EMC²
where information lives®

ESRP Storage Program
EMC CLARiiON CX3-20c(1000 user)
Storage Solution for Microsoft Exchange Server

February 28, 2007

This document contains information about the EMC CLARiiON CX3-20c(1000 User) Storage Solution for Microsoft Exchange Server.

The contents of this document are:

Overview

This document provides information on the EMC CLARiiON ® CX3-20c storage solution based on the Microsoft Exchange Solution Reviewed Program (ESRP) - Storage program1. For any questions or comments regarding the contents of this document, see the "contact information' section.

Disclaimer

This document has been produced independently of Microsoft Corporation. Microsoft Corporation expressly disclaims responsibility for, and makes no warranty, express or implied, with respect to, the accuracy of the contents of this document.

The information contained in this document represents the current view of EMC on the issues discussed as of the date of publication. Due to changing market conditions, it should not be interpreted to be a commitment on the part of EMC, and EMC cannot guarantee the accuracy of any information presented after the date of publication.

Features

This document describes an approach that can be used to configure Exchange solutions around EMC's CLARiiON CX3-20c storage systems.

Built on the innovative EMC CLARiiON CX3 UltraScale architecture, the EMC CX3-20c 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

1.The ESRP - Storage program was developed by Microsoft Corporation to provide a command storage testing framework for EMC to provide information on its storage solution for Microsoft Exchange Server software.

Features

For more details on the Microsoft ESRP - Storage program, please go to http://www.microsoftstoragepartners.com.

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

The CLARiiON CX3-20c Fibre Channel (FC)/iSCSI array offers both

4 Gb/s FC and 1 Gb/s iSCSI ports fully integrated in the same array, enabling customer 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 CX3-20c array.

The CLARiiON CX3-20c Fibre Channel (FC)/iSCSI array gives customers an advantage, 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 CX3-20c 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 CX3-20c 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 CX3-20c, you can chose the drive options that meet your specific needs, thereby providing the flexibility to offer multiple levels of performance in on system. The CX3-20c supports both high-performance and high-capacity disk drives in the same system, can scale from 365GB to 59TB, and supports 128 high-availability hosts. It supports 4 Gb/s (15k RPM) FC drives for demanding applications requiring maximum performance. Choose 2 Gb/s FC(10k RPM) for applications that require balancing performance and costs. Or, choose low-cost 2Gb/s FC drives (7.2k RPM) for Tier 2 applications requiring high capacities and low cost-such as disk-based backup.

The CX3-20c 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, plus 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 CX3-20c for a high-performance Exchange environment. For this solution, a CX3-20c storage system was used and configured for 1000 Exchange 2003 users. The Exchange cluster nodes were connected to the CX3-20c via iSCSI using dedicated NICs used for iSCSI with the Microsoft iSCSI software initiator (v2.0.2), and an iSCSI VLAN.

Each of the 1000 users is profiled using a value of 1 IOPS per user and a 250-MB mailbox requirement.

Solution description

The solution described is for utilizing a single CX3-20c and a single disk enclosure (DAE) full using 15 146 GB drives giving the customer the most performance and fault tolerance utilizing Raid 10 for the Exchange Databases, Raid 1 for the Exchange log files and Services (SMTP/MTA/Message Tracking), and Raid 5 for Backup to Disk Volumes.

Log files will be placed on the first two drives 0_0_0-0_0_1 in a Raid 1 configuration, Backup to Disk and Services(SMTP, MTA and Message Tracking) are placed on the next 4 drives 0_0_2-0_0_5.

Sizing and configuring storage for using 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 "Mid-Sized Enterprise Building Block". The Midsized Enterprise Building Block is used to simplify the sizing and configuration when using low number of disks to insure the highest performance while staying fault tolerant.

This unit of measure - or Mid-Sized Enterprise Building Block - is designed to be scalable in 500 user increments with the ability to grow and expand into the larger building block deployment model detailed in the EMC ESRP Submissions for greater than 4000 users. The Mid-Sized Enterprise Building Blocks help to simplify the design and configuration of a highly available, high performance configuration as a company grows and email requirements.

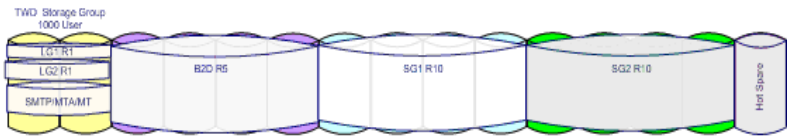
Table 1 describes the characteristics of each building block.

Table 1 Mid-Sized Enterprise Building block characteristics

Number of users	1,000
Number of Exchange Servers	1
IOPS per user	1.0
Mailbox size	250 MB
Number of disks required for Logs and Database	10
Disk type	146 GB/15/Fibre Channel
RAID type Logs	Raid 1
Raid Type Databases	Raid 1/0
Number of storage groups	2

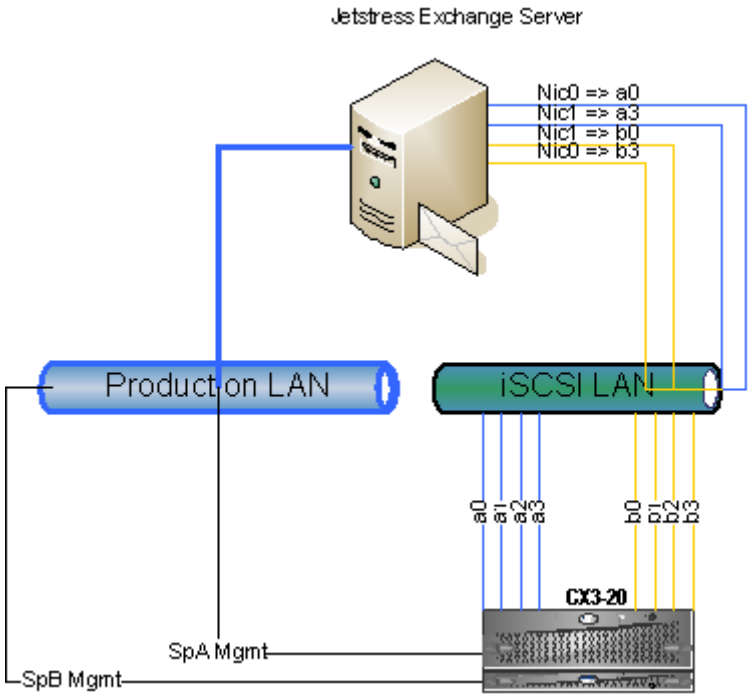
Using the performance characteristics of the CLARiiON CX3-20c architecture and the I/O capabilities of the 146GB disk drives, 10 spindles are required to provide the necessary performance to match the I/O requirements of 1000, 1.0 IOPS users. The Exchange databases reside on 4 spindles in 1: 2+2 Raid 10 Raid Group. To scale this configuration for a larger Exchange environment, this design can be duplicated for 1000 more users utilizing a single DAE. As the number of users increase into the second DAE, please reference the 1500 and 2000 user ESRP submission by EMC. As a company grows and requires the 3rd DAE which would accommodate fully built out 4000, 1.0 user, please reference the release ESRP submission.
http://www.emc.com/techlib/pdf/20084_CX3-20c_iSCSI_4000_Users_Storage_Solution_for_Microsoft_Exchange_Server.pdf

The diagram below illustrates the disk layout for the 1000 user configuration.



The iSCSI configuration is extremely important to insure the highest performance and best fault tolerance.

Utilizing Microsoft's iSCSI initiator 2.02, NaviSphere/NaviCli .22 and EMC's PowerPath 4.6 utilizing two Intel 1 Gb/s Network Interface Cards set in a Balanced Path configuration. The two iSCSI NICs were dedicated and used purely for iSCSI traffic. The first NIC targeted to Spa Path A0 and B3, and the second NIC targeted to Spb Path B0 and A3. The iSCSI Ethernet VLANs were used purely for iSCSI traffic.



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

Due to such variables, 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 designed for small to medium businesses with the target range of 1000 mailbox users.

- 1 Exchange Server
- User IO profile tested was 1.0
- User mailbox size 250MB
- Backup strategy. Backup to Disk.
- One storage group per server
- Five databases per storage group

Tested deployment

The following tables summarize the testing environment.

Simulated Exchange configuration

Table 2 lists the simulated Exchange configuration details.

Table 2 Simulated Exchange configuration

Item	Description
Number of Exchange mailboxes simulated	1,000
Number of hosts	1
Number of mailboxes/hosts	1,000
Number of storage groups/host	2
Number of mailbox stores/storage group	5
Number of mailboxes/mailbox store	100
Number of mailbox store LUNS/storage group	2 database LUNs: 2 log files LUNs
Simulated profile: I/Os per second per mailbox	1
Database LUN size	267 GB
Log LUN size	25 GB
Backup LUN size/storage group	300 GB Raid 5
Total database size for performance testing	25151.01MB per Database - 125 GB per SG
% storage capacity used by Exchange database	46%

Hardware

Table 3 lists the hardware used in the environment.

Table 3 Hardware (list of all hardware used for the test)

Item	Description
Storage type (SAN,DAS, iSCSI, NAS)	iSCSI
Storage model and OS/firmware revision	CLARiiON CX3-20c
Storage cache	2 GB Mirrored-1GB per SP
Number of storage controllers	2
Number of storage ports	2 per SP
Maximum bandwidth of storage connectivity to host	4*1GB Ethernet
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 HBAs/host	2

Table 3 Hardware (list of all hardware used for the test)

Item	Description
Host server type	Dell Computer Corporation PowerEdge 1850 System TypeX86-based PC Processorx86 Family 15 Model 4 Stepping 8 GenuineIntel ~2793 Mhz Processorx86 Family 15 Model 4 Stepping 8 GenuineIntel ~2793 Mhz Processorx86 Family 15 Model 4 Stepping 8 GenuineIntel ~2793 Mhz Processorx86 Family 15 Model 4 Stepping 8 GenuineIntel ~2793 Mhz Processorx86 Family 15 Model 4 Stepping 8 GenuineIntel ~2793 Mhz Processorx86 Family 15 Model 4 Stepping 8 GenuineIntel ~2793 Mhz Processorx86 Family 15 Model 4 Stepping 8 GenuineIntel ~2793 Mhz Processorx86 Family 15 Model 4 Stepping 8 GenuineIntel ~2793 Mhz BIOS Version/DateDell Computer Corporation A05, 1/9/2006 SMBIOS Version2.3 Total Physical Memory4,095.08 MB
Total number of disks tested in solution	11
Maximum number of spindles that can be hosted in the storage	15

Software

Table 4 lists the software used in the environment.

Table 4 Software

Item	Description
HBA driver	Driver: e1000325.sys (8.7.1.0 built by: WinDDK, 160.50 KB (164,352 bytes), 9/14/2006 7:42 AM)
HBA QueueTarget setting	
HBA QueueDepth setting	
Multipathing	Microsoft iSCSI Initiator 2.02, Powerpath 4.6
Host OS	Microsoft(R) Windows(R) Server 2003, Enterprise Edition Version5.2.3790 Service Pack 1 Build 3790
`ESE.dll` file version	6.5.7638.2
Replication solution name/version	N/A

Disk configuration (mailbox store disks)

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

Table 5 Disk configuration (mailbox store)

Item	Description
Disk type, speed and firmware revision	4Gbps 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)	1168 GB
Disk slice size	N/A
Number of slices per LUN or number of disks per LUN	N/A

Table 5 Disk configuration (mailbox store)

Item	Description
RAID level	1/0
Total formatted capacity	267 GB*2= 534 GB
Storage capacity utilization	Formatted capacity/Total raw capacity 45%
Database capacity utilization	Database size / Total raw capacity 22%

Disk configuration (transactional log disks)

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

Table 6 Disk configuration

Item	Description
Disk type, speed and firmware revision	4 Gbps FC SCSI 15,000 RPM - R450
Raw capacity per disk (GB)	146 GB
Number of Spindles in test	2
Total raw storage capacity (GB)	292 GB
Disk slice size	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID 1
Total formatted capacity	25 GB

Streaming backup

Table 7 Disk Configuration(Streaming Back up to disk)

Item	Description
Disk type, speed and firmware revision	4 Gbps FC SCSI 15,000 RPM - R450
Raw capacity per disk (GB)	146 GB
Number of Spindles in test	4
Total raw storage capacity (GB)	400 GB
Disk slice size	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID 5
Total formatted capacity	300 GB

Replication

N/A

Item	Description
Replication Mechanism	N/A
Number of links	N/A
Simulated link distance	N/A
Link type	N/A
Link Bandwidth	N/A

Best practices

Microsoft Exchange Server is a disk-intensive application. It is characterized as a very burst, mostly 4-KB random access, read/write operation to the database file, with a sequential, mostly 512 byte, write operation to the transaction logs. It is this random, burst workload, with periods of high peaks, that makes designing a well performing storage solution with Microsoft Exchange server a challenge. Different corporate environments have different user and storage requirements, so storage design cannot be based simply on generalizations.

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

For Exchange best practices on storage design, please visit http://www.microsoft.com/technet/prodtechnol/exchange/2003/library/optimizestorage.mspx

Core storage/Replication

1. Use diskpart (in Microsoft Windows 2003 SP1) 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 fro Microsoft Exchange and makes troubleshooting efforts easier in the event of a disk related Microsoft Exchange performance issue.
3. Size and configure the environment for spindle performance as a primary consideration, with storage capacity secondary.
4. Tuning the CX3-20c storage system parameters is important in obtaining best performance. The following list details the optimal parameters for Exchange:

- Cache page size of 4KB
- Maximized write cache size
- Read and Write cache enabled for all LUNs
- Read cache minimum of 50-100MB for prefetch

5. iSCSI configuration Using PowerPath 4.6 utilizing a balanced path approach. Logging into with NIC0 into the A0(Spa) and B3(Spb), and NIC1 into B0(Spb) and A3(Spa).
6. TcpAckFrequency = 1 per http://support.microsoft.com/kb/328890 to improve iSCSI performance.

Note: In the event a performance problem cannot be resolved using common performance analysis, EMC Corporation strongly recommends that a case be opened with EMC Customer Service, so that the appropriate Customer Support resources may be engaged.

1. What is the best practice with regard to the number of replication links between enclosures?
2. What is the best practice with grouping Database and Log replication activity?
3. What is the best practice with regard to determining bandwidth and latency requirements between enclosures?
4. What is the best practice with regard to troubleshooting high latency on the database and log LUNs?
5. Recommending to add the following sentence in this section:

Microsoft Exchange has a whitepaper on Deployment Guidelines for Data Replication; for support policies on data replication, please refer to KB 895847.

Backup Strategy

A well designed and implemented disaster recovery strategy should be a top priority for Exchange implementations. Proper planning must be done prior to configuration in order to meet required service-level agreements (SLAs) for server downtime. Various backup and restore strategies can be implemented, depending on the requirements of the environment. EMC offers multiple backup-to disk solutions that deliver all of the flexibility to tape and disk, and Replication Manager, which can manage snapshots or replicas of your Exchange environment, utilizing the ground breaking technology of Snapview ® . Both Replication Manager and NetWorker can be used in conjunction with Exchange 2003 Volume Shadow Copy services (VSS). These solutions are proven, tested and blueprinted with leading backup software applications and can be deployed in existing SAN or LAN storage infrastructures. For example, EMC offers the CLARiiON ® with either ATA or LCFC drives. EMC provides operationally simple disk

libraries that easily integrate with existing backup environments through tape emulation. In this solution, the tested method for backup was a one stage disk-to-disk backup. With this configuration, several best practice considerations must be understood in order to achieve optimal performance.

1. Disk-to-disk backup LUNs should be configured in a separate disk group. Workload isolation will optimize performance of the streaming backups and minimize the impact on the production workload.
2. Higher capacity Fibre Channel or FATA drives should be utilized if the environment requires additional backup copies of the data on the primary disks. FATA drives should not be utilized to host production Exchange traffic without careful consideration of the performance impact. FATA drives operate at a lower rotational speed and will provide much lower throughput than Fibre Channel drives. FATA drives are also designed for an 8*5 duty cycle and not meant to operate 24*7. This results in a shorter mean time between failure (MTBF) than Fibre Channel drives (which are rated for 24*7) if over utilized.
3. Maximize the number of Exchange databases and storage groups on the Exchange server in order to minimize the time required for disaster recovery operations. Exchange storage groups can be backed up in parallel, so having the maximum of four storage groups enables four parallel backup operations. Up to twenty databases can be created for Exchange 2003. By utilizing the maximum number of databases, this keeps the size of each database smaller and reduces the restore window. Best practices are to keep the database sizes in the 30-45GB range.

Contact for Additional Information

http://www.emc.com

Test Result Summary

This section provides a high level summary of the test data from ESRP and the link to the detailed html reports which are generated by 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)

- No errors were reported in the event logs for the storage reliability
- No errors were reported for the database and checksum.
- No errors were during the backup to disk process.

Performance

Performance testing is 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 a sample taken from one of the host/s attached, and it is the average of all the logical disks in the 2 hours test duration.

Performance test results in Appendix A:

Aggregate of All Storage Groups Performance

Average of the database disks read latency (ms)	12.5 ms
Average of the database disks write latency (ms)	5 ms
Average of the log disks write latency (ms)	1 ms
Database Disk Reads/sec	786.67
Database Disk Writes/sec	389.59
Log Disk Writes/sec	97.94
Max database page fault stalls per sec	0

Storage Group 1 Performance

Average of the database disks read latency (ms)	13 ms
Average of the database disks write latency (ms)	5 ms
Average of the log disks write latency (ms)	1 ms
Database Disk Reads/sec	375.65
Database Disk Writes/sec	184.64
Log Disk Writes/sec	46.75
Max database page fault stalls per sec	0

Storage Group 2 Performance

Average of the database disks read latency (ms)	12 ms
Average of the database disks write latency (ms)	5 ms
Average of the log disks write latency (ms)	1 ms
Database Disk Reads/sec	411.02
Database Disk Writes/sec	204.95
Log Disk Writes/sec	51.19
Max database page fault stalls per sec	0

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. 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	60.34 MB/sec
MB read/sec per total	120.1 MB/sec
File size/seconds taken	251633 MB/2095 seconds)

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 100 log files played in a single storage group. Each log file is 5 MB in size.

Average time to play one log file (sec)	7.06
Average log disks read bytes/sec	1557801

Backup to disk Performance

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

Total database size per storage group (GB)	125 GB
Time taken to backup each storage group	01:08:00
Average MB backed up/sec per storage group	30

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. The 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 giving solution. Rather, it is focused on producing recommendations from EMCs for Exchange application. So the data presented in this document should not be used for direct comparisons among the solutions.

Appendix A: Performance Test Results

The following charts and data are from the Jetstress test report for the CX3-20c Jetstress 2 hour performance test.

Jetstress Test Result: 4BPSX91

The purpose of this test is to verify the storage configuration which the customer is planning to deploy. The test run has been successful, meaning 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 tasks listed below):

1. 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.
2. You need to confirm whether the storage solution has synchronous replication as part of the implementation. If the solution does not utilize synchronous replication, then you should check for the database write latency, the desired value should be under 20 ms. (Please refer to http://support.microsoft.com/?kbid=895847 for synchronous replication definitions.)
3. Please check the status pane in the Jetstress window to make sure that no errors were logged during the database checksum validation.

Planned disk subsystem profile:

Total test Database size	Production data size	Total number of databases	Expected I/O	Achieved I/O

244.38 GB (based on the attached database)	(n/a)	10 (2 storage(s) * 5 database(s))	1000.00 (1000 mailboxes of 1.00 IOPS)	1176.26

JetStress test parameter summary:

Instance	threadCount	logBufferSize	opInsert	opReplace	opDelete	lazyCommit
1	5	9000	17	70	5	90
2	5	9000	17	70	5	90

Disk subsystem performance summary:

Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Data (C:\Exchange\SG1\db)	0.013	0.005	375.65	184.64	(n/a)
Data (C:\Exchange\SG2\db)	0.012	0.005	411.02	204.95	(n/a)
Log (C:\Exchange\SG1\lg)	0.000	0.001	0.000	46.75	6293.60
Log (C:\Exchange\SG2\lg)	0.000	0.001	0.000	51.19	6381.80

Processor/memory performance summary:

Counter	Average	Minimum	Maximum
% Processor Time	1.560	1.142	2.756
Available MBytes	2563.81	2559.00	2722.00

Free System Page Table Entries	183054.00	183054.00	183054.00
Pages/Sec	0.043	0.000	17.53
Pool Nonpaged Bytes	38676407.32	38645760.00	38891520.00
Pool Paged Bytes	27363631.57	26324992.00	27525120.00
Database Page Fault Stalls/sec	0.000	0.000	0.000

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\Perf2\Performance_2006_12_6_16-49-34.blg is saved.

12/6/2006 4:49:24 PM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

12/6/2006 4:49:24 PM -- Warning: One or more storage groups are starting the tuning process with non-default tuning parameters. One of the reasons is that this server had a successful test run previously, and the parameters are saved in the JS_config.xml file. If you would like to use the default tuning parameters, please stop the test, then select the "Test Run Info" tab page, and click the "Restore Defaults" button. The test will use the default parameters.

12/6/2006 4:49:24 PM -- Validating input parameters, it may take a few minutes...

12/6/2006 4:49:25 PM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

12/6/2006 4:49:34 PM -- Loading performance counters...

12/6/2006 4:49:34 PM -- Instance4028.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 4:49:34 PM -- Instance4028.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 4:49:34 PM -- Start Jetstress test...

12/6/2006 4:49:37 PM -- Performance logging started.

12/6/2006 4:49:37 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\Perf2\Tuning_2006_12_6_16-49-35.blg.

12/6/2006 4:49:37 PM -- Start tuning process, this may take an hour depending on the testing environment...

12/6/2006 4:50:08 PM -- Volume C:\Exchange\SG1\db has 0.00007 for Read Latency Slope.

12/6/2006 4:50:08 PM -- Volume C:\Exchange\SG2\db has 0.00006 for Read Latency Slope.

12/6/2006 4:52:09 PM -- Instance1: the value for Target disk transfer is 500.

12/6/2006 4:52:09 PM -- Instance1: the value for Actual disk transfer is 564.

12/6/2006 4:52:09 PM -- Volume C:\Exchange\SG1\db has 0.0099 for Database disk read latency.

12/6/2006 4:52:09 PM -- Volume C:\Exchange\SG1\db has 0.0015 for Database disk write latency.

12/6/2006 4:52:09 PM -- Instance2: the value for Target disk transfer is 500.

12/6/2006 4:52:09 PM -- Instance2: the value for Actual disk transfer is 648.

12/6/2006 4:52:09 PM -- Volume C:\Exchange\SG2\db has 0.0089 for Database disk read latency.

12/6/2006 4:52:09 PM -- Volume C:\Exchange\SG2\db has 0.0019 for Database disk write latency.

12/6/2006 4:52:09 PM -- Instance4028.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 4:52:09 PM -- Instance4028.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 4:52:09 PM -- Performance logging stopped.

12/6/2006 4:52:09 PM -- Tuning process has completed. Jetstress test will be started.

12/6/2006 4:52:09 PM -- Starting Performance test run...

12/6/2006 4:52:11 PM -- Performance logging started.

12/6/2006 4:52:11 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\Perf2\Performance_2006_12_6_16-49-34.blg.

12/6/2006 6:51:57 PM -- Adding new data to the performance log file...

12/6/2006 6:52:12 PM -- Performance logging stopped.

12/6/2006 6:52:12 PM -- Stopping Jetstress...

12/6/2006 6:52:34 PM -- Creating test report ...

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG1\db has 0.0134 for Avg. Disk sec/Read.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG2\db has 0.0122 for Avg. Disk sec/Read.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG1\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG1\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG2\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG2\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 6:52:37 PM -- Test has 0 Max Database Page Fault Stalls/sec.

12/6/2006 6:52:37 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

Database Checksum Results

Jetstress Test Result: 4BPSX91

The following table shows a quick overview of checksum statistics:

Database	Pages seen	Bad checksums	Correctable checksums	Wrong page numbers	MB read/sec (File size/Seconds taken)
C:\Exchange\SG1\db\Jetstress.edb	6427906	0	0	0	60.0 MB/sec (25109 MB/418 seconds)
C:\Exchange\SG1\db\Jetstress1.edb	6428930	0	0	0	62.8 MB/sec (25113 MB/399 seconds)

Database Checksum Results

C:\Exchange\SG1\db\Jetstress2.edb	6427650	0	0	0	65.6 MB/sec (25108 MB/382 seconds)
C:\Exchange\SG1\db\Jetstress3.edb	6426882	0	0	0	63.7 MB/sec (25105 MB/394 seconds)
C:\Exchange\SG1\db\Jetstress4.edb	6427906	0	0	0	62.5 MB/sec (25109 MB/401 seconds)
C:\Exchange\SG2\db\Jetstress.edb	6433538	0	0	0	55.4 MB/sec (25131 MB/453 seconds)
C:\Exchange\SG2\db\Jetstress1.edb	6432258	0	0	0	55.4 MB/sec (25126 MB/453 seconds)
C:\Exchange\SG2\db\Jetstress2.edb	6432258	0	0	0	54.7 MB/sec (25126 MB/459 seconds)
C:\Exchange\SG2\db\Jetstress3.edb	6433282	0	0	0	55.8 MB/sec (25130 MB/450 seconds)
C:\Exchange\SG2\db\Jetstress4.edb	6432514	0	0	0	62.4 MB/sec (25127 MB/402 seconds)
(sum)	64303124	0	0	0	119.1 MB/sec (251184 MB/2108 seconds)

The following table shows a quick overview of database and log performance counter sample data:

Storage Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Total Seconds
C:\Exchange\SG1\db	0.539	0.000	957.56	0.000	418.47
C:\Exchange\SG1\db	0.525	0.000	981.02	0.000	399.79
C:\Exchange\SG1\db	0.513	0.000	1003.04	0.000	382.93
C:\Exchange\SG1\db	0.510	0.000	1006.98	0.000	394.32

C:\Exchange\SG1\db	0.511	0.000	1005.48	0.000	402.03
C:\Exchange\SG2\db	0.584	0.011	885.30	0.022	453.38
C:\Exchange\SG2\db	0.581	0.006	885.77	0.011	453.79
C:\Exchange\SG2\db	0.582	0.003	882.20	0.007	459.16
C:\Exchange\SG2\db	0.580	0.003	884.74	0.005	450.66
C:\Exchange\SG2\db	0.569	0.002	905.78	0.004	402.45

The following table shows a quick overview of processor and memory performance counter sample data:

Counter	Average	Minimum	Maximum
% Processor Time	12.68	0.000	19.62
Available MBytes	3540.22	3406.00	3577.00
Free System Page Table Entries	183050.80	183054.00	183054.00
Pages/Sec	0.014	0.000	28.74
Pool Nonpaged Bytes	41410980.00	38621180.00	41766910.00
Pool Paged Bytes	27420950.00	26112000.00	27463680.00

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\Perf2\DatabaseChecksum_2006_12_6_18-52-37.blg is saved.

12/6/2006 4:49:24 PM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

12/6/2006 4:49:24 PM -- Warning: One or more storage groups are starting the tuning process with non-default tuning parameters. One of the reasons is

that this server had a successful test run previously, and the parameters are saved in the JS_config.xml file. If you would like to use the default tuning parameters, please stop the test, then select the "Test Run Info" tab page, and click the "Restore Defaults" button. The test will use the default parameters.

12/6/2006 4:49:24 PM -- Validating input parameters, it may take a few minutes...

12/6/2006 4:49:25 PM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

12/6/2006 4:49:34 PM -- Loading performance counters...

12/6/2006 4:49:34 PM -- Instance4028.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 4:49:34 PM -- Instance4028.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 4:49:34 PM -- Start Jetstress test...

12/6/2006 4:49:37 PM -- Performance logging started.

12/6/2006 4:49:37 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\Perf2\Tuning_2006_12_6_16-49-35.blg.

12/6/2006 4:49:37 PM -- Start tuning process, this may take an hour depending on the testing environment...

12/6/2006 4:50:08 PM -- Volume C:\Exchange\SG1\db has 0.00007 for Read Latency Slope.

12/6/2006 4:50:08 PM -- Volume C:\Exchange\SG2\db has 0.00006 for Read Latency Slope.

12/6/2006 4:52:09 PM -- Instance1: the value for Target disk transfer is 500.

12/6/2006 4:52:09 PM -- Instance1: the value for Actual disk transfer is 564.

12/6/2006 4:52:09 PM -- Volume C:\Exchange\SG1\db has 0.0099 for Database disk read latency.

12/6/2006 4:52:09 PM -- Volume C:\Exchange\SG1\db has 0.0015 for Database disk write latency.

12/6/2006 4:52:09 PM -- Instance2: the value for Target disk transfer is 500.

12/6/2006 4:52:09 PM -- Instance2: the value for Actual disk transfer is 648.

12/6/2006 4:52:09 PM -- Volume C:\Exchange\SG2\db has 0.0089 for Database disk read latency.

12/6/2006 4:52:09 PM -- Volume C:\Exchange\SG2\db has 0.0019 for Database disk write latency.

12/6/2006 4:52:09 PM -- Instance4028.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 4:52:09 PM -- Instance4028.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 4:52:09 PM -- Performance logging stopped.

12/6/2006 4:52:09 PM -- Tuning process has completed. Jetstress test will be started.

12/6/2006 4:52:09 PM -- Starting Performance test run...

12/6/2006 4:52:11 PM -- Performance logging started.

12/6/2006 4:52:11 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\Perf2\Performance_2006_12_6_16-49-34.blg.

12/6/2006 6:51:57 PM -- Adding new data to the performance log file...

12/6/2006 6:52:12 PM -- Performance logging stopped.

12/6/2006 6:52:12 PM -- Stopping Jetstress...

12/6/2006 6:52:34 PM -- Creating test report ...

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG1\db has 0.0134 for Avg. Disk sec/Read.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG2\db has 0.0122 for Avg. Disk sec/Read.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG1\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG1\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG2\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 6:52:37 PM -- Volume C:\Exchange\SG2\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 6:52:37 PM -- Test has 0 Max Database Page Fault Stalls/sec.

12/6/2006 6:52:37 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

12/6/2006 6:52:38 PM -- Performance logging started.

12/6/2006 6:52:38 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\Perf2\DatabaseChecksum_2006_12_6_18-52-37.blg.

12/6/2006 6:52:38 PM -- Checksum validation may take a while depending on the file sizes.

12/6/2006 7:29:38 PM -- Database checksum in progress:

Storage Group #1 (100%), and Storage Group #2 (100%).

12/6/2006 7:29:38 PM -- Performance logging stopped.

12/6/2006 7:29:38 PM -- Checksum is completed, please open C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\Perf2\DatabaseChecksum_2006_12_6_18-52-37.html for checksum result.

Appendix B: Streaming Back

Backup to Disk Results.

The following charts and data are from the Jetstress test report for the CX3-20c Jetstress Streaming Backup: Backup to Disk test.

Performance Log Generation Results

Jetstress Test Result: 4BPSX91

The purpose of this test is to verify the storage configuration which the customer is planning to deploy. The test run has been successful, meaning 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 tasks listed below):

1. 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.

2. You need to confirm whether the storage solution has synchronous replication as part of the implementation. If the solution does not utilize synchronous replication, then you should check for the database write latency, the desired value should be under 20 ms. (Please refer to http://support.microsoft.com/?kbid=895847 for synchronous replication definitions.)
3. Please check the status pane in the Jetstress window, to make sure that no errors were logged during the database checksum validation.

Planned disk subsystem profile:

Total test database size	Production data size	Total number of databases	Expected I/O	Achieved I/O
245.21 GB (based on the attached database)	(n/a)	10 (2 storage(s) * 5 database(s))	1000.00 (1000 mailboxes of 1.00 IOPS)	1179.39

JetStress test parameter summary:

Instance	threadCount	logBufferSize	opInsert	opReplace	opDelete	lazyCommit
1	5	9000	17	70	5	90
2	5	9000	17	70	5	90

Disk subsystem performance summary:

Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Data (C:\Exchange\SG1\db)	0.013	0.004	376.53	185.38	(n/a)
Data (C:\Exchange\SG2\db)	0.012	0.005	411.68	205.81	(n/a)
Log (C:\Exchange\SG1\lg)	0.000	0.001	0.006	47.74	6241.90
Log (C:\Exchange\SG2\lg)	0.000	0.001	0.007	52.42	6333.45

Performance Log Generation Results

Processor/memory performance summary:

Counter	Average	Minimum	Maximum
% Processor Time	2.087	1.265	6.096
Available MBytes	2741.88	2732.00	2895.00
Free System Page Table Entries	182981.88	182974.00	182986.00
Pages/Sec	0.025	0.000	1.600
Pool Nonpaged Bytes	35157665.91	35135488.00	35205120.00
Pool Paged Bytes	25449253.20	24821760.00	25624576.00
Database Page Fault Stalls/sec	0.000	0.000	0.000

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Performance_LogGeneration_2006_12_6_20-16-6.blg is saved.

12/6/2006 8:15:54 PM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

12/6/2006 8:16:01 PM -- Warning: One or more storage groups are starting the tuning process with non-default tuning parameters. One of the reasons is that this server had a successful test run previously, and the parameters are saved in the JS_config.xml file. If you would like to use the default tuning parameters, please stop the test, then select the "Test Run Info" tab page, and click the "Restore Defaults" button. The test will use the default parameters.

12/6/2006 8:16:02 PM -- Validating input parameters, it may take a few minutes...

12/6/2006 8:16:02 PM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

12/6/2006 8:16:06 PM -- Loading performance counters...

12/6/2006 8:16:06 PM -- Instance2856.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:16:06 PM -- Instance2856.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:16:06 PM -- Start Jetstress test...

12/6/2006 8:16:09 PM -- Performance logging started.

12/6/2006 8:16:09 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Tuning_2006_12_6_20-16-7.blg.

12/6/2006 8:16:09 PM -- Start tuning process, this may take an hour depending on the testing environment...

12/6/2006 8:16:43 PM -- Volume C:\Exchange\SG1\db has 0.00006 for Read Latency Slope.

12/6/2006 8:16:43 PM -- Volume C:\Exchange\SG2\db has 0.00007 for Read Latency Slope.

12/6/2006 8:18:57 PM -- Instance1: the value for Target disk transfer is 500.

12/6/2006 8:18:57 PM -- Instance1: the value for Actual disk transfer is 562.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG1\db has 0.0099 for Database disk read latency.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG1\db has 0.0014 for Database disk write latency.

12/6/2006 8:18:57 PM -- Instance2: the value for Target disk transfer is 500.

12/6/2006 8:18:57 PM -- Instance2: the value for Actual disk transfer is 650.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG2\db has 0.0089 for Database disk read latency.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG2\db has 0.0020 for Database disk write latency.

12/6/2006 8:18:57 PM -- Instance2856.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:18:57 PM -- Instance2856.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:18:57 PM -- Performance logging stopped.

12/6/2006 8:18:57 PM -- Tuning process has completed. Jetstress test will be started.

12/6/2006 8:18:57 PM -- Starting StreamingBackup test run...

12/6/2006 8:18:59 PM -- Performance logging started.

12/6/2006 8:18:59 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Performance_LogGeneration_2006_12_6_20-16-6.blg.

12/6/2006 9:17:49 PM -- Adding new data to the performance log file...

12/6/2006 9:18:04 PM -- Performance logging stopped.

12/6/2006 9:18:04 PM -- Stopping Jetstress...

12/6/2006 9:18:21 PM -- Creating test report ...

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\db has 0.0134 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\db has 0.0122 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Test has 0 Max Database Page Fault Stalls/sec.

12/6/2006 9:18:22 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

Jetstress Test Result: 4BPSX91

The following table shows a quick overview of checksum statistics:

Database	Pages seen	Bad checksums	Correctable checksums	Wrong page numbers	MB read/sec (File size/Seconds taken)
C:\Exchange\SG1\db\Jetstress.edb	6438658	0	0	0	65.6 MB/sec (25151 MB/383 seconds)

C:\Exchange\SG1\db\Jetstress1.edb	6439170	0	0	0	64.0 MB/sec (25153 MB/392 seconds)
C:\Exchange\SG1\db\Jetstress2.edb	6438402	0	0	0	65.2 MB/sec (25150 MB/385 seconds)
C:\Exchange\SG1\db\Jetstress3.edb	6437890	0	0	0	63.5 MB/sec (25148 MB/395 seconds)
C:\Exchange\SG1\db\Jetstress4.edb	6438914	0	0	0	62.7 MB/sec (25152 MB/401 seconds)
C:\Exchange\SG2\db\Jetstress.edb	6445826	0	0	0	54.1 MB/sec (25179 MB/465 seconds)
C:\Exchange\SG2\db\Jetstress1.edb	6444546	0	0	0	54.5 MB/sec (25174 MB/461 seconds)
C:\Exchange\SG2\db\Jetstress2.edb	6444034	0	0	0	54.9 MB/sec (25172 MB/458 seconds)
C:\Exchange\SG2\db\Jetstress3.edb	6445826	0	0	0	55.1 MB/sec (25179 MB/457 seconds)
C:\Exchange\SG2\db\Jetstress4.edb	6444802	0	0	0	64.8 MB/sec (25175 MB/388 seconds)
(sum)	64418068	0	0	0	120.1 MB/sec (251633 MB/2095 seconds)

Performance Log Generation Results

The following table shows a quick overview of database and log performance counter sample data:

Storage Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Total Seconds
C:\Exchange\SG1\db	0.488	0.000	1046.27	0.000	383.67
C:\Exchange\SG1\db	0.494	0.000	1035.37	0.000	392.89
C:\Exchange\SG1\db	0.493	0.000	1037.82	0.000	385.96
C:\Exchange\SG1\db	0.496	0.000	1032.33	0.000	395.98
C:\Exchange\SG1\db	0.499	0.000	1026.33	0.000	401.28
C:\Exchange\SG2\db	0.591	0.019	862.83	0.036	465.96
C:\Exchange\SG2\db	0.589	0.011	867.58	0.026	461.94
C:\Exchange\SG2\db	0.587	0.008	871.19	0.017	458.75
C:\Exchange\SG2\db	0.586	0.006	873.64	0.013	457.40
C:\Exchange\SG2\db	0.570	0.005	902.49	0.011	388.75

The following table shows a quick overview of processor and memory performance counter sample data:

Counter	Average	Minimum	Maximum
% Processor Time	12.55	0.00	19.87
Available MBytes	3586.33	3544.00	3615.00
Free System Page Table Entries	183040.20	183042.00	183042.00
Pages/Sec	0.167	0.000	124.24
Pool Nonpaged Bytes	41674250.00	38699010.00	41893890.00
Pool Paged Bytes	25708020.00	24272900.00	25858050.00

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\DatabaseChecksum_2006_12_6_21-41-47.blg is saved.

12/6/2006 8:15:54 PM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

12/6/2006 8:16:01 PM -- Warning: One or more storage groups are starting the tuning process with non-default tuning parameters. One of the reasons is that this server had a successful test run previously, and the parameters are saved in the JS_config.xml file. If you would like to use the default tuning parameters, please stop the test, then select the "Test Run Info" tab page, and click the "Restore Defaults" button. The test will use the default parameters.

12/6/2006 8:16:02 PM -- Validating input parameters, it may take a few minutes...

12/6/2006 8:16:02 PM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

12/6/2006 8:16:06 PM -- Loading performance counters...

12/6/2006 8:16:06 PM -- Instance2856.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:16:06 PM -- Instance2856.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:16:06 PM -- Start Jetstress test...

12/6/2006 8:16:09 PM -- Performance logging started.

12/6/2006 8:16:09 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Tuning_2006_12_6_20-16-7.blg.

12/6/2006 8:16:09 PM -- Start tuning process, this may take an hour depending on the testing environment...

12/6/2006 8:16:43 PM -- Volume C:\Exchange\SG1\db has 0.00006 for Read Latency Slope.

12/6/2006 8:16:43 PM -- Volume C:\Exchange\SG2\db has 0.00007 for Read Latency Slope.

12/6/2006 8:18:57 PM -- Instance1: the value for Target disk transfer is 500.

Performance Log Generation Results

12/6/2006 8:18:57 PM -- Instance1: the value for Actual disk transfer is 562.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG1\db has 0.0099 for Database disk read latency.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG1\db has 0.0014 for Database disk write latency.

12/6/2006 8:18:57 PM -- Instance2: the value for Target disk transfer is 500.

12/6/2006 8:18:57 PM -- Instance2: the value for Actual disk transfer is 650.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG2\db has 0.0089 for Database disk read latency.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG2\db has 0.0020 for Database disk write latency.

12/6/2006 8:18:57 PM -- Instance2856.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:18:57 PM -- Instance2856.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:18:57 PM -- Performance logging stopped.

12/6/2006 8:18:57 PM -- Tuning process has completed. Jetstress test will be started.

12/6/2006 8:18:57 PM -- Starting StreamingBackup test run...

12/6/2006 8:18:59 PM -- Performance logging started.

12/6/2006 8:18:59 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Performance_LogGeneration_2006_12_6_20-16-6.blg.

12/6/2006 9:17:49 PM -- Adding new data to the performance log file...

12/6/2006 9:18:04 PM -- Performance logging stopped.

12/6/2006 9:18:04 PM -- Stopping Jetstress...

12/6/2006 9:18:21 PM -- Creating test report ...

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\db has 0.0134 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\db has 0.0122 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Test has 0 Max Database Page Fault Stalls/sec.

12/6/2006 9:18:22 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

12/6/2006 9:18:22 PM -- Soft recovery may take a while depending on the number of log files.

12/6/2006 9:18:24 PM -- Performance logging started.

12/6/2006 9:18:24 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\SoftRecovery_2006_12_6_21-18-22.blg.

12/6/2006 9:41:45 PM -- Adding new data to the performance log file...

12/6/2006 9:41:47 PM -- Performance logging stopped.

12/6/2006 9:41:47 PM -- Soft recovery is completed, please open C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\SoftRecovery_2006_12_6_21-18-22.html for soft recovery result.

12/6/2006 9:41:49 PM -- Performance logging started.

12/6/2006 9:41:49 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\DatabaseChecksum_2006_12_6_21-41-47.blg.

12/6/2006 9:41:49 PM -- Checksum validation may take a while depending on the file sizes.

12/6/2006 10:19:02 PM -- Database checksum in progress:

Storage Group #1 (100%), and Storage Group #2 (100%).

12/6/2006 10:19:02 PM -- Performance logging stopped.

12/6/2006 10:19:02 PM -- Checksum is completed, please open C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\DatabaseChecksum_2006_12_6_21-41-47.html for checksum result.

Backup to Disk Results

Jetstress Test Result: 4BPSX91

This test is to verify the storage configuration for a streaming backup operation.

This table reports the performance metrics of streaming backup for each storage group backed up.

Storage Group	Storage Group Size (MB)	Backup Time (hh:mm:ss.msec)	Average MB Backed Per Second
1	125754.04	01:07:27.89	31.07
2	125879.04	01:10:03.89	29.94

This table reports the performance metrics of streaming backup for each database backed up.

Storage Group	Database Name	Database Size(MB)
1	C:\Exchange\SG1\db\Jetstress.edb	25151.01
	C:\Exchange\SG1\db\Jetstress1.edb	25153.01
	C:\Exchange\SG1\db\Jetstress2.edb	25150.01
	C:\Exchange\SG1\db\Jetstress3.edb	25148.01
	C:\Exchange\SG1\db\Jetstress4.edb	25152.01
2	C:\Exchange\SG2\db\Jetstress.edb	25179.01
	C:\Exchange\SG2\db\Jetstress1.edb	25174.01
	C:\Exchange\SG2\db\Jetstress2.edb	25172.01
	C:\Exchange\SG2\db\Jetstress3.edb	25179.01
	C:\Exchange\SG2\db\Jetstress4.edb	25175.01

Planned disk subsystem profile:

Total test database size	Production data size	Total number of databases	Expected I/O	Achieved I/O
245.21 GB (based on the attached database)	(n/a)	10 (2 storage(s) * 5 database(s))	1000.00 (1000 mailboxes of 1.00 IOPS)	956.24

JetStress test parameter summary:

Instance	threadCount	logBufferSize	opInsert	opReplace	opDelete	lazyCommit
1	5	9000	17	70	5	90
2	5	9000	17	70	5	90

Disk subsystem performance summary:

Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Data (C:\Exchange\SG1\db)	0.006	0.000	477.11	0.048	(n/a)
Data (C:\Exchange\SG2\db)	0.007	0.000	479.04	0.050	(n/a)
Log (C:\Exchange\SG1\lg)	0.000	0.000	0.019	0.217	93.34
Log (C:\Exchange\SG2\lg)	0.000	0.000	0.019	0.221	95.94

Processor/memory performance summary:

Counter	Average	Minimum	Maximum
% Processor Time	4.667	3.175	5.754
Available MBytes	2682.55	2638.00	3619.00
Free System Page Table Entries	183042.00	183042.00	183042.00
Pages/Sec	0.012	0.000	0.798

Pool Nonpaged Bytes	39793152.00	39612416.00	40099840.00
Pool Paged Bytes	26888440.69	26005504.00	27107328.00
Database Page Fault Stalls/sec	0.000	0.000	0.000

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Backup_To_Disk_2006_12_6_22-20-21.blg is saved.

12/6/2006 8:15:54 PM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

12/6/2006 8:16:01 PM -- Warning: One or more storage groups are starting the tuning process with non-default tuning parameters. One of the reasons is that this server had a successful test run previously, and the parameters are saved in the JS_config.xml file. If you would like to use the default tuning parameters, please stop the test, then select the "Test Run Info" tab page, and click the "Restore Defaults" button. The test will use the default parameters.

12/6/2006 8:16:02 PM -- Validating input parameters, it may take a few minutes...

12/6/2006 8:16:02 PM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

12/6/2006 8:16:06 PM -- Loading performance counters...

12/6/2006 8:16:06 PM -- Instance2856.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:16:06 PM -- Instance2856.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:16:06 PM -- Start Jetstress test...

12/6/2006 8:16:09 PM -- Performance logging started.

12/6/2006 8:16:09 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Tuning_2006_12_6_20-16-7.blg.

12/6/2006 8:16:09 PM -- Start tuning process, this may take an hour depending on the testing environment...

12/6/2006 8:16:43 PM -- Volume C:\Exchange\SG1\db has 0.00006 for Read Latency Slope.

12/6/2006 8:16:43 PM -- Volume C:\Exchange\SG2\db has 0.00007 for Read Latency Slope.

12/6/2006 8:18:57 PM -- Instance1: the value for Target disk transfer is 500.

12/6/2006 8:18:57 PM -- Instance1: the value for Actual disk transfer is 562.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG1\db has 0.0099 for Database disk read latency.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG1\db has 0.0014 for Database disk write latency.

12/6/2006 8:18:57 PM -- Instance2: the value for Target disk transfer is 500.

12/6/2006 8:18:57 PM -- Instance2: the value for Actual disk transfer is 650.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG2\db has 0.0089 for Database disk read latency.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG2\db has 0.0020 for Database disk write latency.

12/6/2006 8:18:57 PM -- Instance2856.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:18:57 PM -- Instance2856.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:18:57 PM -- Performance logging stopped.

12/6/2006 8:18:57 PM -- Tuning process has completed. Jetstress test will be started.

12/6/2006 8:18:57 PM -- Starting StreamingBackup test run...

12/6/2006 8:18:59 PM -- Performance logging started.

12/6/2006 8:18:59 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Performance_LogGeneration_2006_12_6_20-16-6.blg.

12/6/2006 9:17:49 PM -- Adding new data to the performance log file...

12/6/2006 9:18:04 PM -- Performance logging stopped.

12/6/2006 9:18:04 PM -- Stopping Jetstress...

12/6/2006 9:18:21 PM -- Creating test report ...

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\db has 0.0134 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\db has 0.0122 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Test has 0 Max Database Page Fault Stalls/sec.

12/6/2006 9:18:22 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

12/6/2006 9:18:22 PM -- Soft recovery may take a while depending on the number of log files.

12/6/2006 9:18:24 PM -- Performance logging started.

12/6/2006 9:18:24 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\SoftRecovery_2006_12_6_21-18-22.blg.

12/6/2006 9:41:45 PM -- Adding new data to the performance log file...

12/6/2006 9:41:47 PM -- Performance logging stopped.

12/6/2006 9:41:47 PM -- Soft recovery is completed, please open C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\SoftRecovery_2006_12_6_21-18-22.html for soft recovery result.

12/6/2006 9:41:49 PM -- Performance logging started.

12/6/2006 9:41:49 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\DatabaseChecksum_2006_12_6_21-41-47.blg.

12/6/2006 9:41:49 PM -- Checksum validation may take a while depending on the file sizes.

12/6/2006 10:19:02 PM -- Database checksum in progress:

Storage Group #1 (100%), and Storage Group #2 (100%).

12/6/2006 10:19:02 PM -- Performance logging stopped.

12/6/2006 10:19:02 PM -- Checksum is completed, please open C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\DatabaseChecksum_2006_12_6_21-41-47.html for checksum result.

12/6/2006 10:19:04 PM -- Performance logging started.

12/6/2006 10:19:04 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\LogChecksum_2006_12_6_22-19-2.blg.

12/6/2006 10:19:04 PM -- Checksum validation may take a while depending on the file sizes.

12/6/2006 10:20:21 PM -- Log checksum in progress:

C:\Exchange\SG1 (100 files(s) passed), and C:\Exchange\SG2 (100 files(s) passed).

12/6/2006 10:20:21 PM -- Performance logging stopped.

12/6/2006 10:20:21 PM -- Storage Groups being Backed up... The Backup Time may take hours depending on the size of the Storage Group.

12/6/2006 10:33:02 PM -- Performance logging started.

12/6/2006 10:33:02 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Backup_To_Disk_2006_12_6_22-20-21.blg.

12/6/2006 10:33:02 PM -- Loading performance counters...

12/6/2006 11:43:04 PM -- Adding new data to the performance log file...

12/6/2006 11:43:09 PM -- Backup Complete!

12/6/2006 11:43:11 PM -- Performance logging stopped.

12/6/2006 11:43:11 PM -- Creating test report ...

Soft Recovery Results

Jetstress Test Result: 4BPSX91

The following table shows a quick overview of log replay statistics for 100 log files per storage group:

Storage Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Disk Read Bytes/sec	Total Seconds
Log (C:\Exchange\SG1\lg)	0.000	0.000	23.11	0.068	1501667	689.88
Log (C:\Exchange\SG2\lg)	0.000	0.001	24.81	0.204	1613935	713.16

The following table shows a quick overview of processor and memory performance counter sample data:

Counter	Average	Minimum	Maximum
% Processor Time	10.16	0.00	13.80
Available MBytes	2805.23	2702.00	3602.00
Free System Page Table Entries	183029.10	183014.00	183038.00
Pages/Sec	0.000	0.000	0.000
Pool Nonpaged Bytes	37979560.00	36560900.00	38518780.00
Pool Paged Bytes	25564430.00	24059900.00	25669630.00

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\SoftRecovery_2006_12_6_21-18-22.blg is saved.

12/6/2006 8:15:54 PM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

12/6/2006 8:16:01 PM -- Warning: One or more storage groups are starting the tuning process with non-default tuning parameters. One of the reasons is that this server had a successful test run previously, and the parameters are saved in the JS_config.xml file. If you would like to use the default tuning parameters, please stop the test, then select the "Test Run Info" tab page, and click the "Restore Defaults" button. The test will use the default parameters.

12/6/2006 8:16:02 PM -- Validating input parameters, it may take a few minutes...

12/6/2006 8:16:02 PM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

12/6/2006 8:16:06 PM -- Loading performance counters...

12/6/2006 8:16:06 PM -- Instance2856.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:16:06 PM -- Instance2856.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:16:06 PM -- Start Jetstress test...

12/6/2006 8:16:09 PM -- Performance logging started.

12/6/2006 8:16:09 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Tuning_2006_12_6_20-16-7.blg.

12/6/2006 8:16:09 PM -- Start tuning process, this may take an hour depending on the testing environment...

12/6/2006 8:16:43 PM -- Volume C:\Exchange\SG1\db has 0.00006 for Read Latency Slope.

12/6/2006 8:16:43 PM -- Volume C:\Exchange\SG2\db has 0.00007 for Read Latency Slope.

12/6/2006 8:18:57 PM -- Instance1: the value for Target disk transfer is 500.

12/6/2006 8:18:57 PM -- Instance1: the value for Actual disk transfer is 562.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG1\db has 0.0099 for Database disk read latency.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG1\db has 0.0014 for Database disk write latency.

12/6/2006 8:18:57 PM -- Instance2: the value for Target disk transfer is 500.

Soft Recovery Results

12/6/2006 8:18:57 PM -- Instance2: the value for Actual disk transfer is 650.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG2\db has 0.0089 for Database disk read latency.

12/6/2006 8:18:57 PM -- Volume C:\Exchange\SG2\db has 0.0020 for Database disk write latency.

12/6/2006 8:18:57 PM -- Instance2856.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:18:57 PM -- Instance2856.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/6/2006 8:18:57 PM -- Performance logging stopped.

12/6/2006 8:18:57 PM -- Tuning process has completed. Jetstress test will be started.

12/6/2006 8:18:57 PM -- Starting StreamingBackup test run...

12/6/2006 8:18:59 PM -- Performance logging started.

12/6/2006 8:18:59 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\Performance_LogGeneration_2006_12_6_20-16-6.blg.

12/6/2006 9:17:49 PM -- Adding new data to the performance log file...

12/6/2006 9:18:04 PM -- Performance logging stopped.

12/6/2006 9:18:04 PM -- Stopping Jetstress...

12/6/2006 9:18:21 PM -- Creating test report ...

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\db has 0.0134 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\db has 0.0122 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG1\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\lg has 0.0009 for Avg. Disk sec/Write.

12/6/2006 9:18:22 PM -- Volume C:\Exchange\SG2\lg has 0.0000 for Avg. Disk sec/Read.

12/6/2006 9:18:22 PM -- Test has 0 Max Database Page Fault Stalls/sec.

12/6/2006 9:18:22 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

12/6/2006 9:18:22 PM -- Soft recovery may take a while depending on the number of log files.

12/6/2006 9:18:24 PM -- Performance logging started.

12/6/2006 9:18:24 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\SoftRecovery_2006_12_6_21-18-22.blg.

12/6/2006 9:41:45 PM -- Adding new data to the performance log file...

12/6/2006 9:41:47 PM -- Performance logging stopped.

12/6/2006 9:41:47 PM -- Soft recovery is completed, please open C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\b2d\SoftRecovery_2006_12_6_21-18-22.html for soft recovery result.

Appendix C: Stress

The following charts and data are from the Jetstress test report for the CX3-20c Jetstress 2 hour performance test.

Stress Test Results

Jetstress Test Result: 4BPSX91

The purpose of this test is to verify the storage configuration which the customer is planning to deploy. The test run has been successful, meaning 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 tasks listed below):

1. 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.

2. You need to confirm whether the storage solution has synchronous replication as part of the implementation. If the solution does not utilize synchronous replication, then you should check for the database write latency, the desired value should be under 20 ms. (Please refer to http://support.microsoft.com/?kbid=895847 for synchronous replication definitions.)
3. Please check the status pane in the Jetstress window, to make sure that no errors were logged during the database checksum validation.

Planned disk subsystem profile:

Total test database size	Production data size	Total number of databases	Expected I/O	Achieved I/O
249.12 GB (based on the attached database)	(n/a)	10 (4 storage(s) * 5database(s))	1000.00 (1000 mailboxes of 1.00 IOPS)	1173.23

JetStress test parameter summary:

Instance	threadCount	logBufferSize	opInsert	opReplace	opDelete	lazyCommit
1	5	9000	17	70	5	90
2	5	9000	17	70	5	90

Disk subsystem performance summary:

Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Data (C:\Exchange\SG1\db)	0.013	0.005	376.45	181.94	(n/a)
Data (C:\Exchange\SG2\db)	0.012	0.005	411.54	203.30	(n/a)
Log (C:\Exchange\SG1\lg)	0.000	0.001	0.000	45.64	6236.98
Log (C:\Exchange\SG1\lg)	0.000	0.001	0.000	50.65	6295.07

Processor/memory performance summary:

Counter	Average	Minimum	Maximum
% Processor Time	1.552	1.262	5.646

Available MBytes	2645.44	2626.00	2703.00
Free System Page Table Entries	183127.62	183096.00	183128.00
Pages/Sec	1.308	0.000	742.94
Pool Nonpaged Bytes	36978093.10	36966400.00	37052416.00
Pool Paged Bytes	30151373.30	28348416.00	30879744.00
Database Page Fault Stalls/sec	0.000	0.000	0.000

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\stress\Stress_2006_12_8_9-58-17.blg is saved.

12/8/2006 9:58:10 AM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

12/8/2006 9:58:10 AM -- Warning: One or more storage groups are starting the tuning process with non-default tuning parameters. One of the reasons is that this server had a successful test run previously, and the parameters are saved in the JS_config.xml file. If you would like to use the default tuning parameters, please stop the test, then select the "Test Run Info" tab page, and click the "Restore Defaults" button. The test will use the default parameters.

12/8/2006 9:58:10 AM -- Validating input parameters, it may take a few minutes...

12/8/2006 9:58:11 AM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

12/8/2006 9:58:17 AM -- Loading performance counters...

12/8/2006 9:58:17 AM -- Instance3752.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/8/2006 9:58:17 AM -- Instance3752.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/8/2006 9:58:17 AM -- Start Jetstress test...

12/8/2006 9:58:19 AM -- Performance logging started.

12/8/2006 9:58:19 AM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\stress\Tuning_2006_12_8_9-58-18.blg.

12/8/2006 9:58:19 AM -- Start tuning process, this may take an hour depending on the testing environment...

12/8/2006 9:58:53 AM -- Volume C:\Exchange\SG1\db has 0.00007 for Read Latency Slope.

12/8/2006 9:58:53 AM -- Volume C:\Exchange\SG2\db has 0.00006 for Read Latency Slope.

12/8/2006 10:01:00 AM -- Instance1: the value for Target disk transfer is 500.

12/8/2006 10:01:00 AM -- Instance1: the value for Actual disk transfer is 565.

12/8/2006 10:01:00 AM -- Volume C:\Exchange\SG1\db has 0.0099 for Database disk read latency.

12/8/2006 10:01:00 AM -- Volume C:\Exchange\SG1\db has 0.0016 for Database disk write latency.

12/8/2006 10:01:00 AM -- Instance2: the value for Target disk transfer is 500.

12/8/2006 10:01:00 AM -- Instance2: the value for Actual disk transfer is 656.

12/8/2006 10:01:00 AM -- Volume C:\Exchange\SG2\db has 0.0089 for Database disk read latency.

12/8/2006 10:01:00 AM -- Volume C:\Exchange\SG2\db has 0.0018 for Database disk write latency.

12/8/2006 10:01:00 AM -- Instance3752.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/8/2006 10:01:00 AM -- Instance3752.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/8/2006 10:01:00 AM -- Performance logging stopped.

12/8/2006 10:01:00 AM -- Tuning process has completed. Jetstress test will be started.

12/8/2006 10:01:00 AM -- Starting Stress test run...

12/8/2006 10:01:02 AM -- Performance logging started.

12/8/2006 10:01:02 AM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\stress\Stress_2006_12_8_9-58-17.blg.

12/9/2006 10:00:20 AM -- Adding new data to the performance log file...

12/9/2006 10:01:19 AM -- Performance logging stopped.

12/9/2006 10:01:19 AM -- Stopping Jetstress...

12/9/2006 10:01:39 AM -- Creating test report ...

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG1\db has 0.0133 for Avg. Disk sec/Read.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG2\db has 0.0122 for Avg. Disk sec/Read.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG1\lg has 0.0009 for Avg. Disk sec/Write.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG1\lg has 0.0000 for Avg. Disk sec/Read.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG2\lg has 0.0009 for Avg. Disk sec/Write.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG2\lg has 0.0000 for Avg. Disk sec/Read.

12/9/2006 10:01:46 AM -- Test has 0 Max Database Page Fault Stalls/sec.

12/9/2006 10:01:46 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

Database Checksum Results

Jetstress Test Result: 4BPSX91

The following table shows a quick overview of checksum statistics:

Database	Pages seen	Bad checksums	Correctable checksums	Wrong page numbers	MB read/sec (File size/Seconds taken)
C:\Exchange\SG1\db\Jetstress.edb	6794242	0	0	0	58.4 MB/sec (26540 MB/454 seconds)

C:\Exchange\SG1\db\Jetstress1.edb	6796802	0	0	0	62.9 MB/sec (26550 MB/421 seconds)
C:\Exchange\SG1\db\Jetstress2.edb	6795778	0	0	0	63.5 MB/sec (26546 MB/418 seconds)
C:\Exchange\SG1\db\Jetstress3.edb	6791938	0	0	0	62.1 MB/sec (26531 MB/427 seconds)
C:\Exchange\SG1\db\Jetstress4.edb	6795266	0	0	0	62.0 MB/sec (26544 MB/428 seconds)
C:\Exchange\SG2\db\Jetstress.edb	6739202	0	0	0	53.0 MB/sec (26325 MB/497 seconds)
C:\Exchange\SG2\db\Jetstress1.edb	6734082	0	0	0	54.5 MB/sec (26305 MB/482 seconds)
C:\Exchange\SG2\db\Jetstress2.edb	6738434	0	0	0	53.7 MB/sec (26322 MB/490 seconds)
C:\Exchange\SG2\db\Jetstress3.edb	6739458	0	0	0	54.9 MB/sec (26326 MB/479 seconds)
C:\Exchange\SG2\db\Jetstress4.edb	6734082	0	0	0	60.9 MB/sec (26305 MB/432 seconds)
(sum)	67659284	0	0	0	116.7 MB/sec (264294 MB/2265 seconds)

The following table shows a quick overview of database and log performance counter sample data:

Storage Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Total Seconds
C:\Exchange\SG1\db	0.550	0.000	932.72	0.000	454.32
C:\Exchange\SG1\db	0.531	0.000	968.29	0.000	422.01
C:\Exchange\SG1\db	0.523	0.000	983.87	0.000	418.09
C:\Exchange\SG1\db	0.521	0.000	986.42	0.000	427.09
C:\Exchange\SG1\db	0.521	0.000	987.52	0.000	428.10
C:\Exchange\SG2\db	0.608	0.009	845.57	0.019	497.20

C:\Exchange\SG2\db	0.599	0.005	858.61	0.010	482.72
C:\Exchange\SG2\db	0.598	0.003	858.82	0.006	490.11
C:\Exchange\SG2\db	0.595	0.002	863.65	0.005	479.67
C:\Exchange\SG2\db	0.583	0.001	884.05	0.004	432.09

The following table shows a quick overview of processor and memory performance counter sample data:

Counter	Average	Minimum	Maximum
% Processor Time	12.32	0.000	19.89
Available MBytes	3501.41	3454.00	3531.00
Free System Page Table Entries	183145.50	183148.00	183148.00
Pages/Sec	0.000	0.000	0.000
Pool Nonpaged Bytes	40780470.00	38076420.00	41021440.00
Pool Paged Bytes	30953200.00	29458430.00	30982140.00

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\stress\DatabaseChecksum_2006_12_9_10-1-47.blg is saved.

12/8/2006 9:58:10 AM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

12/8/2006 9:58:10 AM -- Warning: One or more storage groups are starting the tuning process with non-default tuning parameters. One of the reasons is that this server had a successful test run previously, and the parameters are saved in the JS_config.xml file. If you would like to use the default tuning parameters, please stop the test, then select the "Test Run Info" tab page, and click the "Restore Defaults" button. The test will use the default parameters.

12/8/2006 9:58:10 AM -- Validating input parameters, it may take a few minutes...

12/8/2006 9:58:11 AM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

12/8/2006 9:58:17 AM -- Loading performance counters...

12/8/2006 9:58:17 AM -- Instance3752.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/8/2006 9:58:17 AM -- Instance3752.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/8/2006 9:58:17 AM -- Start Jetstress test...

12/8/2006 9:58:19 AM -- Performance logging started.

12/8/2006 9:58:19 AM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\stress\Tuning_2006_12_8_9-58-18.blg.

12/8/2006 9:58:19 AM -- Start tuning process, this may take an hour depending on the testing environment...

12/8/2006 9:58:53 AM -- Volume C:\Exchange\SG1\db has 0.00007 for Read Latency Slope.

12/8/2006 9:58:53 AM -- Volume C:\Exchange\SG2\db has 0.00006 for Read Latency Slope.

12/8/2006 10:01:00 AM -- Instance1: the value for Target disk transfer is 500.

12/8/2006 10:01:00 AM -- Instance1: the value for Actual disk transfer is 565.

12/8/2006 10:01:00 AM -- Volume C:\Exchange\SG1\db has 0.0099 for Database disk read latency.

12/8/2006 10:01:00 AM -- Volume C:\Exchange\SG1\db has 0.0016 for Database disk write latency.

12/8/2006 10:01:00 AM -- Instance2: the value for Target disk transfer is 500.

12/8/2006 10:01:00 AM -- Instance2: the value for Actual disk transfer is 656.

12/8/2006 10:01:00 AM -- Volume C:\Exchange\SG2\db has 0.0089 for Database disk read latency.

12/8/2006 10:01:00 AM -- Volume C:\Exchange\SG2\db has 0.0018 for Database disk write latency.

12/8/2006 10:01:00 AM -- Instance3752.1: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/8/2006 10:01:00 AM -- Instance3752.2: IO parameters are thread (5), insert (17), replace (70), delete (5), and lazy commit (90)

12/8/2006 10:01:00 AM -- Performance logging stopped.

12/8/2006 10:01:00 AM -- Tuning process has completed. Jetstress test will be started.

12/8/2006 10:01:00 AM -- Starting Stress test run...

12/8/2006 10:01:02 AM -- Performance logging started.

12/8/2006 10:01:02 AM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\stress\Stress_2006_12_8_9-58-17.blg.

12/9/2006 10:00:20 AM -- Adding new data to the performance log file...

12/9/2006 10:01:19 AM -- Performance logging stopped.

12/9/2006 10:01:19 AM -- Stopping Jetstress...

12/9/2006 10:01:39 AM -- Creating test report ...

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG1\db has 0.0133 for Avg. Disk sec/Read.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG2\db has 0.0122 for Avg. Disk sec/Read.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG1\lg has 0.0009 for Avg. Disk sec/Write.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG1\lg has 0.0000 for Avg. Disk sec/Read.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG2\lg has 0.0009 for Avg. Disk sec/Write.

12/9/2006 10:01:46 AM -- Volume C:\Exchange\SG2\lg has 0.0000 for Avg. Disk sec/Read.

12/9/2006 10:01:46 AM -- Test has 0 Max Database Page Fault Stalls/sec.

12/9/2006 10:01:46 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.

12/9/2006 10:01:48 AM -- Performance logging started.

12/9/2006 10:01:48 AM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\stress\DatabaseChecksum_2006_12_9_10-1-47.blg.

12/9/2006 10:01:48 AM -- Checksum validation may take a while depending on the file sizes.

12/9/2006 10:41:30 AM -- Database checksum in progress:

Storage Group #1 (100%), and Storage Group #2 (100%).

12/9/2006 10:41:30 AM -- Performance logging stopped.

12/9/2006 10:41:30 AM -- Checksum is completed, please open C:\Documents and Settings\Administrator.EXCHANGE\Desktop\Target IO CX320\1000\stress\DatabaseChecksum_2006_12_9_10-1-47.html for checksum result.

Appendix D: Maximum Performance Test Results

Tuning for Maximum I/O Throughput

The configuration of the Mid-Sized Enterprise Building Block is the EMC recommended configuration for the 1000 user workload at 1.0 IOPS per user. The results shown in Appendix A illustrate that this configuration achieved excellent results, with considerable room for growth.

Often the observed user workloads at customers are greater than expected, including use of Blackberry, or MAPI journaling- both of which increase the IO workload generated by a set of users. EMC prides itself on focusing on delivering solutions that meet and exceed customer requirements, so configurations are designed with safety margins.

After showing that the configuration could perform considerably better than the ESRP pass criteria, subsequent tests were run to determine the upper limits of the configuration. The number of Jetstress threads was increased gradually from 5 to 9 with no other configuration changes. The achieved IOPS increased from 1176.26 to 1544.86 - a 34% increase, while still providing latency results that beat the ESRP Pass criteria. While this workload is not recommended for customers, as it is close to ESRP Fail criteria, it highlights the headroom in the recommended Mid-Sized Enterprise building block for 1000 users at 1.0 IOPS.

Performance Results

Jetstress Test Result: 4BPSX91

The purpose of this test is to verify the storage configuration which the customer is planning to deploy. The test run has been successful, meaning 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 tasks listed below):

1. 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.
2. You need to confirm whether the storage solution has synchronous replication as part of the implementation. If the solution does not utilize synchronous replication, then you should check for the database write latency, the desired value should be under 20 ms. (Please refer to http://support.microsoft.com/?kbid=895847 for synchronous replication definitions.)
3. Please check the status pane in the Jetstress window, to make sure that no errors were logged during the database checksum validation.

Planned disk subsystem profile:

Total test database size	Production data size	Total number of databases	Expected I/O	Achieved I/O
244.14 GB (75% of production data)	244.14 GB (1000 mailboxes of 250 MB)	10 (2 storage(s) * 5 database(s))	1000.00 (1000 mailboxes of 1.00 IOPS)	1544.86

JetStress test parameter summary:

Instance	threadCount	logBufferSize	opInsert	opReplace	opDelete	lazyCommit
1	9	9000	17	70	5	90
2	9	9000	17	70	5	90

Disk subsystem performance summary:

Volume	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Data (B:\SG2\DB)	0.017	0.005	519.53	253.74	(n/a)
Data (B:\SG1\DB)	0.017	0.005	518.03	253.56	(n/a)
Log (B:\SG1\LG)	0.000	0.002	0.000	53.09	7618.12
Log (B:\SG2\LG)	0.000	0.002	0.000	54.57	7408.00

Processor/memory performance summary:

Counter	Average	Minimum	Maximum
% Processor Time	2.093	1.612	6.156
Available MBytes	2725.73	2711.00	3527.00
Free System Page Table Entries	182680.00	182680.00	182680.00
Pages/Sec	0.276	0.000	130.73
Pool Nonpaged Bytes	36709993.82	36708352.00	36728832.00
Pool Paged Bytes	26750120.89	25694208.00	26963968.00
Database Page Fault Stalls/sec	0.000	0.000	0.000

Performance log C:\Documents and Settings\Administrator.EXCHANGE\Desktop\j2k3\2sgby24r10\New MP config Perf at 9 threads\Performance_2006_11_30_17-59-27.blg is saved.

11/30/2006 1:35:11 PM -- Environment validation results:

Detected JetstressUI version: 6.5.7830.0

Detected operating system: Microsoft Windows Server 2003 (5.2.3790.0) Service Pack 1

Detected ESE.dll version: 6.5.7638.2

Detected ESEPERF.dll version: 6.5.7638.1

11/30/2006 1:35:11 PM -- Validating input parameters, it may take a few minutes...

11/30/2006 3:19:17 PM -- Inserting records: 9810778 records have been inserted. Database creation process has completed 100%.

11/30/2006 3:19:17 PM -- Database creation has completed and the test database file size is 24940 MB (with an approximate 66% overhead).

11/30/2006 5:59:26 PM -- Duplicating 10 databases: 24.36 GB of 24.36 GB is duplicated (100.00% complete).

11/30/2006 5:59:26 PM -- Attaching databases ... (it may take a few minutes if the databases are in dirty shutdown state)

11/30/2006 5:59:27 PM -- Loading performance counters...

11/30/2006 5:59:27 PM -- Instance3708.1: IO parameters are thread (9), insert (17), replace (70), delete (5), and lazy commit (90)

11/30/2006 5:59:27 PM -- Instance3708.2: IO parameters are thread (9), insert (17), replace (70), delete (5), and lazy commit (90)

11/30/2006 5:59:27 PM -- Start Jetstress test...

11/30/2006 5:59:28 PM -- Starting Performance test run...

11/30/2006 5:59:29 PM -- Performance logging started.

11/30/2006 5:59:29 PM -- Performance data will be saved to C:\Documents and Settings\Administrator.EXCHANGE\Desktop\j2k3\2sgby24r10\New MP config Perf at 9 threads\Performance_2006_11_30_17-59-27.blg.

11/30/2006 7:59:14 PM -- Adding new data to the performance log file...

11/30/2006 7:59:29 PM -- Performance logging stopped.

11/30/2006 7:59:29 PM -- Stopping Jetstress...

11/30/2006 7:59:47 PM -- Creating test report ...

11/30/2006 7:59:50 PM -- Volume B:\SG2\DB has 0.0173 for Avg. Disk sec/Read.

11/30/2006 7:59:50 PM -- Volume B:\SG1\DB has 0.0174 for Avg. Disk sec/Read.

11/30/2006 7:59:50 PM -- Volume B:\SG1\LG has 0.0019 for Avg. Disk sec/Write.

11/30/2006 7:59:50 PM -- Volume B:\SG1\LG has 0.0000 for Avg. Disk sec/Read.

11/30/2006 7:59:50 PM -- Volume B:\SG2\LG has 0.0018 for Avg. Disk sec/Write.

11/30/2006 7:59:50 PM -- Volume B:\SG2\LG has 0.0000 for Avg. Disk sec/Read.

11/30/2006 7:59:50 PM -- Test has 0 Max Database Page Fault Stalls/sec.

11/30/2006 7:59:50 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.