 (lower bound: 966367600.0, upper bound: none)
4/8/2007 10:31:44 PM -- Performance logging ends.
4/8/2007 10:31:44 PM -- JetInterop batch transaction stats: 78153, 78527, 78435, and 78680.
4/8/2007 10:31:44 PM -- Dispatching transactions ends.
4/8/2007 10:31:44 PM -- Shutting down databases ...
4/8/2007 10:31:48 PM -- Instance2052.1 (complete), Instance2052.2 (complete), Instance2052.3 (complete), and Instance2052.4 (complete)
4/8/2007 10:31:48 PM -- Performance logging begins (interval: 15000 ms).
4/8/2007 10:31:48 PM -- Verifying database checksums ...
4/8/2007 11:05:35 PM -- c:\sg1db (100% processed), c:\sg2db (100% processed), c:\sg3db (100% processed), and c:\sg4db (100% processed)
4/8/2007 11:05:36 PM -- Performance logging ends.
4/8/2007 11:05:36 PM -- [C:\Jetstress\14thread\DBChecksum 2007 4 8 22 31 48.blg](#) has 135 samples.