



Dell PowerVault MD3000
3000 Mailbox Single Copy Cluster
Microsoft Exchange 2007 Storage Solution



Tested with: ESRP – Storage Version 2.0
Tested Date: August 08, 2007

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Overview

This document provides information on Dell's PowerVault MD3000 storage solution for Microsoft Exchange Server 2007, based on *Microsoft Exchange Solution Reviewed Program (ESRP) – Storage program**. 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, please click <http://www.microsoft.com/technet/prodtechnol/exchange/2007/esrp.msp>

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Features

This white paper describes a tested and validated storage solution for a 3000 mailbox Exchange 2007 environment with Single Copy Cluster (SCC) in a high availability clustering mechanism based on the Microsoft Cluster Service (MSCS) shared storage. It requires an active and a passive set of Exchange Mailbox server nodes sharing the mailbox databases. During normal operations, mail clients access the primary (active) server. In the event of a primary node failure, the passive or standby node will take over the functionality of the failed node. This process is termed as a fail-over and these types of clusters are also popularly termed as fail-over clusters. Compared with previous versions, Exchange Server 2007 provides improved deployment setup and management experience with this clustering model.

Dell PowerVault MD3000 is a SAS based intelligent storage cabinet. The major features of the storage system are:

- Modular array capable of housing up to fifteen 3.5-inch SAS disk drives in a single rack enclosure
- Support for up to two additional daisy-chained PowerVault MD1000 storage enclosures in unified mode for a total of 45 hard drives
- Connects to host system via Dell SAS 5/E Host Bus Adapter HBA)
- Support for either up to two Highly Available (HA) hosts with redundant data paths or up to four non-HA hosts with a single data path to a SAS 5/E HBA
- Management options: In-band (via SAS connection) and out of band (via Ethernet) enclosure
- RAID and system management using Dell MD Storage Manger and Modular Disk Storage Manager Client.

Even though each PowerVault MD3000 and daisy-chained MD1000 enclosures support up to 15 drives, for a total of 45 disk drives, the solution presented in this paper utilizes a total of 36 disks, 30 disks for Exchange information stores and 6 for transaction logs. One or more disks may be configured as a hot-spares. The remaining disks provide room for future growth.

Solution Description

The Dell™ PowerVault™ MD3000 is a modular disk storage system capable of expansion with up to two PowerVault MD1000 storage enclosures.

[Dell PowerVault MD3000 Windows Server Catalog Listing](#)

[Dell PowerVault MD1000 Windows Server Catalog Listing](#)



Figure 1: Dell PowerVault MD3000 Storage system with 15 SAS drives – Front view



Dell PowerVault MD3000



Dell PowerVault MD1000



Dell PowerVault MD1000

Figure 2: Dell PowerVault MD3000 Storage system with PowerVault MD1000 Expansion – Rear view

SAS 5/E is the Host Bus Adapter used to connect the PowerVault MD3000 storage system to the Exchange server. It supports 3 Gbps Serial Attached SCSI (SAS) as the storage interconnect technology and PCI Express (PCI-E) as the host-based interconnect technology.

The presented solution is a Single Copy Cluster solution for up to 3000 mailboxes. It includes two PowerEdge 2950 servers directly attached to Dell PowerVault MD3000 storage system. The primary node, or the *active* node provides client access to the exchange store. The secondary node or the *passive* node is configured to be identical to the active node. The storage is shared between the *active* and *passive* nodes as shown in Figure 2.

The tested user profile was 0.5 IOPS per user (0.42 IOPS per user with 20% headroom) with a 1 GB (1024 MB) mailbox size.

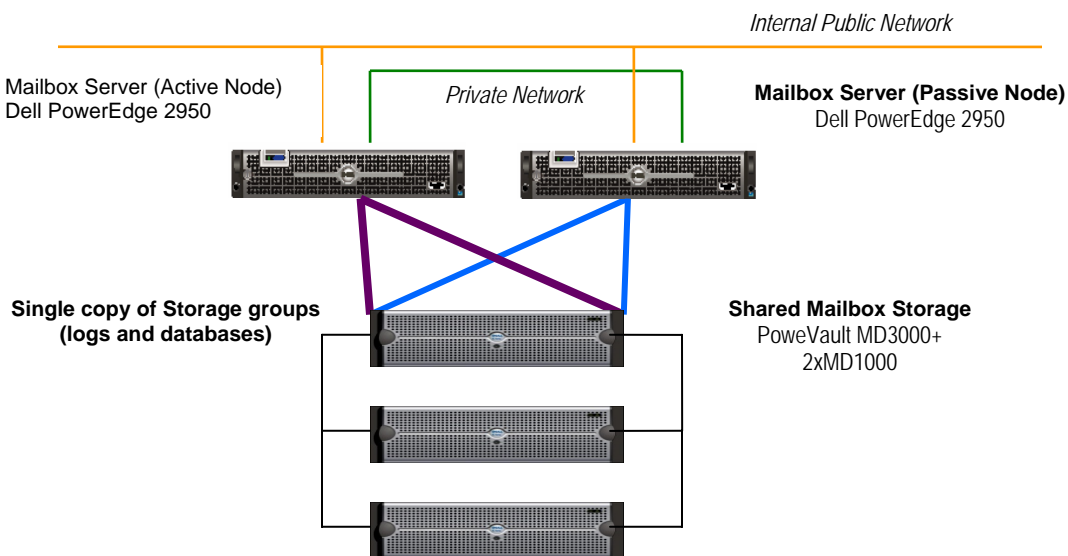


Figure 3: Test Set up Diagram

Microsoft Exchange Server System:

Server	Dell PowerEdge 2950
CPU	2 Intel® Xeon® CPU; 5160@3.00GHz
Memory	16 GB DDR2 ECC
NIC	Broadcom NeXtreme II
RAID Controller	PERC 5i (FW Version 1.00.01-0088)
Internal Disks	2 Seagate 73 GB 15K RPM SAS (ST373454SS)

Storage System:

Storage System	Dell PowerVault MD3000 (FW 06.17.77.60)
Disks	15 Seagate 300GB 15K RPM SAS (ST33006555ss/Rev S512) Drives
RAID Controller	SAS 5E (FW Version V.00.10.49.00)

Storage Configuration:

The storage configuration was as follows:

- Three 10-disk RAID 5 volumes were created from physical disks 0 through 9 of the three storage enclosures. This was used for Exchange Information stores.
- Three 2-disk RAID 1 volumes were created from physical disks 10 and 11 of each of the three storage enclosures. This was used for the transaction logs.
- Disk 12 in each storage enclosure was left as a hot spare
- Disks 13 and 14 in each enclosure were left for additional head room for future growth

This solution is designed with future growth and scalability in mind. The presented solution can be scaled out by adding additional servers and storage building blocks similar to the one presented to this solution.

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 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, 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 to mid size organizations hosting up to 3000 Exchange 2007 mailboxes. The configuration used for testing was as follows:

- Number of mailboxes : 3000
- Number of hosts attached to the storage system: 2
- User IO profile: 0.42 I/O Operation per second with 20% headroom (Tested 0.5 IOPS)
- 1 GB (024 MB) Mailbox quota per mailbox
- Single Copy Clustering for High Availability

Tested Deployment

The following tables summarize the testing environment:

Simulated Exchange Configuration:

Number of Exchange mailboxes simulated	3000
Number of hosts	1
Number of mailboxes/host	3000
Number of storage groups/host	15
Number of mailbox stores/storage group	1
Number of mailboxes/mailbox store	200
Number of mailbox store LUNs/storage group	5 Storage Groups per LUN (Total 15 Storage Groups on 3 LUN's)
Simulated profile: I/O's per second per mailbox (IOPS, include 20% headroom)	0.42 IOPS/user (Tested 0.5)
Database LUN size	2448 GB per LUN Total = 2448 x 3= 7344 GB
Log LUN size	279 GB per LUN Total = 279 x 3 = 837GB
Total database size for performance testing	2970GB
% storage capacity used by Exchange database**	2970 / 7344 = 41%

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

Storage Hardware

Storage Connectivity (Fiber Channel, SAS, SATA, iSCSI)	SAS
Storage model and OS/firmware revision	PowerVault MD3000 Firmware 06.17.77.60
Storage cache	512 MB
Number of storage controllers	2
Number of storage ports	4
Maximum bandwidth of storage connectivity to host	3 GBit
Switch type/model/firmware revision	N/A
HBA model and firmware	Dell SAS 5/E (HBA) Firmware 0.10.49.00-IT
Number of HBA's/host	2
Host server type	Dell PowerEdge 2950 2 Intel® Xeon® CPU; 5160@3.00GHz
Total number of disks tested in solution	36
Maximum number of spindles can be hosted in the storage	15 per cabinet –up to 45 in daisy chain configuration with PowerVault MD1000

Storage Software

HBA driver	Dell SAS 5/E 1.24.4.0
Multi-Pathing	Yes
Host OS	Windows Server 2003 Enterprise X64 Edition SP2
ESE.dll file version	8.0.685.24
Replication solution name/version	N/A

Storage Disk Configuration (Mailbox Store Disks)

Disk type, speed and firmware revision	Seagate SAS 15K (ST33006555ss/Rev S512) 300 GB Drives
Raw capacity per disk (GB)	300 GB
Number of physical disks in test	30
Total raw storage capacity (GB)	9000GB
Number of disks per LUN	10
Raid level	RAID 5 (9+1)
Total formatted capacity	7344 GB
Storage capacity utilization	7344 GB/ 9000 GB = 82%
Database capacity utilization	2970 GB / 9000 GB= 33%

Storage Disk Configuration (Transactional Log Disks)

Disk type, speed and firmware revision	Seagate SAS 15K (ST33006555ss/Rev S512) 300 GB Drives
Raw capacity per disk (GB)	300 GB
Number of Spindles in test	6
total raw storage capacity (GB)	1800 GB
Number of disks per LUN	2
Raid level	RAID 1
Total formatted capacity	837 GB

Solution Constraints

RAID10 offers the best performance with high protection, but only 50% of the RAID group capacity is useable. RAID5 offers a higher useable capacity per RAID group than RAID10 but lower I/O throughput. It can be effective for environments with very large mailboxes and/or lower IOPS requirements.

The storage solution presented in this paper uses RAID5 containers for the exchange database. Although RAID5 provides a better value in terms of capacity, as compared to RAID1 or RAID10, it does not perform as well in terms of I/O throughput. There are two reasons for this: First, under normal operating conditions, RAID5 has to do extra work because it has to generate and update parity information. Parity information is what makes RAID5 fault tolerant and RAID recovery possible. Second, in case of disk failures, a RAID5 container has the added task of restoring data and parity it in addition to serving IO normal I/O requests and this can significantly deteriorate the performance during rebuild. Additionally, a RAID5 volume can only tolerate a single disk failure as compared to RAID10 which can survive up to N disk failures for an N+N RAID10 volume.

RAID5 Performance

	Before Failure (Optimal)	While Degraded	During Rebuild Cycle
Database IOPS	1709	1545	1116
Read Latency	11 ms	14 ms	18 ms
Write Latency	9 ms	9 ms	16 ms

As seen in the RAID5 performance table, performance significantly suffers during a RAID5 rebuild cycle. In the optimal state, the RAID5 database disks provide 1709 IOPS with a read latency of 11 ms and write latency of 9 ms. In a degraded state the IO throughput reduces to 1545 IOPS and the database read latency increases to 14 ms. During the rebuild cycle the throughput further reduces to 1116 IOPS with read latency of 18ms and write latency of 16 ms. The disk throughput reduces by about 35% during the rebuild cycle as compared to the optimal state.

A variation of this solution would be to use RAID10 for the Exchange databases. RAID10 volume will provide better throughput as compared to RAID5. However, it would reduce the total size of the database LUNs from 7344 GB to approximately 4080 GB. Using the same mailbox size calculations as shown above that would limit the size of a user mailbox to 650 MB rather than 1 GB when using RAID5.

Best Practices

The older versions of Exchange including Exchange Server 2003 are 32-bit applications and are limited by the amount of addressable memory. Roughly 3GB of user mode virtual memory can be utilized for Exchange Server 2003 and the remaining 1GB is required for the kernel.

Exchange Server 2007 overcomes the memory limitations by providing support as a 64-bit application capable of running on supported x64 platforms. On Windows Server 2003 x64 Editions about 8TB of addressable memory is available for the kernel mode and the user mode applications. Support for up to 1TB of physical RAM is provided on Windows Server 2003 Enterprise x64 Editions. Both the application and kernel can have sufficient memory for operations, allowing the Extensible Storage Engine (ESE) in Exchange Server 2007 to utilize more memory to buffer data pages. The result is a reduction in the number of I/Os, specifically the read operations, required to the disk sub-system. The total number of database disk I/O operations for a given user load is dependent on the available system memory. For a given load, the total database disk I/O operations required per second (IOPS) decreases over a period with increase in system memory. This decrease in database IOPS is primarily caused by a decrease in database reads.

Even with the decrease in database IOPS using larger server memory, Exchange server remains a disk I/O intensive application. The disk subsystem should be capable to support both the capacity and I/O throughput demands of the application. Here are some best practices to help improve the I/O subsystem performance:

- Exchange Server can benefit from having the disk partitions track-aligned. For Windows 2003 Server SP1 or above use DiskPart to verify that your disk tracks are sector-aligned. Use a value of 64 to align the Exchange disks to a 64 KB boundary. In Exchange Server 2007, the data page size is increased from 4KB to 8KB and can provide I/O optimization in certain scenarios by containing larger messages within a page and holding internal data structures within one page due to the larger page size.
- Exchange Server 2007 also provides support for more storage groups to host mailbox database stores or databases – up to 50 storage groups per server, compared to 4 in Exchange 2003. This enables splitting user mailboxes across multiple available storage groups, providing ease of management for administrative operations such as backup/restore. Besides management ease, splitting mailboxes across multiple storage groups provides increased log checkpoint depth available for user data operations. In certain scenarios dirty data pages can be optimized to reside in memory for a longer period of time and reduce the number of write I/O operations required to the disk

sub-system. The solution described in this paper contains five storage groups with 400 users per storage group.

- Due to the high I/O demand, it is best to have dedicated disks for Exchange 2007. This will isolate the Exchange I/O's to dedicated set of disks and prevent other applications from competing for I/O throughput with Exchange disks. This will also help troubleshoot any disk latency issues as Exchange will have its own set of dedicated spindles.
- It is also recommended to place the database and transaction logs onto separate set of disks. The transaction logs generate 100% serial write I/O's to disk while the database generates 100% random read/writes. Isolating the transaction log and database I/O's onto separate disks will prevent mixing of serial and random I/O's and help improve performance.

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

For other detailed PowerVault MD3000 please refer to [PowerVault MD3000 Documentation](#)

Backup strategy

To protect e-mail data from potential disasters having a well designed and implemented backup solution is critical. Depending on the requirements of an environment different backup strategies may be implemented such as:

- Backup to disk
- Backup to tape
- LAN/SAN based backup etc.

The tests performed for backup include: backup-to-disk (read only) and log replay. The backup-to-disk test measures the read I/O performance by running a checksum on all the databases and log files. This test can help determine what kind of database read throughput can be achieved during backups. The backup speed and throughput achieved will depend upon the backup device used. The log replay test was used to measure the maximum rate at which the log files can be played against the databases. This is used to determine the restore times and also database write throughput can be achieved during a log recovery.

Contact for Additional Information

For additional information please visit <http://www.dell.com/exchange2007>

Test Result Summary

This section provides a high level summary of the test data from ESRP and the link to the detailed html reports which are generated by ESRP testing framework. Please click on the underlined headings below to view the html report for each test.

Reliability

A number of tests in the framework are to check Reliability tests runs for 24 hours. The goal is to verify the storage can handle high IO 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 following list provides an overview: (click on the underlined word will show the html report after the reliability tests run)

- Any errors reported in the saved eventlog file?
No errors were reported in the eventlog file.
- Any errors reported in during the database and log checksum process?
 - No errors were reported in the [database](#) and [log](#) checksum process.
- If backup to disk test is done, any errors reported during the process?
 - Backup to disk was not tested

Primary Storage Performance Results

The Primary Storage performance testing is designed to exercise the storage with maximum sustainable Exchange type of IO for 2 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 of 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	1709
Average Database Disk Reads/sec	887
Average Database Disk Writes/sec	822
Average Database Disk Read Latency (ms)	12
Average Database Disk Write Latency (ms)	11
Transaction Log I/O	
Average Log Disk Writes/sec	518
Average Log Disk Write Latency (ms)	2

Streaming Backup/Recovery Performance

ESRP Version 2.0 release supports only streaming backup type for testing. There are three tests in this section. The first two tests measure the database and log read I/O performance metrics by running a checksum on all the databases and log files. A third test to measure the end-to-end performance when the databases are backed up to disks was not performed.

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	22.4 (Average)
MB read/sec total	336

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)	0.50 Seconds
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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.

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

Appendix A: Performance Testing

Performance Test Result Report

Test Summary

Overall Test Result **Pass**

Machine Name M34-SCC-NODE2

Test Description 3000 users
1 GB mailboxes
15 Storage Groups
0.5 IOPS

Test Start Time 8/3/2007 11:47:16 AM

Test End Time 8/4/2007 1:40:26 AM

Jetstress Version 08.01.0136.000

Ese Version 08.00.0685.024

Operating System Microsoft Windows Server 2003 R2 Service Pack 2, v.2825 (5.2.3790.131072)

Performance Log C:\Program Files\Exchange\Jetstress\Performance_2007_8_3_23_25_29.blg
C:\Program Files\Exchange\Jetstress\DBChecksum_2007_8_4_1_40_26.blg

Database Sizing and Throughput

Achieved I/O per Second 1709.299

Planned I/O per Second 1500

Initial database size 3221280768000

Final database size 3238540328960

Database files (count) 15

Jetstress System Parameters

Thread count 4 (per-storage group)

Log buffers 9000

Minimum database cache 480.0 MB

Maximum database cache 3840.0 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 (D:)	0.011	0.011	295.947	272.441	(n/a)
Database (F:)	0.013	0.011	295.919	275.622	(n/a)
Database (K:)	0.012	0.012	295.741	273.629	(n/a)
Log (E:)	1.21085594989562E-05	0.003	0.000	171.520	11244.994
Log (J:)	0.000	0.002	0.000	173.559	11299.447
Log (L:)	0.000	0.003	0.000	173.164	11226.111

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	4.389	2.422	8.490
Available MBytes	11297.675	11293.000	11638.000
Free System Page Table Entries	16755622.000	16755622.000	16755622.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	49549516.800	49537024.000	49610752.000
Pool Paged Bytes	39340381.867	39284736.000	39387136.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log8/3/2007 11:47:04 AM -- Jetstress testing begins ...

8/3/2007 11:47:16 AM -- Prepare testing begins ...

8/3/2007 11:47:16 AM -- Creating D:\SG1\Jetstress1.edb.

8/3/2007 11:47:16 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)

8/3/2007 11:47:16 AM -- Database flush thresholds: (start: 2.6 MB, stop: 5.1 MB)

8/3/2007 12:52:48 PM -- 60.0% of 200.0 GB complete (7312489 records inserted).

8/3/2007 1:41:33 PM -- 100.0% of 200.0 GB complete (11739470 records inserted).

8/3/2007 1:41:37 PM -- Duplicating 15 databases:

8/3/2007 11:24:57 PM -- 100.0% of 2.9 TB complete (2.9 TB duplicated).

8/3/2007 11:25:12 PM -- Attaching databases ...

8/3/2007 11:25:12 PM -- Prepare testing ends.

8/3/2007 11:25:12 PM -- Dispatching transactions begins ...

8/3/2007 11:25:12 PM -- Database cache settings: (minimum: 480.0 MB, maximum: 3.8 GB)

8/3/2007 11:25:12 PM -- Database flush thresholds: (start: 38.4 MB, stop: 76.8 MB)

8/3/2007 11:25:29 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

8/3/2007 11:25:29 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

8/3/2007 11:25:30 PM -- Operation mix: Sessions 4, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

8/3/2007 11:25:30 PM -- Performance logging begins (interval: 15000 ms).

8/3/2007 11:25:30 PM -- Attaining prerequisites:

8/3/2007 11:39:31 PM -- \Database(JetstressWin)\Database Cache Size, Last: 3626697000.0 (lower bound: 3623879000.0, upper bound: none)

8/4/2007 1:39:33 AM -- Performance logging ends.

8/4/2007 1:39:33 AM -- JetInterop batch transaction stats: 27346, 27279, 27177, 27286,

27424, 27370, 27426, 27456, 27147, 27245, 27289, 27329, 27219, 27375, and 27241.
8/4/2007 1:39:34 AM -- Dispatching transactions ends.
8/4/2007 1:39:34 AM -- Shutting down databases ...
8/4/2007 1:40:26 AM -- Instance1892.1 (complete), Instance1892.2 (complete),
Instance1892.3 (complete), Instance1892.4 (complete), Instance1892.5 (complete),
Instance1892.6 (complete), Instance1892.7 (complete), Instance1892.8 (complete),
Instance1892.9 (complete), Instance1892.10 (complete), Instance1892.11 (complete),
Instance1892.12 (complete), Instance1892.13 (complete), Instance1892.14 (complete), and
Instance1892.15 (complete)
8/4/2007 1:40:26 AM -- Performance logging begins (interval: 30000 ms).
8/4/2007 1:40:26 AM -- Verifying database checksums ...
8/4/2007 4:30:47 AM -- D: (100% processed), F: (100% processed), and K: (100%
processed)
8/4/2007 4:30:48 AM -- Performance logging ends.
8/4/2007 4:30:48 AM -- [C:\Program Files\Exchange
Jetstress\DBChecksum_2007_8_4_1_40_26.blg](#) has 340 samples.
8/4/2007 4:30:51 AM -- [C:\Program Files\Exchange
Jetstress\DBChecksum_2007_8_4_1_40_26.html](#) is saved.
8/4/2007 4:30:51 AM -- Verifying log checksums ...
8/4/2007 4:31:18 AM -- E:\LOG1 (22 logs passed), E:\LOG2 (21 logs passed), E:\LOG3 (22
logs passed), E:\LOG4 (22 logs passed), E:\LOG5 (22 logs passed), J:\LOG6 (22 logs passed),
J:\LOG7 (22 logs passed), J:\LOG8 (22 logs passed), J:\LOG9 (22 logs passed), J:\LOG10 (21
logs passed), L:\LOG11 (21 logs passed), L:\LOG12 (22 logs passed), L:\LOG13 (22 logs
passed), L:\LOG14 (21 logs passed), and L:\LOG15 (21 logs passed)
8/4/2007 4:31:18 AM -- [C:\Program Files\Exchange
Jetstress\Performance_2007_8_3_23_25_29.blg](#) has 536 samples.
8/4/2007 4:31:18 AM -- Creating test report ...
8/4/2007 4:31:21 AM -- Volume D: has 0.0108 for Avg. Disk sec/Read.
8/4/2007 4:31:21 AM -- Volume F: has 0.0126 for Avg. Disk sec/Read.
8/4/2007 4:31:21 AM -- Volume K: has 0.0121 for Avg. Disk sec/Read.
8/4/2007 4:31:21 AM -- Volume E: has 0.0025 for Avg. Disk sec/Write.
8/4/2007 4:31:21 AM -- Volume E: has 0.0000 for Avg. Disk sec/Read.
8/4/2007 4:31:21 AM -- Volume J: has 0.0025 for Avg. Disk sec/Write.
8/4/2007 4:31:21 AM -- Volume J: has 0.0000 for Avg. Disk sec/Read.
8/4/2007 4:31:21 AM -- Volume L: has 0.0025 for Avg. Disk sec/Write.
8/4/2007 4:31:21 AM -- Volume L: has 0.0000 for Avg. Disk sec/Read.
8/4/2007 4:31:21 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
8/4/2007 4:31:21 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
8/4/2007 4:31:21 AM -- [C:\Program Files\Exchange
Jetstress\Performance_2007_8_3_23_25_29.xml](#) has 479 samples queried.

Database Checksum Test Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page no pages	File length / seconds taken
D:\SG1\Jetstress1.edb	26352578	0	0	0	205879 MBytes / 2190 seconds
D:\SG2\Jetstress1.edb	26355138	0	0	0	205899 MBytes / 2085 seconds
D:\SG3\Jetstress1.edb	26355906	0	0	0	205905 MBytes / 2083 seconds
D:\SG4\Jetstress1.edb	26350786	0	0	0	205865 MBytes / 2054 seconds
D:\SG5\Jetstress1.edb	26353346	0	0	0	205885 MBytes / 1805 seconds
F:\SG6\Jetstress1.edb	26355650	0	0	0	205903 MBytes / 2041 seconds
F:\SG7\Jetstress1.edb	26356162	0	0	0	205907 MBytes / 2026 seconds
F:\SG8\Jetstress1.edb	26356674	0	0	0	205911 MBytes / 2028 seconds
F:\SG9\Jetstress1.edb	26362562	0	0	0	205957 MBytes / 2010 seconds
F:\SG10\Jetstress1.edb	26354626	0	0	0	205895 MBytes / 1974 seconds
K:\SG11\Jetstress1.edb	26354370	0	0	0	205893 MBytes / 2022 seconds
K:\SG12\Jetstress1.edb	26355650	0	0	0	205903 MBytes / 1998 seconds
K:\SG13\Jetstress1.edb	26353346	0	0	0	205885 MBytes / 2025 seconds
K:\SG14\Jetstress1.edb	26355138	0	0	0	205899 MBytes / 1996 seconds
K:\SG15\Jetstress1.edb	26357698	0	0	0	205919 MBytes / 1998 seconds
(Sum)	395329630	0	0	0	3088512 MBytes / 10220 seconds

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec
D:	0.511	0.009	1607.555	0.003
F:	0.510	0.009	1634.598	0.003
K:	0.509	0.008	1641.424	0.003

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	9.261	6.615	11.276
Available MBytes	15136.321	15132.000	15262.000
Free System Page Table Entries	16755510.412	16755342.000	16755552.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	62395861.835	61419520.000	62943232.000
Pool Paged Bytes	38903229.741	38707200.000	38903808.000

Test Log 8/3/2007 11:47:04 AM -- Jetstress testing begins ...

8/3/2007 11:47:16 AM -- Prepare testing begins ...
8/3/2007 11:47:16 AM -- Creating D:\SG1\Jetstress1.edb.
8/3/2007 11:47:16 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
8/3/2007 11:47:16 AM -- Database flush thresholds: (start: 2.6 MB, stop: 5.1 MB)
8/3/2007 12:52:48 PM -- 60.0% of 200.0 GB complete (7312489 records inserted).
8/3/2007 1:41:33 PM -- 100.0% of 200.0 GB complete (11739470 records inserted).
8/3/2007 1:41:37 PM -- Duplicating 15 databases:
8/3/2007 11:24:57 PM -- 100.0% of 2.9 TB complete (2.9 TB duplicated).
8/3/2007 11:25:12 PM -- Attaching databases ...
8/3/2007 11:25:12 PM -- Prepare testing ends.
8/3/2007 11:25:12 PM -- Dispatching transactions begins ...
8/3/2007 11:25:12 PM -- Database cache settings: (minimum: 480.0 MB, maximum: 3.8 GB)
8/3/2007 11:25:12 PM -- Database flush thresholds: (start: 38.4 MB, stop: 76.8 MB)
8/3/2007 11:25:29 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
8/3/2007 11:25:29 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
8/3/2007 11:25:30 PM -- Operation mix: Sessions 4, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.
8/3/2007 11:25:30 PM -- Performance logging begins (interval: 15000 ms).
8/3/2007 11:25:30 PM -- Attaining prerequisites:
8/3/2007 11:39:31 PM -- \Database(JetstressWin)\Database Cache Size, Last: 3626697000.0 (lower bound: 3623879000.0, upper bound: none)
8/4/2007 1:39:33 AM -- Performance logging ends.
8/4/2007 1:39:33 AM -- JetInterop batch transaction stats: 27346, 27279, 27177, 27286, 27424, 27370, 27426, 27456, 27147, 27245, 27289, 27329, 27219, 27375, and 27241.
8/4/2007 1:39:34 AM -- Dispatching transactions ends.
8/4/2007 1:39:34 AM -- Shutting down databases ...
8/4/2007 1:40:26 AM -- Instance1892.1 (complete), Instance1892.2 (complete), Instance1892.3 (complete), Instance1892.4 (complete), Instance1892.5 (complete), Instance1892.6 (complete), Instance1892.7 (complete), Instance1892.8 (complete), Instance1892.9 (complete), Instance1892.10 (complete), Instance1892.11 (complete), Instance1892.12 (complete), Instance1892.13 (complete), Instance1892.14 (complete), and Instance1892.15 (complete)
8/4/2007 1:40:26 AM -- Performance logging begins (interval: 30000 ms).
8/4/2007 1:40:26 AM -- Verifying database checksums ...
8/4/2007 4:30:47 AM -- D: (100% processed), F: (100% processed), and K: (100% processed)
8/4/2007 4:30:48 AM -- Performance logging ends.
8/4/2007 4:30:48 AM -- [C:\Program Files\Exchange Jetstress\DBChecksum_2007_8_4_1_40_26.blg](#) has 340 samples.

Appendix B: Stress Testing

Stress Test Result Report

Stress Test Result Report

Test Summary

Overall Test **Pass**

Result

Machine Name M34-SCC-NODE2

Test Description 3000 users
1 GB mailboxes
15 Storage Groups
0.5 IOPS

Test Start Time 8/5/2007 12:06:47 AM

Test End Time 8/6/2007 11:38:14 AM

Jetstress Version 08.01.0136.000

Ese Version 08.00.0685.024

Operating System Microsoft Windows Server 2003 R2 Service Pack 2, v.2825 (5.2.3790.131072)

Performance Log C:\Program Files\Exchange\Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Performance\Stress_2007_8
C:\Program Files\Exchange\Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Performance\DBChecksum

Database Sizing and Throughput

Achieved I/O per Second 1726.561

Planned I/O per Second 1500

Initial database size 3221280768000

Final database size 3392534200320

Database files (count) 15

Jetstress System Parameters

Thread count 4 (per-storage group)

Log buffers 9000

Minimum database cache 480.0 MB

Maximum database cache 3840.0 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 (D:)	0.011	0.011	309.193	265.700	(n/a)
Database (F:)	0.012	0.011	309.761	265.995	(n/a)
Database (K:)	0.012	0.012	309.847	266.066	(n/a)
Log (E:)	0.000	0.002	0.000	161.374	11149.968
Log (J:)	0.000	0.002	0.000	161.396	11157.970
Log (L:)	0.000	0.002	0.000	161.339	11162.426

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	4.385	2.109	9.401
Available MBytes	11232.678	11212.000	11592.000
Free System Page Table Entries	16755100.208	16755082.000	16755272.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	54436910.933	54423552.000	54538240.000
Pool Paged Bytes	41055688.533	40509440.000	42033152.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 8/5/2007 12:06:35 AM -- Jetstress testing begins ...

8/5/2007 12:06:47 AM -- Prepare testing begins ...

8/5/2007 12:06:47 AM -- Duplicating 15 databases:

8/5/2007 11:23:31 AM -- 100.0% of 2.9 TB complete (2.9 TB duplicated).

8/5/2007 11:23:47 AM -- Attaching databases ...

8/5/2007 11:23:47 AM -- Prepare testing ends.

8/5/2007 11:23:47 AM -- Dispatching transactions begins ...

8/5/2007 11:23:47 AM -- Database cache settings: (minimum: 480.0 MB, maximum: 3.8 GB)

8/5/2007 11:23:47 AM -- Database flush thresholds: (start: 38.4 MB, stop: 76.8 MB)

8/5/2007 11:24:04 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.1 seconds/read).

8/5/2007 11:24:04 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.1 seconds/write).

8/5/2007 11:24:05 AM -- Operation mix: Sessions 4, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

8/5/2007 11:24:05 AM -- Performance logging begins (interval: 15000 ms).

8/5/2007 11:24:05 AM -- Attaining prerequisites:

8/5/2007 11:37:21 AM -- \Database(JetstressWin)\Database Cache Size, Last: 3625722000.0 (lower bound: 3623879000.0, upper bound: none)

8/6/2007 11:37:22 AM -- Performance logging ends.

8/6/2007 11:37:22 AM -- JetInterop batch transaction stats: 275032, 276596, 275578, 275358, 275078, 275344, 275739, 275473, 274952, 275230, 275518, 275885, 274946, 274523, and 275816.

8/6/2007 11:37:23 AM -- Dispatching transactions ends.

8/6/2007 11:37:23 AM -- Shutting down databases ...

8/6/2007 11:38:14 AM -- Instance2376.1 (complete), Instance2376.2 (complete), Instance2376.3 (complete), Instance2376.4 (complete), Instance2376.5 (complete),

Instance2376.6 (complete), Instance2376.7 (complete), Instance2376.8 (complete), Instance2376.9 (complete), Instance2376.10 (complete), Instance2376.11 (complete), Instance2376.12 (complete), Instance2376.13 (complete), Instance2376.14 (complete), and Instance2376.15 (complete)

8/6/2007 11:38:15 AM -- Performance logging begins (interval: 30000 ms).

8/6/2007 11:38:15 AM -- Verifying database checksums ...

8/6/2007 2:36:04 PM -- D: (100% processed), F: (100% processed), and K: (100% processed)

8/6/2007 2:36:05 PM -- Performance logging ends.

8/6/2007 2:36:05 PM -- [C:\Program Files\Exchange\Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Performance\DBChecksum_2007_8_6_11_38_14.blg](#) has 355 samples.

8/6/2007 2:36:08 PM -- [C:\Program Files\Exchange\Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Performance\DBChecksum_2007_8_6_11_38_14.html](#) is saved.

8/6/2007 2:36:08 PM -- Verifying log checksums ...

8/6/2007 2:36:35 PM -- E:\LOG1 (22 logs passed), E:\LOG2 (22 logs passed), E:\LOG3 (21 logs passed), E:\LOG4 (22 logs passed), E:\LOG5 (22 logs passed), J:\LOG6 (21 logs passed), J:\LOG7 (21 logs passed), J:\LOG8 (22 logs passed), J:\LOG9 (21 logs passed), J:\LOG10 (21 logs passed), L:\LOG11 (22 logs passed), L:\LOG12 (22 logs passed), L:\LOG13 (22 logs passed), L:\LOG14 (21 logs passed), and L:\LOG15 (22 logs passed)

8/6/2007 2:36:35 PM -- [C:\Program Files\Exchange\Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Performance\Stress_2007_8_5_1_1_24_4.blg](#) has 5813 samples.

8/6/2007 2:36:35 PM -- Creating test report ...

8/6/2007 2:37:37 PM -- Volume D: has 0.0114 for Avg. Disk sec/Read.

8/6/2007 2:37:37 PM -- Volume F: has 0.0116 for Avg. Disk sec/Read.

8/6/2007 2:37:37 PM -- Volume K: has 0.0117 for Avg. Disk sec/Read.

8/6/2007 2:37:37 PM -- Volume E: has 0.0024 for Avg. Disk sec/Write.

8/6/2007 2:37:37 PM -- Volume E: has 0.0000 for Avg. Disk sec/Read.

8/6/2007 2:37:37 PM -- Volume J: has 0.0024 for Avg. Disk sec/Write.

8/6/2007 2:37:37 PM -- Volume J: has 0.0000 for Avg. Disk sec/Read.

8/6/2007 2:37:37 PM -- Volume L: has 0.0024 for Avg. Disk sec/Write.

8/6/2007 2:37:37 PM -- Volume L: has 0.0000 for Avg. Disk sec/Read.

8/6/2007 2:37:37 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

8/6/2007 2:37:37 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

8/6/2007 2:37:37 PM -- [C:\Program Files\Exchange\Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Performance\Stress_2007_8_5_1_1_24_4.xml](#) has 5759 samples queried.

Stress Test - Database Checksum Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page no pages	File length / seconds taken
D:\SG1\Jetstress1.edb	27602882	0	0	0	215647 MBytes / 2240 seconds
D:\SG2\Jetstress1.edb	27613378	0	0	0	215729 MBytes / 2199 seconds
D:\SG3\Jetstress1.edb	27611586	0	0	0	215715 MBytes / 2108 seconds
D:\SG4\Jetstress1.edb	27617474	0	0	0	215761 MBytes / 2187 seconds

D:\SG5\Jetstress1.edb	27597250	0	0	0	215603 MBytes / 1931 seconds
F:\SG6\Jetstress1.edb	27602626	0	0	0	215645 MBytes / 2159 seconds
F:\SG7\Jetstress1.edb	27595970	0	0	0	215593 MBytes / 2142 seconds
F:\SG8\Jetstress1.edb	27622594	0	0	0	215801 MBytes / 2076 seconds
F:\SG9\Jetstress1.edb	27602626	0	0	0	215645 MBytes / 2150 seconds
F:\SG10\Jetstress1.edb	27618498	0	0	0	215769 MBytes / 2049 seconds
K:\SG11\Jetstress1.edb	27605186	0	0	0	215665 MBytes / 2146 seconds
K:\SG12\Jetstress1.edb	27607490	0	0	0	215683 MBytes / 2122 seconds
K:\SG13\Jetstress1.edb	27612354	0	0	0	215721 MBytes / 2052 seconds
K:\SG14\Jetstress1.edb	27598530	0	0	0	215613 MBytes / 2136 seconds
K:\SG15\Jetstress1.edb	27619266	0	0	0	215775 MBytes / 2051 seconds
(Sum)	414127710	0	0	0	3235372 MBytes / 10669 seconds

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec
D:	0.513	0.009	1615.747	0.003
F:	0.510	0.010	1632.123	0.003
K:	0.506	0.009	1644.574	0.003

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	9.327	6.758	11.380
Available MBytes	15057.639	15040.000	15192.000
Free System Page Table Entries	16755073.324	16755012.000	16755082.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	63796226.885	62889984.000	64081920.000
Pool Paged Bytes	43654510.332	42418176.000	44900352.000

Test Log8/5/2007 12:06:35 AM -- Jetstress testing begins ...

8/5/2007 12:06:47 AM -- Prepare testing begins ...

8/5/2007 12:06:47 AM -- Duplicating 15 databases:

8/5/2007 11:23:31 AM -- 100.0% of 2.9 TB complete (2.9 TB duplicated).

8/5/2007 11:23:47 AM -- Attaching databases ...

8/5/2007 11:23:47 AM -- Prepare testing ends.

8/5/2007 11:23:47 AM -- Dispatching transactions begins ...
8/5/2007 11:23:47 AM -- Database cache settings: (minimum: 480.0 MB, maximum: 3.8 GB)
8/5/2007 11:23:47 AM -- Database flush thresholds: (start: 38.4 MB, stop: 76.8 MB)
8/5/2007 11:24:04 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.1 seconds/read).
8/5/2007 11:24:04 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.1 seconds/write).
8/5/2007 11:24:05 AM -- Operation mix: Sessions 4, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.
8/5/2007 11:24:05 AM -- Performance logging begins (interval: 15000 ms).
8/5/2007 11:24:05 AM -- Attaining prerequisites:
8/5/2007 11:37:21 AM -- \Database(JetstressWin)\Database Cache Size, Last: 3625722000.0 (lower bound: 3623879000.0, upper bound: none)
8/6/2007 11:37:22 AM -- Performance logging ends.
8/6/2007 11:37:22 AM -- JetInterop batch transaction stats: 275032, 276596, 275578, 275358, 275078, 275344, 275739, 275473, 274952, 275230, 275518, 275885, 274946, 274523, and 275816.
8/6/2007 11:37:23 AM -- Dispatching transactions ends.
8/6/2007 11:37:23 AM -- Shutting down databases ...
8/6/2007 11:38:14 AM -- Instance2376.1 (complete), Instance2376.2 (complete), Instance2376.3 (complete), Instance2376.4 (complete), Instance2376.5 (complete), Instance2376.6 (complete), Instance2376.7 (complete), Instance2376.8 (complete), Instance2376.9 (complete), Instance2376.10 (complete), Instance2376.11 (complete), Instance2376.12 (complete), Instance2376.13 (complete), Instance2376.14 (complete), and Instance2376.15 (complete)
8/6/2007 11:38:15 AM -- Performance logging begins (interval: 30000 ms).
8/6/2007 11:38:15 AM -- Verifying database checksums ...
8/6/2007 2:36:04 PM -- D: (100% processed), F: (100% processed), and K: (100% processed)
8/6/2007 2:36:05 PM -- Performance logging ends.
8/6/2007 2:36:05 PM -- [C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Performance\DBChecksum_2007_8_6_11_38_14.blg](#) has 355 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
Instance3300.1	204801.52	02:34:39	22.07
Instance3300.2	204801.52	02:32:53	22.33
Instance3300.3	204801.52	02:34:38	22.07
Instance3300.4	204801.52	02:33:18	22.26
Instance3300.5	204801.52	02:34:30	22.09
Instance3300.6	204801.52	02:33:11	22.28
Instance3300.7	204801.52	02:33:28	22.24
Instance3300.8	204801.52	02:34:10	22.14
Instance3300.9	204801.52	02:34:35	22.08
Instance3300.10	204801.52	02:35:13	21.99
Instance3300.11	204801.52	02:28:26	22.99
Instance3300.12	204801.52	02:27:17	23.18
Instance3300.13	204801.52	02:30:57	22.61
Instance3300.14	204801.52	02:26:41	23.27
Instance3300.15	204801.52	02:30:29	22.68

Jetstress System Parameters

Thread count	4 (per-storage group)
Log buffers	9000
Minimum database cache	480.0 MB
Maximum database cache	3840.0 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 (D:)	0.006	5.52270069139001E-05	881.535	0.019	(n/a)
Database (F:)	0.006	5.64306790515813E-05	879.687	0.017	(n/a)
Database (K:)	0.005	0.000	881.094	0.021	(n/a)

Log (E:)	0.000	4.52197680980074E-05	0.000	0.023	320.652
Log (J:)	0.000	3.52177415463468E-05	0.000	0.020	279.191
Log (L:)	0.000	0.000	0.000	0.026	522.991

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	8.396	3.893	9.844
Available MBytes	14756.661	14542.000	15174.000
Free System Page Table Entries	16754947.000	16754947.000	16754947.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	54843246.658	54816768.000	54874112.000
Pool Paged Bytes	50925898.323	50147328.000	50999296.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 8/7/2007 8:27:19 AM -- Jetstress testing begins ...

8/7/2007 8:27:31 AM -- Prepare testing begins ...

8/7/2007 8:27:37 AM -- Duplicating 15 databases:

8/7/2007 7:49:06 PM -- 100.0% of 2.9 TB complete (2.9 TB duplicated).

8/7/2007 7:49:22 PM -- Attaching databases ...

8/7/2007 7:49:22 PM -- Prepare testing ends.

8/7/2007 7:49:38 PM -- Performance logging begins (interval: 30000 ms).

8/7/2007 7:49:38 PM -- Streaming backup databases ...

8/7/2007 10:24:53 PM -- Performance logging ends.

8/7/2007 10:24:53 PM -- Instance3300.1 (100% processed), Instance3300.2 (100% processed), Instance3300.3 (100% processed), Instance3300.4 (100% processed), Instance3300.5 (100% processed), Instance3300.6 (100% processed), Instance3300.7 (100% processed), Instance3300.8 (100% processed), Instance3300.9 (100% processed), Instance3300.10 (100% processed), Instance3300.11 (100% processed), Instance3300.12 (100% processed), Instance3300.13 (100% processed), Instance3300.14 (100% processed), and Instance3300.15 (100% processed)

8/7/2007 10:24:53 PM -- C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\bakup\StreamingBackup_2007_8_7_19_49_22.blg has 310 samples.

8/7/2007 10:24:53 PM -- Creating test report ...

Appendix D: Soft Recovery Testing

SoftRecovery Test Result Report

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance2736.1	516	258.75
Instance2736.2	511	258
Instance2736.3	512	244.75
Instance2736.4	517	255.25
Instance2736.5	526	262.5
Instance2736.6	516	261.75
Instance2736.7	514	265.5
Instance2736.8	502	262.75
Instance2736.9	504	265.25
Instance2736.10	516	259.75
Instance2736.11	503	261
Instance2736.12	506	256.25
Instance2736.13	500	259
Instance2736.14	508	256
Instance2736.15	510	259.75

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (D:)	0.035	0.007	2360.581	40.110	(n/a)
Database (F:)	0.042	0.009	2350.896	39.047	(n/a)
Database (K:)	0.038	0.008	2356.530	39.040	(n/a)
Log (E:)	0.003	0.005	325.218	15.156	4916.039
Log (J:)	0.003	0.005	318.639	14.545	4994.668
Log (L:)	0.003	0.005	316.601	14.533	4846.009

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	15.523	8.008	28.906
Available MBytes	11849.379	11147.000	14872.000
Free System Page Table Entries	16755012.000	16755012.000	16755012.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	56927635.394	55877632.000	63406080.000
Pool Paged Bytes	45332790.303	44544000.000	45355008.000

Database Page Fault Stalls/sec 0.000 0.000 0.000

Test Log8/6/2007 3:35:41 PM -- Jetstress testing begins ...
8/6/2007 3:35:53 PM -- Prepare testing begins ...
8/6/2007 3:35:54 PM -- Duplicating 15 databases:
8/7/2007 2:56:59 AM -- 100.0% of 2.9 TB complete (2.9 TB duplicated).
8/7/2007 2:57:14 AM -- Attaching databases ...
8/7/2007 2:57:14 AM -- Prepare testing ends.
8/7/2007 2:57:14 AM -- Dispatching transactions begins ...
8/7/2007 2:57:14 AM -- Database cache settings: (minimum: 480.0 MB, maximum: 3.8 GB)
8/7/2007 2:57:14 AM -- Database flush thresholds: (start: 38.4 MB, stop: 76.8 MB)
8/7/2007 2:57:31 AM -- Database read latency thresholds: (average: 0.02 seconds/read,
maximum: 0.05 seconds/read).
8/7/2007 2:57:31 AM -- Log write latency thresholds: (average: 0.01 seconds/write,
maximum: 0.05 seconds/write).
8/7/2007 2:57:32 AM -- Operation mix: Sessions 4, Inserts 25%, Deletes 10%, Replaces 50%,
Reads 15%, Lazy Commits 80%.
8/7/2007 2:57:32 AM -- Performance logging begins (interval: 15000 ms).
8/7/2007 2:57:32 AM -- Generating log files ...
8/7/2007 3:43:24 AM -- E:\LOG1 (103.4% generated), E:\LOG2 (102.4% generated),
E:\LOG3 (102.6% generated), E:\LOG4 (103.6% generated), E:\LOG5 (105.4% generated),
J:\LOG6 (103.4% generated), J:\LOG7 (103.0% generated), J:\LOG8 (100.6% generated),
J:\LOG9 (101.0% generated), J:\LOG10 (103.4% generated), L:\LOG11 (100.6% generated),
L:\LOG12 (101.4% generated), L:\LOG13 (100.2% generated), L:\LOG14 (101.8%
generated), and L:\LOG15 (102.2% generated)
8/7/2007 3:43:25 AM -- Performance logging ends.
8/7/2007 3:43:25 AM -- JetInterop batch transaction stats: 9944, 9921, 9856, 9829, 10093,
9985, 10115, 10134, 9958, 9952, 9933, 10001, 9806, 9935, and 9933.
8/7/2007 3:43:25 AM -- Dispatching transactions ends.
8/7/2007 3:43:25 AM -- Shutting down databases ...
8/7/2007 3:44:12 AM -- Instance2736.1 (complete), Instance2736.2 (complete),
Instance2736.3 (complete), Instance2736.4 (complete), Instance2736.5 (complete),
Instance2736.6 (complete), Instance2736.7 (complete), Instance2736.8 (complete),
Instance2736.9 (complete), Instance2736.10 (complete), Instance2736.11 (complete),
Instance2736.12 (complete), Instance2736.13 (complete), Instance2736.14 (complete), and
Instance2736.15 (complete)
8/7/2007 3:44:13 AM -- Performance logging begins (interval: 30000 ms).
8/7/2007 3:44:13 AM -- Verifying database checksums ...
8/7/2007 6:32:19 AM -- D: (100% processed), F: (100% processed), and K: (100%
processed)
8/7/2007 6:32:20 AM -- Performance logging ends.
8/7/2007 6:32:20 AM -- [C:\Program Files\Exchange
Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\DBChecksum_2007_8_7_3_44_12.blg](C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\DBChecksum_2007_8_7_3_44_12.blg)
has 336 samples.
8/7/2007 6:32:23 AM -- [C:\Program Files\Exchange
Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\DBChecksum_2007_8_7_3_44_12.html](C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\DBChecksum_2007_8_7_3_44_12.html)
is saved.
8/7/2007 6:32:23 AM -- Verifying log checksums ...
8/7/2007 6:34:36 AM -- E:\LOG1 (100 logs passed), E:\LOG2 (100 logs passed), E:\LOG3
(100 logs passed), E:\LOG4 (100 logs passed), E:\LOG5 (100 logs passed), J:\LOG6 (100 logs
passed), J:\LOG7 (100 logs passed), J:\LOG8 (100 logs passed), J:\LOG9 (100 logs passed),
J:\LOG10 (100 logs passed), L:\LOG11 (100 logs passed), L:\LOG12 (100 logs passed),
L:\LOG13 (100 logs passed), L:\LOG14 (100 logs passed), and L:\LOG15 (100 logs passed)
8/7/2007 6:34:36 AM -- [C:\Program Files\Exchange
Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\Performance_2007_8_7_2_57_31.blg](C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\Performance_2007_8_7_2_57_31.blg)
has 183 samples.
8/7/2007 6:34:36 AM -- Creating test report ...
8/7/2007 6:34:37 AM -- Volume D: has 0.0111 for Avg. Disk sec/Read.

8/7/2007 6:34:37 AM -- Volume F: has 0.0116 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume K: has 0.0114 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume E: has 0.0024 for Avg. Disk sec/Write.
8/7/2007 6:34:37 AM -- Volume E: has 0.0008 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume J: has 0.0024 for Avg. Disk sec/Write.
8/7/2007 6:34:37 AM -- Volume J: has 0.0009 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume L: has 0.0025 for Avg. Disk sec/Write.
8/7/2007 6:34:37 AM -- Volume L: has 0.0009 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Test has 0.466752201276593 Maximum Database Page Fault Stalls/sec.
8/7/2007 6:34:37 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
8/7/2007 6:34:37 AM -- C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\Performance_2007_8_7_2_57_31.xml has 182 samples queried.
8/7/2007 6:34:37 AM -- C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\Performance_2007_8_7_2_57_31.html is saved.
8/7/2007 6:34:44 AM -- Performance logging begins (interval: 4000 ms).
8/7/2007 6:34:44 AM -- Recovering databases ...
8/7/2007 6:39:10 AM -- Performance logging ends.
8/7/2007 6:39:10 AM -- Instance2736.1 (258.75), Instance2736.2 (258), Instance2736.3 (244.75), Instance2736.4 (255.25), Instance2736.5 (262.5), Instance2736.6 (261.75), Instance2736.7 (265.5), Instance2736.8 (262.75), Instance2736.9 (265.25), Instance2736.10 (259.75), Instance2736.11 (261), Instance2736.12 (256.25), Instance2736.13 (259), Instance2736.14 (256), and Instance2736.15 (259.75)
8/7/2007 6:39:10 AM -- C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\SoftRecovery_2007_8_7_6_34_37.blg has 66 samples.
8/7/2007 6:39:10 AM -- Creating test report ...

SoftRecovery Performance Test Result Report

Test Summary

Overall Test Result **Pass**

Machine Name M34-SCC-NODE2

Test Description

Test Start Time 8/6/2007 3:35:53 PM

Test End Time 8/7/2007 3:44:12 AM

Jetstress Version 08.01.0136.000

Ese Version 08.00.0685.024

Operating System Microsoft Windows Server 2003 R2 Service Pack 2, v.2825 (5.2.3790.131072)

Performance Log C:\Program Files\Exchange\Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\Performance_20070806133553PM.txt
C:\Program Files\Exchange\Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\DBChecksum_20070807034412AM.txt

Database Sizing and Throughput

Achieved I/O per Second 1726.022

Planned I/O per Second 1500

Initial database size 3221280768000

Final database size 3227582709760

Database files (count) 15

Jetstress System Parameters

Thread count 4 (per-storage group)

Log buffers 9000

Minimum database cache 480.0 MB

Maximum database cache 3840.0 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 (D:)	0.011	0.013	302.443	272.723	(n/a)
Database (F:)	0.012	0.013	309.393	271.068	(n/a)
Database (K:)	0.011	0.014	303.286	267.109	(n/a)
Log (E:)	0.001	0.002	0.231	183.546	11376.626
Log (J:)	0.001	0.002	0.228	185.670	11098.197
Log (L:)	0.001	0.002	0.226	181.979	11196.260

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	8.204	3.464	25.365
Available MBytes	11663.262	11162.000	14364.000
Free System Page Table Entries	16755012.000	16755012.000	16755012.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	54624479.825	54566912.000	55062528.000
Pool Paged Bytes	45126997.333	44269568.000	45146112.000
Database Page Fault Stalls/sec	0.003	0.000	0.467

Test Log8/6/2007 3:35:41 PM -- Jetstress testing begins ...

8/6/2007 3:35:53 PM -- Prepare testing begins ...

8/6/2007 3:35:54 PM -- Duplicating 15 databases:

8/7/2007 2:56:59 AM -- 100.0% of 2.9 TB complete (2.9 TB duplicated).

8/7/2007 2:57:14 AM -- Attaching databases ...

8/7/2007 2:57:14 AM -- Prepare testing ends.

8/7/2007 2:57:14 AM -- Dispatching transactions begins ...

8/7/2007 2:57:14 AM -- Database cache settings: (minimum: 480.0 MB, maximum: 3.8 GB)

8/7/2007 2:57:14 AM -- Database flush thresholds: (start: 38.4 MB, stop: 76.8 MB)

8/7/2007 2:57:31 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

8/7/2007 2:57:31 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

8/7/2007 2:57:32 AM -- Operation mix: Sessions 4, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.

8/7/2007 2:57:32 AM -- Performance logging begins (interval: 15000 ms).

8/7/2007 2:57:32 AM -- Generating log files ...

8/7/2007 3:43:24 AM -- E:\LOG1 (103.4% generated), E:\LOG2 (102.4% generated), E:\LOG3 (102.6% generated), E:\LOG4 (103.6% generated), E:\LOG5 (105.4% generated), J:\LOG6 (103.4% generated), J:\LOG7 (103.0% generated), J:\LOG8 (100.6% generated), J:\LOG9 (101.0% generated), J:\LOG10 (103.4% generated), L:\LOG11 (100.6% generated), L:\LOG12 (101.4% generated), L:\LOG13 (100.2% generated), L:\LOG14 (101.8% generated), and L:\LOG15 (102.2% generated)

8/7/2007 3:43:25 AM -- Performance logging ends.

8/7/2007 3:43:25 AM -- JetInterop batch transaction stats: 9944, 9921, 9856, 9829, 10093, 9985, 10115, 10134, 9958, 9952, 9933, 10001, 9806, 9935, and 9933.

8/7/2007 3:43:25 AM -- Dispatching transactions ends.

8/7/2007 3:43:25 AM -- Shutting down databases ...

8/7/2007 3:44:12 AM -- Instance2736.1 (complete), Instance2736.2 (complete), Instance2736.3 (complete), Instance2736.4 (complete), Instance2736.5 (complete), Instance2736.6 (complete), Instance2736.7 (complete), Instance2736.8 (complete), Instance2736.9 (complete), Instance2736.10 (complete), Instance2736.11 (complete),

Instance2736.12 (complete), Instance2736.13 (complete), Instance2736.14 (complete), and Instance2736.15 (complete)
8/7/2007 3:44:13 AM -- Performance logging begins (interval: 30000 ms).
8/7/2007 3:44:13 AM -- Verifying database checksums ...
8/7/2007 6:32:19 AM -- D: (100% processed), F: (100% processed), and K: (100% processed)
8/7/2007 6:32:20 AM -- Performance logging ends.
8/7/2007 6:32:20 AM -- C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\DBChecksum_2007_8_7_3_44_12.blg has 336 samples.
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8/7/2007 6:32:23 AM -- Verifying log checksums ...
8/7/2007 6:34:36 AM -- E:\LOG1 (100 logs passed), E:\LOG2 (100 logs passed), E:\LOG3 (100 logs passed), E:\LOG4 (100 logs passed), E:\LOG5 (100 logs passed), J:\LOG6 (100 logs passed), J:\LOG7 (100 logs passed), J:\LOG8 (100 logs passed), J:\LOG9 (100 logs passed), J:\LOG10 (100 logs passed), L:\LOG11 (100 logs passed), L:\LOG12 (100 logs passed), L:\LOG13 (100 logs passed), L:\LOG14 (100 logs passed), and L:\LOG15 (100 logs passed)
8/7/2007 6:34:36 AM -- C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\Performance_2007_8_7_2_57_31.blg has 183 samples.
8/7/2007 6:34:36 AM -- Creating test report ...
8/7/2007 6:34:37 AM -- Volume D: has 0.0111 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume F: has 0.0116 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume K: has 0.0114 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume E: has 0.0024 for Avg. Disk sec/Write.
8/7/2007 6:34:37 AM -- Volume E: has 0.0008 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume J: has 0.0024 for Avg. Disk sec/Write.
8/7/2007 6:34:37 AM -- Volume J: has 0.0009 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Volume L: has 0.0025 for Avg. Disk sec/Write.
8/7/2007 6:34:37 AM -- Volume L: has 0.0009 for Avg. Disk sec/Read.
8/7/2007 6:34:37 AM -- Test has 0.466752201276593 Maximum Database Page Fault Stalls/sec.
8/7/2007 6:34:37 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
8/7/2007 6:34:37 AM -- C:\Program Files\Exchange Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\Performance_2007_8_7_2_57_31.xml has 182 samples queried.

Database Checksum Test Result Report

Test Result Report

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page no pages	File length / seconds taken
D:\SG1\Jetstress1.edb	26269122	0	0	0	205227 MBytes / 2154 seconds
D:\SG2\Jetstress1.edb	26267330	0	0	0	205213 MBytes / 2070 seconds
D:\SG3\Jetstress1.edb	26268098	0	0	0	205219 MBytes / 1989 seconds
D:\SG4\Jetstress1.edb	26267842	0	0	0	205217 MBytes

					/ 2067 seconds
D:\SG5\Jetstress1.edb	26267586	0	0	0	205215 MBytes / 1804 seconds
F:\SG6\Jetstress1.edb	26267330	0	0	0	205213 MBytes / 1993 seconds
F:\SG7\Jetstress1.edb	26264002	0	0	0	205187 MBytes / 1993 seconds
F:\SG8\Jetstress1.edb	26262466	0	0	0	205175 MBytes / 1938 seconds
F:\SG9\Jetstress1.edb	26264258	0	0	0	205189 MBytes / 2015 seconds
F:\SG10\Jetstress1.edb	26267074	0	0	0	205211 MBytes / 1961 seconds
K:\SG11\Jetstress1.edb	26264258	0	0	0	205189 MBytes / 2046 seconds
K:\SG12\Jetstress1.edb	26264770	0	0	0	205193 MBytes / 2017 seconds
K:\SG13\Jetstress1.edb	26265026	0	0	0	205195 MBytes / 1943 seconds
K:\SG14\Jetstress1.edb	26265282	0	0	0	205197 MBytes / 2025 seconds
K:\SG15\Jetstress1.edb	26267586	0	0	0	205215 MBytes / 1929 seconds
(Sum)	393992030	0	0	0	3078062 MBytes / 10086 seconds

Disk Subsystem Performance (of checksum)

	LogicalDisk Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec
D:	0.506	0.007	1626.925	0.003
F:	0.504	0.009	1658.129	0.002
K:	0.503	0.009	1648.363	0.003

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	9.304	6.211	11.198
Available MBytes	15006.586	15002.000	15132.000
Free System Page Table Entries	16755012.000	16755012.000	16755012.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	63531398.095	62889984.000	63995904.000
Pool Paged Bytes	44588604.952	44392448.000	44597248.000

Test Log8/6/2007 3:35:41 PM -- Jetstress testing begins ...

8/6/2007 3:35:53 PM -- Prepare testing begins ...

8/6/2007 3:35:54 PM -- Duplicating 15 databases:

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J:\LOG6 (103.4% generated), J:\LOG7 (103.0% generated), J:\LOG8 (100.6% generated),
J:\LOG9 (101.0% generated), J:\LOG10 (103.4% generated), L:\LOG11 (100.6% generated),
L:\LOG12 (101.4% generated), L:\LOG13 (100.2% generated), L:\LOG14 (101.8%
generated), and L:\LOG15 (102.2% generated)
8/7/2007 3:43:25 AM -- Performance logging ends.
8/7/2007 3:43:25 AM -- JetInterop batch transaction stats: 9944, 9921, 9856, 9829, 10093,
9985, 10115, 10134, 9958, 9952, 9933, 10001, 9806, 9935, and 9933.
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8/7/2007 3:43:25 AM -- Shutting down databases ...
8/7/2007 3:44:12 AM -- Instance2736.1 (complete), Instance2736.2 (complete),
Instance2736.3 (complete), Instance2736.4 (complete), Instance2736.5 (complete),
Instance2736.6 (complete), Instance2736.7 (complete), Instance2736.8 (complete),
Instance2736.9 (complete), Instance2736.10 (complete), Instance2736.11 (complete),
Instance2736.12 (complete), Instance2736.13 (complete), Instance2736.14 (complete), and
Instance2736.15 (complete)
8/7/2007 3:44:13 AM -- Performance logging begins (interval: 30000 ms).
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8/7/2007 6:32:19 AM -- D: (100% processed), F: (100% processed), and K: (100%
processed)
8/7/2007 6:32:20 AM -- Performance logging ends.
8/7/2007 6:32:20 AM -- [C:\Program Files\Exchange
Jetstress\SCC_15SG_3000User_1GBMailbox_4ThreadperSG\Recovery\DBChecksum_2007_8_7_3_44_12.blg](#) has 336 samples.