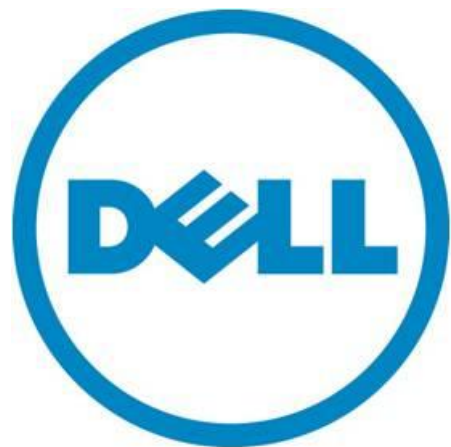# Dell™ PowerVault™MD1220
10K SAS
5000 Mailbox Resiliency
Exchange 2010 Storage Solution

Tested with: ESRP – Storage Version 3.0
Tested Date: June 09, 2011

Content

Overview

This document provides information on Dell's storage solution for Microsoft Exchange Server, based the *Microsoft Exchange Solution Reviewed Program (ESRP) – Storage* program*. For any questions or comments regarding the contents of this document, see <u>Contact for Additional Information.</u>

*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.mspx

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Features

This white paper describes a tested and validated storage solution for a 5000 mailbox Exchange 2010 environment with Data Availability Group. A DAG is the new high availability mechanism in Microsoft Exchange 2010. This model of mailbox resiliency supports multiple copies of Exchange database (up to 16) in a DAG. There is only one active copy of a given Exchange 2010 database at any given time. Secondary copies are periodically synched with the primary copy. Mail clients access the primary (active) copy, and database changes to the primary copy are copied to the secondary (passive) copies in the form of transaction logs. The copied log records are played on the secondary copy to keep the secondary database copies consistent with the primary copy. The secondary hosts are configured to be identical to the primary. The primary and secondary copy storages do not share storage array controllers or disks.

Dell™ PowerVault™ MD1220 is a SAS based storage enclosure. The major features of the storage system include:

- Capacity for 24 2.5-inch, hot-plug, 6.0-Gbps, serial-attached SCSI (SAS) hard drives , 900 GB capacity, and rated at 10K RPM
- Support for up to 4 daisy-chained storage enclosures per channel in unified mode for a total of (96) hard drives per channel
- Host-based RAID support via a PERC H800 adapter
- In-band enclosure management provided through SCSI enclosure services (SES)

- RAID and system management using Dell™ OpenManage™ Server Administrator Storage Management Service

The solution presented in this paper utilizes (2) Dell™ PowerVault™ MD1220 enclosure with (24) 900 GB 10K SAS disk drives. Four virtual disks each with 6 disks configured as RAID 5 containers house one Exchange database and its transaction Logs.

Solution Description

The Dell™ PowerVault™ MD1220 is a modular disk storage expansion enclosure for PowerEdge™ servers capable of housing up to (24) 2.5-inch disk drives in a single 2U rack able chassis. The expansion enclosure can support 1 Terabyte Near-Line SAS (7200 RPM) as well as 10K and 15K RPM SAS drives ranging in capacities up to 900GB.

Dell™ PowerVault™ MD1220 Product Page

Figure 1:Dell™ PowerVault™ MD1220 enclosure with (24) 2.5-inch drives

PERC H800 is the host-based RAID controller used to connect to the PowerVault™ MD1220 storage enclosures. The controller supports 6 Gbps Serial Attached SCSI (SAS) as the storage interconnect technology and PCI Express 2.0 (PCI-E) as the host-based interconnect technology.

The PERC H800 controller offers:

- 8 port LSI 2108 Chipset
- 512MB of customized DDR2 400MHz, Error-Correcting Code (ECC) cache memory with optional upgrade to 1 GIG
- 6 Gbps maximum speed for each SAS lane
- Two external x4 ("by four") mini-SAS wide ports, each aggregating 4 SAS lanes for a total bandwidth per port of 12.0 Gbps
- x8 PCI E host interface for a total bandwidth of 32.0 Gbps
- Up to 72 hours of intelligent, transportable, battery-backed, cache memory

The presented solution is a Data Availability Group solution for up to 5000 mailboxes. It includes a single primary PowerEdge™ R610 server directly attached to 1 Dell™ PowerVault™ MD1220 storage enclosures. The secondary server is configured to be identical to the primary. The primary and secondary storage do not share storage array controllers or disks.

The tested user profile was 0.2 IOPS per user with a 2048 MB mailbox size. This IO profile for Exchange 2010 represents about 200 messages (sent/received) per mailbox per day. Sometimes additional applications, such as certain mobile messaging applications, can raise

the IOPS profile of a user as high as three or four times that of normal. Using 10K RPM drives gives high performance achieving over 50% more than the target of 1000 IOPS. Four RAID 5 virtual disks of 6 spindles were configured on the MD1220 under test.

Microsoft Exchange Server System:

Server	Dell™ PowerEdge™ R610
CPU	2 Intel®Xeon®CPU;5620@2.4GHz
Memory	64 GB DDR2 ECC
NIC	Broadcom NeXtreme II
RAID Controller	H200 (FW 07.01.33.00)
Internal Disks	2 Seagate 146GB 15K RPM SAS(ST9146852SS)

Storage System:

Storage System	Dell™ PowerVault™ MD1220
Disks	24 Seagate 900GB 10K RPM SASST9900805SS Drives
RAID Controller	PERC H800 (FW 12.10.1.0001)

Storage Configuration:

The storage configuration per enclosure was as follows:
- 4RAID 5 arrays were created on each containing 6 disks each on Dell™ PowerVault™ MD1220 enclosure. These arrays were used for Exchange Information stores and transaction logs.

The ESRP-Storage program focuses on storage solution testing to address performance and reliability issues with storage design. However, storage is not the only factor to take into consideration when designing a 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 5000 Exchange 2010 mailboxes. The configuration used for testing was as follows:
- Number of mailboxes : 5000
- Number of hosts attached to the storage system: 1
- User IO profile: 0.2 I/O Operation per second
- 2.0GB MB Mailbox quota per mailbox
- Backup strategy: Streaming backup to disk
- Data Availability Group (DAG) for Mailbox Resiliency

The table below summarizes the testing environment.

Simulated Exchange Configuration

Number of Exchange mailboxes simulated	5000
Number of Database Availability Groups (DAGs)	1
Number of servers/DAG	2
Number of active mailboxes/server	2500
Number of databases/host	8
Number of copies/database	2
Number of mailboxes/database	625
Simulated profile: I/O's per second per mailbox (IOPS, include 30% headroom)	0.2
Database LUN size	16,752 GB (4 x 4188GB container size)
Log LUN size	N/A
Total database size for performance testing	10,035 GB (8 x 1254GB database size)
% storage capacity used by Exchange database**	59.9% (10035GB/16752GB)

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

Primary Storage Hardware

Storage Connectivity (Fiber Channel, SAS, SATA, iSCSI)	SAS
Storage model and OS/firmware revision	PowerVault™ MD1220 + PERC H800 Firmware (FW 12.10.1.000191)
Storage cache	1024 MB – PERC H800 RAID controller cache

Number of storage controllers	1
Number of storage ports	2
Maximum bandwidth of storage connectivity to host	6GBit
Switch type/model/firmware revision	N/A
HBA model and firmware	PERC H800 (RAID controller)
Number of HBA's/host	1
Host server type	Dell™ PowerEdge™ T610 2 Intel®Xeon®CPU;5620@2.93GHz 64GB memory
Total number of disks tested in solution	24
Maximum number of spindles can be hosted in the storage	24 per cabinet – up to 96 in daisy chain configuration

Storage Software

HBA driver	Dell™ PERC H800
HBA QueueTarget Setting	N/A
HBA QueueDepth Setting	N/A
Multi-Pathing	N/A
Host OS	Windows Server 2008 R2 Enterprise X64 Edition
ESE.dll file version	14.01.0225.017
Replication solution name/version	N/A

Primary Storage Disk Configuration (Mailbox Store Disks)

Disk type, speed and firmware revision	Seagate 900 GB 10K RPM SAS Drives (AS01 CS05)
Raw capacity per disk (GB)	838GB
Number of physical disks in test	24
Total raw storage capacity (GB)	20112 GB (838GB * 24)
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	1
Raid level	RAID 5
Total formatted capacity	(4188.62GB x 4 RAID5 volumes) 16754GB
Storage capacity utilization	(4188.62GB * 4 RAID5 volumes)16754/20122 = 83.26% Formatted capacity/total raw capacity
Database capacity utilization	10035-/20112GB = 49.87% utilized Database size/total raw capacity

Replication Configuration

Replication mechanism	Exchange 2010 Data Availability Group Mailbox Resiliency
Number of links	2
Simulated link distance	LAN
Link type	IP
Link bandwidth	Gigabit Ethernet (1 Gbps)

The figure below shows the DAG configuration with 8 active database copies and 8 passive copies.
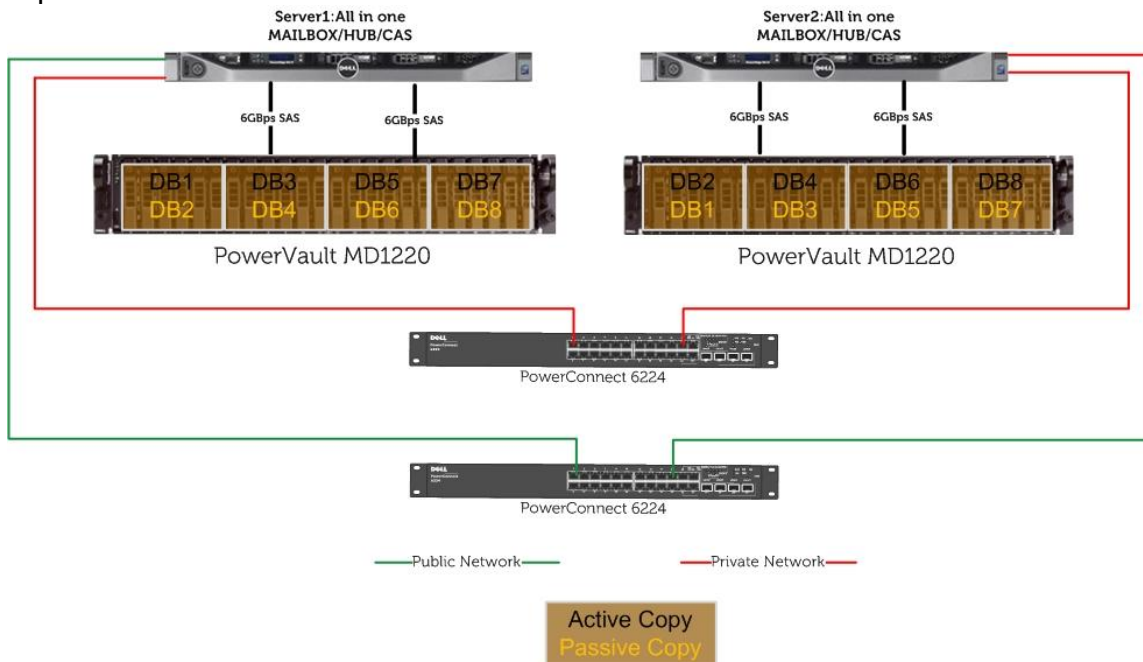
Figure 2: Layout of Mailbox Databases with active and passive copies

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 databases. 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 on all write operations. 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 can significantly deteriorate the I/O performance. Additionally, a RAID5 volume can only tolerate a single disk failure before is unrecoverable.

RAID5 Performance

RAID Container State	Optimal State (Before Failure)	Degraded State (Disk Failure)	During RAID 5 Rebuild Cycle
Database IOPS	1573.98	1190.74	1083.79
Read Latency	16.05	20.31	22.41
Write Latency	6.30	6.10	6.8

RAID5 performance seen in the table above was measured with all RAID5 database containers in optimal, degraded, and while in RAID5 container rebuild cycle state. In degraded state, a single disk was removed from each of the 4 RAID5 database containers and performance measured. Once the degraded performance measurement was complete, all drives were placed back into their respective RAID5 containers. Once all RAID5 containers' status switched from degraded to the rebuilding cycle, a final performance measurement was taken.

During the RAID5 container rebuild cycle, I/O performance is significantly reduced as the container must restore data and parity in addition to serving normal I/O requests. In optimal state, the RAID5 database containers provided 1,573 IOPS. In a degraded state, the IOPS throughput is reduced to 1,190, a 24% drop in performance compared to optimal state. I/O performance measured while the database containers were in the rebuild cycle achieved 1,083 IOPS, a 31% drop in performance compared to optimal state.

Best Practices

Exchange Server 2007 and 2010 overcome the memory limitations of previous Exchange versions by providing support as a 64-bit application capable of running on supported x64 platforms. On Windows Server 2008 R2 x64 Edition about 2TB of addressable memory is available for the kernel mode and the user mode applications. Both the application and kernel can have sufficient memory for operations, allowing the Extensible Storage Engine (ESE) in Exchange Server 2010 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. Based on testing using the ESRP framework, we would recommend the following best practices to help improve the I/O subsystem performance:

1. Exchange 2010 is an IO intensive application. Sharing Exchange 2010 storage resources with other applications may negatively impact the performance of Exchange 2010 deployment and therefore is not recommended.
2. In our testing, the database and log folders shared the same physical disk. Other testing indicated that separating the database folders from log folders on to different

set of disks does not provide a noticeable performance advantage. In an Exchange Server 2010 resiliency solution, separating the database and log folders is no longer a required best practice.

3. For Exchange 2010 Database, it is recommended that the size of elements within a RAID stripe be set 256K for best performance.
4. Windows NTFS allocation unit size for Exchange 2010 database partitions should be set to 64K for best performance. For log partitions, if separated from database, the default allocation unit size should be used.
5. Exchange Server 2010 storage latencies are most often related the number of disks available for given a workload. Windows Performance Monitor may be used to monitor Exchange Server 2010 database counters. Average database read latencies (Avg. Disk sec/Read) should not exceed 20ms.

For Exchange Server 2010 Mailbox Storage Design, please visit
http://technet.microsoft.com/en-us/library/dd346703.aspx

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.

In this solution, DAG is used to maintain a passive database copy on a separate storage system. This passive copy of the database may be used to perform to tape or disk.

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 Dell™ and Exchange Server 2010

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 event log file? No errors reported on event log.
  No
- Any errors reported in during the database and log checksum process?
  No

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.

Server Metrics:

Database I/O	
Database Disks Transfers/sec	1573
Average Database Disks Reads/sec	986.4
Average Database Disks Writes/sec	586.6
Average Database Disk Read Latency (ms)	16.1
Average Database Disk Write Latency (ms)	6.3
Transaction Log I/O	
Log Disks Writes/sec	489.3
Average Log Disk Write Latency (ms)	1.4

Database Backup/Recovery Performance

There are two tests reports in this section. The first one is to measure the sequential read rate of the database files, and the second is to measure the recovery/replay performance (playing transaction logs in to the database).

Database Read- only Performance

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

MB read/sec per database	60.05(Average)
MB read/sec total per server	480.41 (Sum)

Transaction Log Recovery/Replay [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)	1.60 (avg. resp. to replay log/avg. # of logs replayed)

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 giving 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: Stress Testing
Microsoft Exchange JetStress 2010

Performance Test Result Report
Test Summary

Overall Test Result	Pass
Machine Name	WIN-PVCKE1IJFQ1
Test Description	5000 mailboxes .2 IOP 2048GB mailboxes
Test Start Time	5/31/2011 2:17:42 PM
Test End Time	6/1/2011 2:20:15 PM
Collection Start Time	5/31/2011 2:20:04 PM
Collection End Time	6/1/2011 2:20:04 PM
Jetstress Version	14.01.0225.017
ESE Version	14.01.0218.012
Operating System	Windows Server 2008 R2 Foundation Service Pack 1 (6.1.7601.65536)
Performance Log	[C:\Jetstress\results\7_2driveFW_2iop_7threads_24hrs\Performance_2011_5_31_14_17_59.blg](#)

Database Sizing and Throughput
Achieved Transactional I/O per Second 1488.848
Target Transactional I/O per Second 1000

Initial Database Size (bytes)	10748000993280	
Final Database Size (bytes)	10800320741376	
Database Files (Count)	8	

Jetstress System Parameters

Thread Count	7 (per database)
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2

Database Configuration

Instance2836.1 Log path: C:\databases\dbs_set1\log1
            Database: C:\databases\dbs_set1\db1\Jetstress001001.edb

Instance2836.2 Log path: C:\databases\dbs_set1\log2
            Database: C:\databases\dbs_set1\db2\Jetstress002001.edb

Instance2836.3 Log path: C:\databases\dbs_set2\log3
            Database: C:\databases\dbs_set2\db3\Jetstress003001.edb

Instance2836.4 Log path: C:\databases\dbs_set2\log4
            Database: C:\databases\dbs_set2\db4\Jetstress004001.edb

Instance2836.5 Log path: C:\databases\dbs_set3\log5
            Database: C:\databases\dbs_set3\db5\Jetstress005001.edb

Instance2836.6 Log path: C:\databases\dbs_set3\log6
            Database: C:\databases\dbs_set3\db6\Jetstress006001.edb

Instance2836.7 Log path: C:\databases\dbs_set4\log7
            Database: C:\databases\dbs_set4\db7\Jetstress007001.edb

Instance2836.8 Log path: C:\databases\dbs_set4\log8
            Database: C:\databases\dbs_set4\db8\Jetstress008001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O DB Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O DB Reads /sec	I/O DB Writes /sec	I/O DB Reads Average Bytes	I/O DB Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Avg Bytes	I/O Log Writes Avg Bytes
Instance2836.1	15.851	7.491	115.052	70.482	34105.758	35355.394	0.000	1.514	0.000	56.297	0.000	4868.095
Instance2836.2	15.536	7.817	115.564	70.833	34112.820	35349.309	0.000	1.517	0.000	56.395	0.000	4875.776

Instance2836.3	16.705	10.052	115.551	70.795	33928.060	35349.309	0.000	1.742	0.000	56.412	0.000	4875.145
Instance2836.4	16.823	10.374	115.529	70.832	33911.683	35363.038	0.000	1.727	0.000	56.364	0.000	4893.535
Instance2836.5	16.341	8.319	115.465	70.740	34130.593	35361.833	0.000	1.593	0.000	56.358	0.000	4883.660
Instance2836.6	16.253	7.691	115.120	70.542	34106.957	35364.837	0.000	1.609	0.000	56.238	0.000	4884.595
Instance2836.7	16.994	6.529	115.682	70.907	34023.220	35353.200	0.000	1.688	0.000	56.464	0.000	4882.116
Instance2836.8	17.108	6.623	115.204	70.550	34015.425	35361.086	0.000	1.685	0.000	56.114	0.000	4878.034

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2836.1	26.399	261850.951
Instance2836.2	26.689	261853.605
Instance2836.3	25.952	261834.931
Instance2836.4	26.028	261845.359
Instance2836.5	26.302	261841.818
Instance2836.6	26.207	261828.654
Instance2836.7	25.782	261845.246
Instance2836.8	25.885	261824.175

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2836.1	1.113	232511.060
Instance2836.2	1.117	232354.493
Instance2836.3	1.115	232551.845
Instance2836.4	1.119	232257.268
Instance2836.5	1.118	232389.783
Instance2836.6	1.115	232474.137
Instance2836.7	1.119	232264.218
Instance2836.8	1.111	232510.279

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2836.1	15.851	7.491	141.451	70.482	76609.658	35355.394	3.847	1.514	1.113	56.297	232511.060	4868.095
Instance2836.2	15.536	7.817	142.252	70.833	76840.503	35349.309	3.832	1.517	1.117	56.395	232354.493	4875.776
Instance2836.3	16.705	10.052	141.503	70.795	75727.456	35349.309	3.573	1.742	1.115	56.412	232551.845	4875.145
Instance2836.4	16.823	10.374	141.557	70.832	75821.692	35363.038	3.749	1.727	1.119	56.364	232257.268	4893.535
Instance2836.5	16.341	8.319	141.767	70.740	76378.353	35361.833	3.802	1.593	1.118	56.358	232389.783	4883.660
Instance2836.6	16.253	7.691	141.327	70.542	76334.836	35364.837	3.740	1.609	1.115	56.238	232474.137	4884.595
Instance2836.7	16.994	6.529	141.464	70.907	75543.544	35353.200	3.934	1.688	1.119	56.464	232264.218	4882.116
Instance2836.8	17.108	6.623	141.089	70.550	75810.496	35361.086	4.104	1.685	1.111	56.114	232510.279	4878.034

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.396	0.753	3.885
Available MBytes	4848.499	4828.000	4884.000
Free System Page Table Entries	33555082.171	33555078.000	33555594.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	48226936.617	48066560.000	48386048.000
Pool Paged Bytes	139668929.023	139161600.000	139997184.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log5/31/2011 2:17:42 PM -- Jetstress testing begins ...
5/31/2011 2:17:42 PM -- Preparing for testing ...
5/31/2011 2:17:50 PM -- Attaching databases ...
5/31/2011 2:17:50 PM -- Preparations for testing are complete.
5/31/2011 2:17:50 PM -- Starting transaction dispatch ..
5/31/2011 2:17:50 PM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
5/31/2011 2:17:50 PM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
5/31/2011 2:17:59 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
5/31/2011 2:17:59 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
5/31/2011 2:18:04 PM -- Operation mix: Sessions 7, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/31/2011 2:18:04 PM -- Performance logging started (interval: 15000 ms).
5/31/2011 2:18:04 PM -- Attaining prerequisites:
5/31/2011 2:20:04 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1944568000.0 (lower bound: 1932735000.0, upper bound: none)
6/1/2011 2:20:05 PM -- Performance logging has ended.
6/1/2011 2:20:05 PM -- JetInterop batch transaction stats: 466143, 467676, 466999, 467811, 466913, 466391, 467456 and 466544.
6/1/2011 2:20:05 PM -- Dispatching transactions ends.
6/1/2011 2:20:05 PM -- Shutting down databases ...
6/1/2011 2:20:15 PM -- Instance2836.1 (complete), Instance2836.2 (complete), Instance2836.3 (complete), Instance2836.4 (complete), Instance2836.5 (complete), Instance2836.6 (complete), Instance2836.7 (complete) and Instance2836.8 (complete)
6/1/2011 2:20:15 PM -- C:\Jetstress\results\7_2driveFW_2iop_7threads_24hrs\Performance_2011_5_31_14_17_59.blg has 5764 samples.
6/1/2011 2:20:15 PM -- Creating test report ...
6/1/2011 2:20:38 PM -- Instance2836.1 has 15.9 for I/O Database Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.1 has 1.5 for I/O Log Writes Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.1 has 1.5 for I/O Log Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.2 has 15.5 for I/O Database Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.2 has 1.5 for I/O Log Writes Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.2 has 1.5 for I/O Log Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.3 has 16.7 for I/O Database Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.3 has 1.7 for I/O Log Writes Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.3 has 1.7 for I/O Log Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.4 has 16.8 for I/O Database Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.4 has 1.7 for I/O Log Writes Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.4 has 1.7 for I/O Log Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.5 has 16.3 for I/O Database Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.5 has 1.6 for I/O Log Writes Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.5 has 1.6 for I/O Log Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.6 has 16.3 for I/O Database Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.6 has 1.6 for I/O Log Writes Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.6 has 1.6 for I/O Log Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.7 has 17.0 for I/O Database Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.7 has 1.7 for I/O Log Writes Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.7 has 1.7 for I/O Log Reads Average Latency.

6/1/2011 2:20:38 PM -- Instance2836.8 has 17.1 for I/O Database Reads Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.8 has 1.7 for I/O Log Writes Average Latency.
6/1/2011 2:20:38 PM -- Instance2836.8 has 1.7 for I/O Log Reads Average Latency.
6/1/2011 2:20:38 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/1/2011 2:20:38 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/1/2011 2:20:38 PM --
C:\Jetstress\results\7_2driveFW_2iop_7threads_24hrs\Performance_2011_5_31_14_17_59.xml has 5755 samples queried.

Appendix B: Performance Testing

Microsoft Exchange Jetstress 2010

Performance Test Result Report

Test Summary

Overall Test Result	Pass
Machine Name	WIN-PVCKE1IJFQ1
Test Description	5000 mailboxes .2 IOP 2048GB mailboxes
Test Start Time	5/28/2011 11:38:14 AM
Test End Time	5/28/2011 1:40:37 PM
Collection Start Time	5/28/2011 11:40:24 AM
Collection End Time	5/28/2011 1:40:11 PM
Jetstress Version	14.01.0225.017
ESE Version	14.01.0218.012
Operating System	Windows Server 2008 R2 Foundation Service Pack 1 (6.1.7601.65536)
Performance Log	C:\Jetstress\results\7_2driveFW_2iop_7threads_2hrs\Performance_2011_5_28_11_38_30.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1573.982
Target Transactional I/O per Second	1000
Initial Database Size (bytes)	10743244652544
Final Database Size (bytes)	10748000993280
Database Files (Count)	8

Jetstress System Parameters

Thread Count	7 (per database)
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2

Database Configuration
Instance2836.1 Log path: C:\databases\dbs_set1\log1

Database: C:\databases\dbs_set1\db1\Jetstress001001.edb

Instance2836.2 Log path: C:\databases\dbs_set1\log2
Database: C:\databases\dbs_set1\db2\Jetstress002001.edb

Instance2836.3 Log path: C:\databases\dbs_set2\log3
Database: C:\databases\dbs_set2\db3\Jetstress003001.edb

Instance2836.4 Log path: C:\databases\dbs_set2\log4
Database: C:\databases\dbs_set2\db4\Jetstress004001.edb

Instance2836.5 Log path: C:\databases\dbs_set3\log5
Database: C:\databases\dbs_set3\db5\Jetstress005001.edb

Instance2836.6 Log path: C:\databases\dbs_set3\log6
Database: C:\databases\dbs_set3\db6\Jetstress006001.edb

Instance2836.7 Log path: C:\databases\dbs_set4\log7
Database: C:\databases\dbs_set4\db7\Jetstress007001.edb

Instance2836.8 Log path: C:\databases\dbs_set4\log8
Database: C:\databases\dbs_set4\db8\Jetstress008001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2836.1	16.661	8.916	122.475	72.839	33673.689	36356.428	0.000	1.609	0.000	60.743	0.000	4902.074
Instance2836.2	16.385	9.199	123.673	73.648	33753.836	36307.779	0.000	1.591	0.000	60.603	0.000	4878.731
Instance2836.3	16.724	10.736	124.569	74.258	33645.087	36335.588	0.000	1.822	0.000	61.220	0.000	4870.760
Instance2836.4	17.226	11.504	123.995	73.929	33619.152	36362.270	0.000	1.751	0.000	61.318	0.000	4892.732
Instance2836.5	14.795	1.811	122.577	73.027	34161.945	36310.769	0.000	1.011	0.000	61.170	0.000	4807.161
Instance2836.6	14.600	1.623	121.994	72.771	34106.184	36380.098	0.000	0.967	0.000	61.061	0.000	4848.027
Instance2836.7	15.872	3.313	124.527	74.312	34109.632	36394.146	0.000	1.212	0.000	62.354	0.000	4825.480
Instance2836.8	16.150	3.360	122.519	72.869	34021.363	36372.392	0.000	1.202	0.000	60.778	0.000	4845.391

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2836.1	25.494	261876.409
Instance2836.2	26.066	261856.784
Instance2836.3	25.477	261840.470
Instance2836.4	25.730	261842.658
Instance2836.5	27.430	261830.104
Instance2836.6	27.020	261872.516
Instance2836.7	26.206	261852.700
Instance2836.8	26.685	261877.373

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2836.1	1.209	232060.297

Instance2836.2	1.202	232558.570
Instance2836.3	1.210	231567.120
Instance2836.4	1.215	232569.370
Instance2836.5	1.194	232052.193
Instance2836.6	1.207	232561.200
Instance2836.7	1.224	232076.951
Instance2836.8	1.198	232078.300

Total I/O Performance

MSExchange Database ==> Instances	I/O DB Reads Avg Latency (msec)	I/O DB Writes Avg Latency (msec)	I/O DB Reads /sec	I/O DB Writes /sec	I/O DB Reads Avg Bytes	I/O DB Writes Avg Bytes	I/O Log Reads Avg Latency (msec)	I/O Log Writes Avg Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Avg Bytes	I/O Log Writes Avg Bytes
Instance2836.1	16.661	8.916	147.969	72.839	72991.338	36356.428	3.167	1.609	1.209	60.743	232060.297	4902.074
Instance2836.2	16.385	9.199	149.739	73.648	73461.741	36307.779	3.386	1.591	1.202	60.603	232558.570	4878.731
Instance2836.3	16.724	10.736	150.046	74.258	72391.900	36335.588	2.975	1.822	1.210	61.220	231567.120	4870.760
Instance2836.4	17.226	11.504	149.725	73.929	72839.298	36362.270	3.023	1.751	1.215	61.318	232569.370	4892.732
Instance2836.5	14.795	1.811	150.007	73.027	75792.916	36310.769	4.003	1.011	1.194	61.170	232052.193	4807.161
Instance2836.6	14.600	1.623	149.014	72.771	75405.822	36380.098	4.070	0.967	1.207	61.061	232561.200	4848.027
Instance2836.7	15.872	3.313	150.734	74.312	73704.965	36394.146	3.202	1.212	1.224	62.354	232076.951	4825.480
Instance2836.8	16.150	3.360	149.205	72.869	74773.599	36372.392	3.790	1.202	1.198	60.778	232078.300	4845.391

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.559	0.935	3.816
Available MBytes	4935.386	4921.000	4989.000
Free System Page Table Entries	33555082.010	33555081.000	33555084.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	47535396.877	47296512.000	47620096.000
Pool Paged Bytes	135914540.894	135839744.000	135970816.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log5/28/2011 11:38:14 AM -- Jetstress testing begins ...
5/28/2011 11:38:14 AM -- Preparing for testing ...
5/28/2011 11:38:22 AM -- Attaching databases ...
5/28/2011 11:38:22 AM -- Preparations for testing are complete.
5/28/2011 11:38:22 AM -- Starting transaction dispatch ..
5/28/2011 11:38:22 AM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
5/28/2011 11:38:22 AM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
5/28/2011 11:38:30 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
5/28/2011 11:38:30 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
5/28/2011 11:38:36 AM -- Operation mix: Sessions 7, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/28/2011 11:38:36 AM -- Performance logging started (interval: 15000 ms).
5/28/2011 11:38:36 AM -- Attaining prerequisites:
5/28/2011 11:40:24 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1936568000.0 (lower bound: 1932735000.0, upper bound: none)
5/28/2011 1:40:25 PM -- Performance logging has ended.
5/28/2011 1:40:25 PM -- JetInterop batch transaction stats: 42572, 42640, 42707, 42649, 42328, 42270, 42865 and 42447.
5/28/2011 1:40:25 PM -- Dispatching transactions ends.
5/28/2011 1:40:25 PM -- Shutting down databases ...
5/28/2011 1:40:37 PM -- Instance2836.1 (complete), Instance2836.2 (complete), Instance2836.3 (complete), Instance2836.4 (complete), Instance2836.5 (complete), Instance2836.6 (complete), Instance2836.7 (complete) and Instance2836.8 (complete)
5/28/2011 1:40:37 PM --

C:\Jetstress\results\7_2driveFW_2iop_7threads_2hrs\Performance_2011_5_28_11_38_30.blg has 486 samples.
5/28/2011 1:40:37 PM -- Creating test report ...
5/28/2011 1:40:39 PM -- Instance2836.1 has 16.7 for I/O Database Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.1 has 1.6 for I/O Log Writes Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.1 has 1.6 for I/O Log Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.2 has 16.4 for I/O Database Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.2 has 1.6 for I/O Log Writes Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.2 has 1.6 for I/O Log Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.3 has 16.7 for I/O Database Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.3 has 1.8 for I/O Log Writes Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.3 has 1.8 for I/O Log Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.4 has 17.2 for I/O Database Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.4 has 1.8 for I/O Log Writes Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.4 has 1.8 for I/O Log Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.5 has 14.8 for I/O Database Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.5 has 1.0 for I/O Log Writes Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.5 has 1.0 for I/O Log Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.6 has 14.6 for I/O Database Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.6 has 1.0 for I/O Log Writes Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.6 has 1.0 for I/O Log Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.7 has 15.9 for I/O Database Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.7 has 1.2 for I/O Log Writes Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.7 has 1.2 for I/O Log Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.8 has 16.2 for I/O Database Reads Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.8 has 1.2 for I/O Log Writes Average Latency.
5/28/2011 1:40:39 PM -- Instance2836.8 has 1.2 for I/O Log Reads Average Latency.
5/28/2011 1:40:39 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/28/2011 1:40:39 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/28/2011 1:40:39 PM --
C:\Jetstress\results\7_2driveFW_2iop_7threads_2hrs\Performance_2011_5_28_11_38_30.xml has 478 samples
queried.

Appendix C Backup Testing

Microsoft Exchange Jetstress 2010

Database backup Test Result Report

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance2836.1	1287466.59	05:51:58	60.96
Instance2836.2	1287506.59	05:53:25	60.72
Instance2836.3	1287482.59	05:53:41	60.67
Instance2836.4	1287522.59	05:54:18	60.56
Instance2836.5	1287490.59	05:52:04	60.95
Instance2836.6	1287482.59	05:50:58	61.14
Instance2836.7	1287506.59	06:11:32	57.76
Instance2836.8	1287466.59	06:12:12	57.65

Jetstress System Parameters
Thread Count	7 (per database)
Minimum Database Cache	256.0 MB

Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance2836.1 Log path: C:\databases\dbs_set1\log1
Database: C:\databases\dbs_set1\db1\Jetstress001001.edb

Instance2836.2 Log path: C:\databases\dbs_set1\log2
Database: C:\databases\dbs_set1\db2\Jetstress002001.edb

Instance2836.3 Log path: C:\databases\dbs_set2\log3
Database: C:\databases\dbs_set2\db3\Jetstress003001.edb

Instance2836.4 Log path: C:\databases\dbs_set2\log4
Database: C:\databases\dbs_set2\db4\Jetstress004001.edb

Instance2836.5 Log path: C:\databases\dbs_set3\log5
Database: C:\databases\dbs_set3\db5\Jetstress005001.edb

Instance2836.6 Log path: C:\databases\dbs_set3\log6
Database: C:\databases\dbs_set3\db6\Jetstress006001.edb

Instance2836.7 Log path: C:\databases\dbs_set4\log7
Database: C:\databases\dbs_set4\db7\Jetstress007001.edb

Instance2836.8 Log path: C:\databases\dbs_set4\log8
Database: C:\databases\dbs_set4\db8\Jetstress008001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O DB Reads Avg Latency (msec)	I/O DB Writes Avg Latency	I/O DB Reads /sec	I/O DB Writes /sec	I/O DB Reads Average Bytes	I/O DB Writes Avg Bytes	I/O Log Reads Avg Latency	I/O Log Writes Avg Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Avg Bytes	I/O Log Writes Avg Bytes

	(msec)					(msec)						
Instance2836.1	7.201	0.000	243.878	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2836.2	7.449	0.000	241.989	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2836.3	6.934	0.000	242.603	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2836.4	7.058	0.000	241.686	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2836.5	7.100	0.000	242.051	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2836.6	6.892	0.000	244.466	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2836.7	7.251	0.000	230.865	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2836.8	7.328	0.000	230.442	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.432	0.097	4.365
Available MBytes	6995.473	6980.000	7000.000
Free System Page Table Entries	33555082.022	33555082.000	33555084.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	48254309.849	48250880.000	48275456.000
Pool Paged Bytes	144991876.129	144625664.000	145104896.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log6/3/2011 10:55:25 AM -- Jetstress testing begins ...
6/3/2011 10:55:25 AM -- Preparing for testing ...
6/3/2011 10:55:33 AM -- Attaching databases ...
6/3/2011 10:55:33 AM -- Preparations for testing are complete.
6/3/2011 10:55:44 AM -- Performance logging started (interval: 30000 ms).
6/3/2011 10:55:44 AM -- Backing up databases ...
6/3/2011 5:07:56 PM -- Performance logging has ended.
6/3/2011 5:07:56 PM -- Instance2836.1 (100% processed), Instance2836.2 (100% processed), Instance2836.3 (100% processed), Instance2836.4 (100% processed), Instance2836.5 (100% processed), Instance2836.6 (100% processed), Instance2836.7 (100% processed) and Instance2836.8 (100% processed)
6/3/2011 5:07:56 PM --
C:\Jetstress\results\7_2driveFW_7threads_backup\DatabaseBackup_2011_6_3_10_55_33.blg has 744 samples.
6/3/2011 5:07:56 PM -- Creating test report ...

Appendix D Soft Recovery Testing

Microsoft Exchange *Jetstress 2010*

SoftRecovery Test Result Report

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance2836.1	507	788.4409848
Instance2836.2	515	787.9105839
Instance2836.3	501	819.4694393
Instance2836.4	509	817.8782365
Instance2836.5	514	826.6298519
Instance2836.6	514	831.6686608
Instance2836.7	512	852.3542971
Instance2836.8	507	842.5418799

Database Configuration

Instance2836.1 Log path: C:\databases\dbs_set1\log1
Database: C:\databases\dbs_set1\db1\Jetstress001001.edb

Instance2836.2 Log path: C:\databases\dbs_set1\log2
Database: C:\databases\dbs_set1\db2\Jetstress002001.edb

Instance2836.3 Log path: C:\databases\dbs_set2\log3
Database: C:\databases\dbs_set2\db3\Jetstress003001.edb

Instance2836.4 Log path: C:\databases\dbs_set2\log4
Database: C:\databases\dbs_set2\db4\Jetstress004001.edb

Instance2836.5 Log path: C:\databases\dbs_set3\log5
Database: C:\databases\dbs_set3\db5\Jetstress005001.edb

Instance2836.6 Log path: C:\databases\dbs_set3\log6
Database: C:\databases\dbs_set3\db6\Jetstress006001.edb

Instance2836.7 Log path: C:\databases\dbs_set4\log7
Database: C:\databases\dbs_set4\db7\Jetstress007001.edb

Instance2836.8 Log path: C:\databases\dbs_set4\log8
Database: C:\databases\dbs_set4\db8\Jetstress008001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O DB Reads Avg Latency (msec)	I/O DB Writes Avg Latency (msec)	I/O DB Reads /sec	I/O DB Writes /sec	I/O DB Reads Avg Bytes	I/O DB Writes Avg Bytes	I/O Log Reads Avg Latency (msec)	I/O Log Writes Avg Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Avg Bytes	I/O Log Writes Average Bytes
Instance2836.1	10.464	0.775	605.461	3.860	40878.493	32768.000	7.114	0.000	5.790	0.000	232530.969	0.000

Instance2836.2	10.099	0.812	622.980	3.921	40744.128	32768.000	8.055	0.000	5.882	0.000	232519.763	0.000
Instance2836.3	10.665	0.819	585.992	3.664	40953.344	32768.000	7.699	0.000	5.496	0.000	232520.481	0.000
Instance2836.4	10.493	0.797	598.639	3.741	40884.414	32768.000	7.996	0.003	5.617	0.015	232514.947	2.522
Instance2836.5	10.419	0.801	597.679	3.730	40918.147	32768.000	9.370	0.000	5.595	0.000	232504.355	0.000
Instance2836.6	10.609	0.786	585.493	3.698	40910.285	32768.000	7.519	0.000	5.546	0.000	232521.675	0.000
Instance2836.7	10.968	0.799	569.080	3.596	40885.752	32768.000	7.102	0.000	5.394	0.000	232522.390	0.000
Instance2836.8	10.747	0.788	563.597	3.616	40888.825	32768.000	10.506	0.011	5.424	0.004	232481.179	2.450

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2836.1	24.694	262044.019
Instance2836.2	26.410	261839.087
Instance2836.3	24.597	261901.066
Instance2836.4	25.753	261871.099
Instance2836.5	25.943	261878.476
Instance2836.6	24.879	261811.958
Instance2836.7	24.545	261924.813
Instance2836.8	25.636	261808.654

Total I/O Performance

MSExchange Database ==> Instances	I/O DB Reads Avg Latency (msec)	I/O DB Writes Avg Latency (msec)	I/O DB Reads /sec	I/O DB Writes /sec	I/O DB Reads Avg Bytes	I/O DB Writes Avg Bytes	I/O Log Reads Avg Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2836.1	10.464	0.775	630.156	3.860	49545.478	32768.000	7.114	0.000	5.790	0.000	232530.969	0.000
Instance2836.2	10.099	0.812	649.390	3.921	49735.666	32768.000	8.055	0.000	5.882	0.000	232519.763	0.000
Instance2836.3	10.665	0.819	610.589	3.664	49854.092	32768.000	7.699	0.000	5.496	0.000	232520.481	0.000
Instance2836.4	10.493	0.797	624.392	3.741	49999.132	32768.000	7.996	0.003	5.617	0.015	232514.947	2.522
Instance2836.5	10.419	0.801	623.621	3.730	50110.056	32768.000	9.370	0.000	5.595	0.000	232504.355	0.000
Instance2836.6	10.609	0.786	610.373	3.698	49914.475	32768.000	7.519	0.000	5.546	0.000	232521.675	0.000
Instance2836.7	10.968	0.799	593.625	3.596	50025.310	32768.000	7.102	0.000	5.394	0.000	232522.390	0.000
Instance2836.8	10.747	0.788	589.233	3.616	50500.406	32768.000	10.506	0.011	5.424	0.004	232481.179	2.450

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	4.116	0.243	7.003
Available MBytes	4882.509	4814.000	6691.000
Free System Page Table Entries	33555082.000	33555082.000	33555082.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	49425253.434	49360896.000	49508352.000
Pool Paged Bytes	146510712.755	146485248.000	146587648.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 6/4/2011 9:37:07 AM -- Jetstress testing begins ...
6/4/2011 9:37:07 AM -- Preparing for testing ...

6/4/2011 9:37:16 AM -- Attaching databases ...
6/4/2011 9:37:16 AM -- Preparations for testing are complete.
6/4/2011 9:37:16 AM -- Starting transaction dispatch ..
6/4/2011 9:37:16 AM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
6/4/2011 9:37:16 AM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
6/4/2011 9:37:24 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
6/4/2011 9:37:24 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
6/4/2011 9:37:27 AM -- Operation mix: Sessions 7, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
6/4/2011 9:37:27 AM -- Performance logging started (interval: 15000 ms).
6/4/2011 9:37:27 AM -- Generating log files ...
6/4/2011 10:48:07 AM -- C:\databases\dbs_set1\log1 (101.4% generated), C:\databases\dbs_set1\log2 (103.0% generated), C:\databases\dbs_set2\log3 (100.2% generated), C:\databases\dbs_set2\log4 (101.8% generated), C:\databases\dbs_set3\log5 (102.8% generated), C:\databases\dbs_set3\log6 (102.8% generated), C:\databases\dbs_set4\log7 (102.4% generated) and C:\databases\dbs_set4\log8 (101.4% generated)
6/4/2011 10:48:07 AM -- Performance logging has ended.
6/4/2011 10:48:07 AM -- JetInterop batch transaction stats: 22112, 22267, 22056, 22381, 22420, 22387, 22278 and 22126.
6/4/2011 10:48:08 AM -- Dispatching transactions ends.
6/4/2011 10:48:08 AM -- Shutting down databases ...
6/4/2011 10:48:18 AM -- Instance2836.1 (complete), Instance2836.2 (complete), Instance2836.3 (complete), Instance2836.4 (complete), Instance2836.5 (complete), Instance2836.6 (complete), Instance2836.7 (complete) and Instance2836.8 (complete)
6/4/2011 10:48:18 AM -- [C:\Jetstress\results\7_2driveFW_7threads_softrecovery\Performance_2011_6_4_9_37_24.blg](C:\Jetstress\results\7_2driveFW_7threads_softrecovery\Performance_2011_6_4_9_37_24.blg) has 282 samples.
6/4/2011 10:48:18 AM -- Creating test report ...
6/4/2011 10:48:19 AM -- Instance2836.1 has 14.5 for I/O Database Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.1 has 1.2 for I/O Log Writes Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.1 has 1.2 for I/O Log Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.2 has 14.0 for I/O Database Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.2 has 1.2 for I/O Log Writes Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.2 has 1.2 for I/O Log Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.3 has 14.8 for I/O Database Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.3 has 1.2 for I/O Log Writes Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.3 has 1.2 for I/O Log Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.4 has 14.5 for I/O Database Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.4 has 1.2 for I/O Log Writes Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.4 has 1.2 for I/O Log Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.5 has 24.0 for I/O Database Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.5 has 4.5 for I/O Log Writes Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.5 has 4.5 for I/O Log Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.6 has 23.7 for I/O Database Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.6 has 4.5 for I/O Log Writes Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.6 has 4.5 for I/O Log Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.7 has 15.4 for I/O Database Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.7 has 1.2 for I/O Log Writes Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.7 has 1.2 for I/O Log Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.8 has 15.1 for I/O Database Reads Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.8 has 1.2 for I/O Log Writes Average Latency.
6/4/2011 10:48:19 AM -- Instance2836.8 has 1.2 for I/O Log Reads Average Latency.
6/4/2011 10:48:19 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/4/2011 10:48:19 AM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/4/2011 10:48:19 AM -- [C:\Jetstress\results\7_2driveFW_7threads_softrecovery\Performance_2011_6_4_9_37_24.xml](C:\Jetstress\results\7_2driveFW_7threads_softrecovery\Performance_2011_6_4_9_37_24.xml) has 281 samples queried.

6/4/2011 10:48:19 AM --
C:\Jetstress\results\7_2driveFW_7threads_softrecovery\Performance_2011_6_4_9_37_24.html was saved.
6/4/2011 10:48:22 AM -- Performance logging started (interval: 4000 ms).
6/4/2011 10:48:22 AM -- Recovering databases ...
6/4/2011 11:02:35 AM -- Performance logging has ended.
6/4/2011 11:02:35 AM -- Instance2836.1 (788.4409848), Instance2836.2 (787.9105839), Instance2836.3 (819.4694393), Instance2836.4 (817.8782365), Instance2836.5 (826.6298519), Instance2836.6 (831.6686608), Instance2836.7 (852.3542971) and Instance2836.8 (842.5418799)
6/4/2011 11:02:35 AM --
C:\Jetstress\results\7_2driveFW_7threads_softrecovery\SoftRecovery_2011_6_4_10_48_19.blg has 212 samples.
6/4/2011 11:02:35 AM -- Creating test report ...