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Sun ZFS Storage 7120 Appliance 5,000 Mailbox Resiliency Exchange 2010 Storage Solution

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Overview

This document describes Oracle's storage solution for Microsoft Exchange Server, based on the Microsoft Exchange Solution Reviewed Program (ESRP) – Storage program. The ESRP – Storage program was developed by Microsoft Corporation to provide a common storage testing framework for vendors to provide information on its storage solutions for Microsoft Exchange Server software. For more details on the Microsoft ESRP – Storage program, go to <http://technet.microsoft.com/en-us/exchange/ff182054.aspx>. For any questions or comments regarding the contents of this document, see the section *Contact for Additional Information*.

Introduction

Oracle's Sun ZFS Storage Appliance is an excellent platform for implementation of Microsoft Exchange deployments. Its comprehensive set of features is available without a license fee, making it a solution that will save initial as well as ongoing (overhead) expenses. The Microsoft Exchange Server 2010 Mailbox server role is the focus of this document. Mailbox servers host the Microsoft Exchange databases and user mailboxes. Other server roles, such as Hub transport, edge transport, client access, and unified messaging roles, are not discussed in this document.

Simplified Storage

The Sun ZFS Storage 7120 offers these benefits to simplify storage management:

- Installs in minutes without training
- Is simple to configure and optimize
- Has easy-to-use graphical tools that provide real-time visibility
- Provides comprehensive self-healing

Flash Hybrid Storage Pool

Hybrid Storage Pools can help maximize performance while slashing capital and operating expenses:

- *Optimized storage pool* – The Sun ZFS Storage 7120 uses a virtual storage pool to seamlessly optimize access to the different media types, including SSDs, improving efficiencies, and increasing application performance. In fact, it is the only system on the market with a hybrid storage pool that delivers over twice the performance at half the cost of traditional storage solutions, enabling you to shatter IO bottlenecks and increase productivity without breaking the bank.
- *Hybrid architecture with SSDs increases performance* – The Sun ZFS Storage 7120's hybrid architecture utilizes write-optimized SSD-based Flash Accelerators with high-capacity disk drives to deliver higher performance and reduce power consumption and cooling requirements. This makes the Sun

ZFS Storage 7120 ideal for organizations that require high throughput and lower response times for write intensive application workloads. In addition, using SSDs lowers power consumption by up to 80 percent compared to spinning disks.

Customers with write-intensive applications (synchronous writes) and can see the most benefit with the use of flash-based SSDs. For Sun ZFS Storage 7120 configurations, at least two SSD-based Read Flash Accelerators should be used for read-intensive workloads, and at least two Write Flash Accelerators should be used for write-intensive workloads.

- *Flexibility to meet your changing needs* – The Sun ZFS Storage 7120 provides you with a high-density server/storage solution. Unlike traditional storage architectures, the Sun ZFS Storage 7120 is highly adaptable to changing business needs. The system not only scales up to 120 TB of storage capacity, but also scales in multiple dimensions, including IO throughput, processor performance, cache, and total capacity.

For example, you can increase performance by adding SSDs. As your application requirements change, you can increase computational power by adding more CPUs and cache and expand total capacity by adding enterprise-class high-capacity drive expansion trays.

Cost-Effective

Flat or declining budgets are a fact of life in today's IT environments. So are growing storage demands. Compared to the competition, the Sun ZFS Storage 7120 delivers higher performance at significant savings when compared to the competition.

Eco-efficient

The Sun ZFS Storage 7120 helps you lower costs by reducing energy consumption and offering higher storage density, which reduces space requirements.

No additional software licenses

Unlike other vendors, who charge license fees for protocols and data services, Oracle includes features like iSCSI, Fibre Channel, IB, CIFS, NFS, HTTP, FTP, replication, snapshots, de-duplication, compression, and clones with the price of the system. No additional licenses are required.

Analytics

Storage bottlenecks have often plagued Exchange administrators. In the past, the solution to a disk performance problem was to add additional expensive spindles, move from 10k RPM to 15k RPM, or add expensive NVRAM.

With built-in Analytics based on DTrace, unprecedented visibility is now available to pinpoint storage bottlenecks. Breakdowns of IOPS, throughput, disk usage, disk offset, and dozens more statistics are readily available in graphical representations or via the scriptable CLI. Figures 1 and 2 illustrate various measurements during an arbitrary Jetstress run.

Figure 1 shows four Exchange servers each running with two FC ports. This graph shows isv-4150b has only a single port active, running roughly twice the throughput as the others, while the other three servers have half the throughput via two ports. It looks like isv-4150b's MPIIO settings may be set to failover only, or a port may be down.

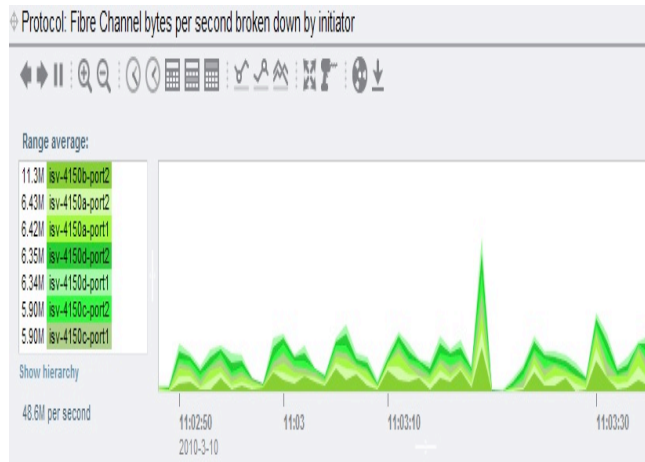


Figure 1. Sun ZFS Storage Appliance Analytics graph showing Fibre Channel bytes per second

Each Exchange server has three dbvol LUNs. As shown in Figure 2, each LUN can be viewed to see where hot spots may be. Additional mailboxes can be placed in lower utilized LUNs.

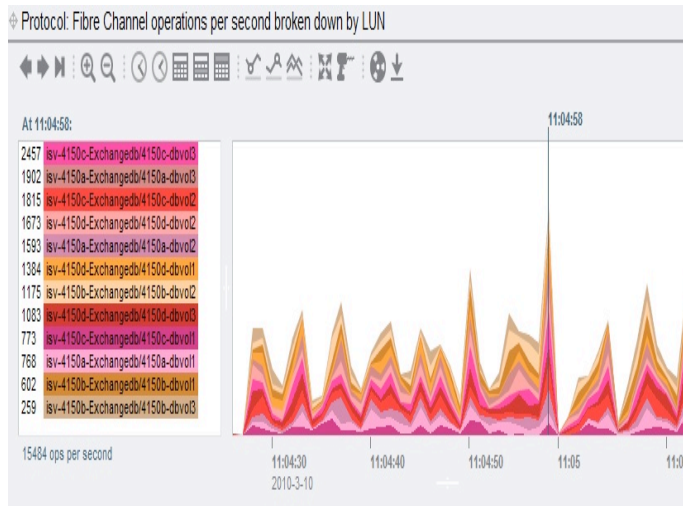


Figure 2. Sun ZFS Storage Appliance Analytics graph showing Fibre Channel operations per second

Sun ZFS Storage Appliances

The Sun ZFS Storage Appliance is available in four versions that meet diverse requirements including price, performance, capacity, and data protection. The Sun ZFS Storage 7120, for example, is an entry-level storage system for workgroup environments that do not have medium-to-high READ performance requirements and thus are not equipped with a read-optimized flash device. Three additional platforms offer up to 2 TB of read cache, which substantially enables many applications to show much faster response times that are typically in the low single digit milliseconds.

The write flash on all Sun ZFS Storage Appliances can improve response times for synchronous write IO intensive applications. Faster CPUs (that have up to eight threads per core) can provide up to 32 threads to process data in each Sun ZFS Storage Appliance controller. Specifically, the Sun ZFS Storage 7120 offers 72 GB of primary cache and offers up to 512 GB of DRAM memory. Up to 2.5 TB of cache storage is offered, which can dramatically improve READ intensive application throughput (IOPS)

Solution Description

This solution includes a 5,000-mailbox, single database-availability-group (DAG) node with two copies hosted across two separate Sun Fire servers attached via Fibre Channel to two Sun ZFS Storage 7120 controllers. The user profile used was one IOPS per mailbox.

Mailbox Storage

Two 7120 controllers are attached to one 24-disk J4410 storage shelf. Each 7120 controller has four write-optimized cache devices. The database LUNs use three write-cache devices and the log LUNs utilize one write-cache device.

ISCSI 10GbE Redundancy

Each 7120 storage appliance and Sun Fire mailbox server utilize one dual port 8-Gb FC HBA. Each of these devices has a separate port connected to two Brocade 8-Gb FC switches, providing full data path redundancy to and from each mailbox server and storage device.

DAG Solution

This solution is a single DAG node utilizing two mailbox servers. Mailbox server aie-4240a contains primary database 1 and passive database 2. Mailbox server aie-4240b contains primary database 2 and passive databases 1-6. In the event of a mailbox server related failure, the passive copies of the mailbox databases are activated on the alternate mailbox server. In the event of a storage path related failure, the passive database copies are made active on the alternate storage controller.

In this solution, the primary copy storage and the secondary copy storage are configured identically from the host on down to the spindle, including brand, model, firmware, drivers, etc. Table 1 shows what each controller looks like.

TABLE 1. DAG SOLUTION STORAGE LAYOUT

STORAGE APPLIANCE	STORAGE POOLS	RAID LEVEL	CACHE DEVICES	PROJECTS	LUNS	LUN SIZE	LOGS AND DATABASES
Storage Appliance AIE-7120A	pool-0	10	1 write-cache	logs	logvol1	150 GB	Log1
	pool-1	10	2 write-cache	dbvols	dbvol1	1.5 TB	DB1
			2 read-cache	dbcopies	cpvol1	1.5 TB	CP2
Controller AIE-7120B	pool-0	10	1 write-cache	logs	logvol1	150 GB	Log2
	pool-1	10	2 write-cache	dbvols	dbvol1	1.5 TB	DB2
			2 read-cache	dbcopies	cpvol1	1.5 TB	CP1

Sizing

The following items are important considerations when sizing an Exchange mailbox solution:

- Number of mailboxes
- Mailbox size
- IOPS per mailbox
- Physical drive type
- Fault tolerance

Mailbox Servers

High performance Sun Fire x4240 dual core processors with 32 GB RAM. Each server has expansion room for 5 PCI-e IO slots and up to 128 GB RAM.

For links to the Sun ZFS Storage Appliances in the Windows Server Catalog, go to

<http://www.windowservercatalog.com/item.aspx?idItem=2999cdf3-6031-ea71-5734-996fe0021336&bCatID=1282>

The ESRP-Storage program focuses on testing storage solutions that address performance and reliability issues through storage design. However, storage is not the only factor to take into consideration when designing a scale-up Exchange solution. Other factors that affect server scalability are server processor utilization, server physical and virtual memory limitations, resource requirements for other applications, directory and network service latencies, network infrastructure limitations, replication and recovery requirements, and client usage profiles. All these factors are beyond the scope of the ESRP-Storage program. Therefore, the number of mailboxes hosted per server in the test configuration may not be viable for some customer deployments.

For more information about identifying and addressing performance bottlenecks in an Exchange system, refer to Microsoft's Troubleshooting Microsoft Exchange Server Performance, available at <http://technet.microsoft.com/en-us/library/dd335215.aspx>.

Targeted Customer Profile

The solution described in this paper targets a small to medium mailbox deployment. This solution includes two concurrent servers, but as many servers can be used as the IOPS and response time requirements allow. The tested solution includes:

- 5,000 mailboxes
- Two mailbox servers
- User IO profile of 0.80 IOPs, 1 IOPs (includes 20% headroom)
- 512 MB mailboxes
- 24x7 background database maintenance configured

- Mailbox resiliency used as the primary data protection mechanism
- 3 TB database
- Solaris ZFS data integrity features used to minimize risk of silent data corruption

Tested Deployment

The following tables summarize the testing environment.

TABLE 1. SIMULATED EXCHANGE CONFIGURATION

SOLUTION COMPONENT	DESCRIPTION
Number of Exchange mailboxes simulated	5,000
Number of Database Availability Groups (DAGs)	1
Number of servers/DAG	2 (1 tested)
Number of active mailboxes/server	2,500
Number of databases/host	1 (2 total)
Number of copies/database	2
Number of mailboxes/database	2,500
Simulated profile: I/O's per second per mailbox (IOPS, include 20% headroom)	.8 IOPS – 1 IOPS tested (0.8 +.2) for headroom
Database LUN size	1.5 TB
Log LUN size	150 GB
Total database size for performance testing	3 TB (1.5 TB tested)
Percent storage capacity used by Exchange database**	20 percent

**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.

TABLE 2. STORAGE HARDWARE

SOLUTION COMPONENT	DESCRIPTION
Storage Connectivity	iSCSI
Storage model and OS/firmware revision	Sun ZFS Storage 7120, 2010.Q3.2.0 Software Release
Storage cache	96 GB total per controller 24 GB ARC per controller 72 GB Write cache per controller
Number of storage controllers	2 (1 Tested)
Number of storage ports	2 iSCSI Ports per controller
Maximum bandwidth of storage connectivity to host	20 Gb total – 2 x 10 Gb per controller
Switch type/model/firmware revision	
HBA model and firmware	Oracle 2x10 Gb Optical Ethernet
Number of HBA's/host	Intel X520-2 10 GbE
Host server type	2 Dual Core AMD 2222 ,32 GB RAM
Total number of disks tested in solution	72 (36 tested)
Maximum number of spindles that can be hosted in the storage	60 (120 total)

TABLE 3. STORAGE SOFTWARE

SOLUTION COMPONENT	DESCRIPTION
HBA driver	Microsoft iSCSI Initiator 6.0.6002.18005
HBA QueueTarget Setting	NA
HBA QueueDepth Setting	NA
Multi-Pathing	Microsoft MPIO 6.0.6002.18005 RoundRobin
Host OS	Microsoft Windows Server Enterprise Edition 2008 SP2 x64
ESE.dll file version	14.00.0639.019
Replication solution name/version	NA

TABLE 4. STORAGE DISK CONFIGURATION (MAILBOX STORE DISKS)

SOLUTION COMPONENT	DESCRIPTION
Disk type, speed and firmware revision	SAS II - 7200 RPM FW v.0514 Write-SSD - FW v.9002
Raw capacity per disk (GB)	1 TB
Number of physical disks in test	60 (30 tested)
Total raw storage capacity (GB)	60 TB (30 TB tested)
Disk slice size (GB)	NA
Number of slices per LUN or number of disks per LUN	NA
Raid level	RAID 10
Total formatted capacity	30 TB (15 TB tested)
Storage capacity utilization	50.00 percent
Database capacity utilization	10.00 percent

TABLE 5. STORAGE DISK CONFIGURATION (TRANSACTIONAL LOG DISKS)

SOLUTION COMPONENT	DESCRIPTION
Disk type, speed and firmware revision	SAS II – 7200 RPM – 0514 Write-SSD - D20Y
Raw capacity per disk (GB)	1 TB
Number of Spindles in test	12 (6 tested)
total raw storage capacity (GB)	12 TB (6 TB tested)
Disk slice size (GB)	NA
Number of slices per LUN or number of disks per LUN	NA
Raid level	RAID 10
Total formatted capacity	300 GB (150 GB tested)

Best Practices

Best practices for configuring database and log LUNs in the Sun ZFS Storage Appliance for use with Exchange 2010 and troubleshooting latency issues are described below.

Database and Log LUNs

Exchange server is a disk-intensive application. Based on the testing run using the ESRP framework, we recommend the following to improve storage performance:

- Use the mirrored profile when creating pools for both database LUNs and transactional log LUNs.
- Create database LUNs with a 32 KB volume record size.
- Create log LUNs with a 128 KB volume record size.
- Do not enable write cache.
- With Windows Server 2003, use `diskpart.exe` to align the sectors at 64 KB. Windows Server 2008 does this automatically.
- Format both DB and Log Volumes with a NTFS allocation unit size of 64 KB.
- When sizing databases, consider using fewer, larger databases. Our testing showed a direct improvement in IOPs and response time when the size of the databases was increased and the number of databases decreased.
- Do not share Exchange 2010 disks with other IO-intensive applications. This will have a negative effect on your disk subsystem performance.

Backup strategy

N/A

Troubleshooting

Use the Analytics feature of the ZFS Storage Appliance to troubleshoot any latency issues.

For Exchange 2010 best practices on storage design, go to <http://technet.microsoft.com/en-us/library/dd346703.aspx>

Contact for Additional Information

Oracle phone numbers are listed below.

- General inquiries: +1.650.506.7000 or +1.800.392.2999
- International: +1.650.506.7000
- Sales: +1.800.ORACLE1

The Oracle mailing address is:

Oracle Corporation
500 Oracle Parkway
Redwood Shores, CA 94065

More information can be found here:

- [Sun Unified Storage](#)
- [Sun ZFS Storage 7120 Appliance](#)
- [Sun ZFS Storage Appliance Software](#)
- [ZFS Storage Appliance Resource Kit](#)
- [Oracle's Sun Unified Storage Simulator](#)

Test Result Summary

This section provides a high-level summary of the test data from ESRP. Links are provided to the detailed html reports generated by the ESRP testing framework.

Reliability

A number of tests in the framework test reliability using 24-hour test runs. The goal is to verify the storage can handle high IO load for a long period of time. After the stress test, log and database files are analyzed for integrity to ensure no database/log corruption.

For these tests, the integrity analysis showed:

- No errors were reported in the saved eventlog file.
- No errors were reported in during the database and log checksum process (see the *Database Checksum Result Report*).

Storage Performance Results

The primary storage performance test is designed to exercise the storage with maximum sustainable Exchange-type IO for 2 hours. The test shows how long it takes for the storage to respond to an IO under load. Table 6 and Table 7 show the sum of all logical disk IOs and an average of all logical disk IO latencies during the 2-hour duration of the test with results shown per server and aggregated across all servers.

Table 6 shows the sum of database IOs across storage groups and the average latency across all storage groups on a per server basis. For complete results, see the *Performance Test Result Report*.

TABLE 6. INDIVIDUAL SERVER PERFORMANCE (HOST: AIE-4240A)

METRIC	RESULT
Database I/O:	
Database Disks Transfers/sec	5306
Database Disks Reads/sec	3592
Database Disks Writes/sec	1714
Average Database Disk Read Latency (ms)	11
Average Database Disk Write Latency (ms)	11.6
Transaction Log I/O:	
Log Disks Writes/sec	389
Average Log Disk Write Latency (ms)	3.1

Table 7 shows the sum of database IOs and the average latency across all servers in solution.

TABLE 7. AGGREGATE PERFORMANCE ACROSS ALL SERVERS

METRIC	RESULT
Database I/O:	
Database Disks Transfers/sec	5306
Database Disks Reads/sec	3592
Database Disks Writes/sec	1714
Average Database Disk Read Latency (ms)	11

Average Database Disk Write Latency (ms)	11.6
Transaction Log I/O:	
Log Disks Writes/sec	389
Average Log Disk Write Latency (ms)	3.1

Database Backup/Recovery Performance

This section contains two test reports. The first test is to measure the sequential read rate of the database files, and the second test is to measure the recovery/replay performance (playing transaction logs in to the database).

Database Read-only Performance

This test measures the maximum rate at which databases can be backed up via VSS. Table 8 shows the average rate for a single database file. For complete results, see the *Database Backup Test Result Report*.

TABLE 8. DATABASE READ-ONLY PERFORMANCE FOR A SINGLE DATABASE FILE (HOST: AIE-4240A)

METRIC	RESULT
MB read/sec per database	12.51
MB read/sec total per server	25.14

Transaction Log Recovery/Replay Performance

This test measures the maximum rate at which the log files can be played against the databases. Table 9 shows the average rate for 500 log files played in a single storage group. Each log file is 1 MB in size. For complete results, see the *Soft Recovery Test Result Report*.

TABLE 9. LOG RECOVERY/REPLAY TRANSATION PERFORMANCE (HOST: AIE-4240A)

METRIC	RESULT
Average time to play one Log file (sec)	0.69

Conclusion

The Sun ZFS Storage Appliance series is a family of unified storage systems that are ideal solutions for Microsoft Exchange environments as well as numerous other applications. A comprehensive set of data services, storage efficiency features, analytics, massive scalability, intuitive user interface and excellent performance, along with cost effectiveness make the Sun ZFS Storage Appliance an excellent candidate for the data center.

For more information visit the following websites:

- Sun ZFS Storage Appliance Solutions
<http://www.oracle.com/us/products/servers-storage/storage/unified-storage/index.html>
- Microsoft Exchange Solution Center
<http://support.microsoft.com/ph/13965>
- Exchange 2010 Mailbox Server Role Requirements Calculator
<http://msexchangeteam.com/archive/2009/11/09/453117.aspx>

This document is developed by storage solution providers and reviewed by the Microsoft Exchange Product team. The test results and data presented in this document are conducted in the ESRP test framework. Customers should not quote the data directly for pre-deployment verification. It is still necessary to go through the exercises to validate the storage design for your specific customer environment.

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

Appendix: Test Results

The results of each test from the systems were virtually identical. This appendix includes test results from one of the two servers tested (host AIE-4240B).

Performance Test Result Report

Test Summary

Overall Test Result	Pass
Machine Name	AIE-4240A
Test Description	Two Hour Performance - 5,000 One GB Mailboxes, 2 Copies
Test Start Time	3/4/2011 11:31:47 AM
Test End Time	3/4/2011 1:33:10 PM
Collection Start Time	3/4/2011 11:33:05 AM
Collection End Time	3/4/2011 1:33:04 PM
Jetstress Version	14.01.0180.003
Ese Version	14.00.0639.019
Operating System	Windows Server (R) 2008 Enterprise without Hyper-V Service Pack 2 (6.0.6002.131072)
Performance Log	C:\Exchange\7120_5k_12hr-performance\Performance_2011_3_4_11_31_52.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	5306.114
Target Transactional I/O per Second	5000
Initial Database Size (bytes)	2849296744448
Final Database Size (bytes)	2858482270208
Database Files (Count)	2

Jetstress System Parameters

Thread Count	40 (per database)
Minimum Database Cache	64.0 MB
Maximum Database Cache	512.0 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

Instance2292.1	Log Path: O:\log1 Database: M:\db1\Jetstress001001.edb
Instance2292.2	Log Path: P:\log2 Database: N:\db2\Jetstress002001.edb

Transactional I/O Performance

MSEXCHANGE DB ==> INSTANCES	I/O DB			I/O DB			I/O LOG		I/O LOG		I/O LOG	
	READS AVE LATENCY (MSEC)	WRITES AVE LATENCY (MSEC)	READS/SEC	WRITES/SEC	READS AVE AVE BYTES	WRITES AVE BYTES	READS AVE LATENCY (MSEC)	WRITES AVE LATENCY (MSEC)	READS/SEC	WRITES/SEC	READS AVE BYTES	WRITES AVE BYTES
Instance2292.1	10.901	11.689	1796.283	857.425	32899.017	33949.024	0.000	3.094	0.000	194.701	0.000	10962.92
Instance2292.2	11.083	11.455	1795.556	856.848	32879.489	33957.988	0.000	3.107	0.000	194.178	0.000	11034.166

Background Database Maintenance I/O Performance

MSEXCHANGE DATABASE ==> INSTANCES	DATABASE MAINTENANCE IO READS/SEC	DATABASE MAINTENANCE IO READS AVERAGE BYTES
Instance2292.1	21.494	261809.345
Instance2292.2	21.845	261828.073

Log Replication I/O Performance

MSEXCHANGE DATABASE ==> INSTANCES	I/O LOG READS/SEC	I/O LOG READS AVERAGE BYTES
Instance2292.1	9.039	232562.110
Instance2292.2	9.079	232561.577

Total I/O Performance

MSEXCHANGE DB => INSTANCES	I/O DB		I/O DB				I/O LOG		I/O LOG		I/O LOG		I/O LOG	
	READS	WRITES	I/O DB	I/O DB	I/O DB READS	I/O DB	READS	WRITES	I/O LOG	I/O LOG	I/O LOG READS	I/O LOG	WRITES	WRITES
	AVE	AVE	READS/SEC	WRITES/	AVE BYTES	WRITES	AVE	AVE	READS/	WRITES/	AVE BYTES	WRITES	AVE BYTES	AVE BYTES
	LATENCY (MSEC)	LATENCY (MSEC)	SEC	SEC	SEC	BYTES	LATENCY (MSEC)	LATENCY (MSEC)	SEC	SEC	AVE BYTES	WRITES	AVE BYTES	AVE BYTES
Instance2292.1	10.901	11.689	1817.777	857.425	35605.716	33949.024	3.111	3.094	9.039	194.701	232562.110	10962.92		
Instance2292.2	11.083	11.455	1817.401	856.848	35631.377	33957.988	3.173	3.107	9.079	194.178	232561.577	11034.17		

Host System Performance

COUNTER	AVERAGE	MINIMUM	MAXIMUM
% Processor Time	32.985	4.725	38.785
Available MBytes	30099.258	30062.000	30106.000
Free System Page Table Entries	33560584.990	33560400.000	33560797.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	121032294.400	120283136.000	122130432.000
Pool Paged Bytes	133907242.667	133443584.000	172994560.000
Database Page Fault Stalls/sec	0.126	0.000	4.660

Test Log

Test Log 3/4/2011 11:31:47 AM -- Jetstress testing begins ...
 3/4/2011 11:31:47 AM -- Prepare testing begins ...
 3/4/2011 11:31:49 AM -- Attaching databases ...
 3/4/2011 11:31:49 AM -- Prepare testing ends.
 3/4/2011 11:31:49 AM -- Dispatching transactions begins ...
 3/4/2011 11:31:49 AM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
 3/4/2011 11:31:49 AM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
 3/4/2011 11:31:52 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 3/4/2011 11:31:52 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 3/4/2011 11:31:54 AM -- Operation mix: Sessions 40, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/4/2011 11:31:54 AM -- Performance logging begins (interval: 15000 ms).
 3/4/2011 11:31:54 AM -- Attaining prerequisites:
 3/4/2011 11:33:05 AM -- \MSEXchange Database(JetstressWin)\Database Cache Size, Last: 505303000.0 (lower bound: 483183800.0, upper bound: none)
 3/4/2011 1:33:05 PM -- Performance logging ends.
 3/4/2011 1:33:05 PM -- JetInterop batch transaction stats: 302281 and 302515.

3/4/2011 1:33:05 PM -- Dispatching transactions ends.
3/4/2011 1:33:05 PM -- Shutting down databases ...
3/4/2011 1:33:10 PM -- Instance2292.1 (complete) and Instance2292.2 (complete)
3/4/2011 1:33:10 PM -- C:\Exchange\7120_5k_i\2hr-performance\Performance_2011_3_4_11_31_52.blg has 484 samples.
3/4/2011 1:33:10 PM -- Creating test report ...
3/4/2011 1:33:13 PM -- Instance2292.1 has 10.9 for I/O Database Reads Average Latency.
3/4/2011 1:33:13 PM -- Instance2292.1 has 3.1 for I/O Log Writes Average Latency.
3/4/2011 1:33:13 PM -- Instance2292.1 has 3.1 for I/O Log Reads Average Latency.
3/4/2011 1:33:13 PM -- Instance2292.2 has 11.1 for I/O Database Reads Average Latency.
3/4/2011 1:33:13 PM -- Instance2292.2 has 3.1 for I/O Log Writes Average Latency.
3/4/2011 1:33:13 PM -- Instance2292.2 has 3.1 for I/O Log Reads Average Latency.
3/4/2011 1:33:13 PM -- Test has 4.6595535165231 Maximum Database Page Fault Stalls/sec.
3/4/2011 1:33:13 PM -- Test has 45 Database Page Fault Stalls/sec samples higher than 0.
3/4/2011 1:33:13 PM -- C:\Exchange\7120_5k_i\2hr-performance\Performance_2011_3_4_11_31_52.xml has 479 samples queried.

Stress Test Result Report

Test Summary

Overall Test Result	Pass
Machine Name	AIE-4240A
Test Description	Twenty Four Hour Performance - 5,000 .5 GB Mailboxes, 2 Copies
Test Start Time	3/8/2011 4:17:22 PM
Test End Time	3/9/2011 4:18:59 PM
Collection Start Time	3/8/2011 4:18:55 PM
Collection End Time	3/9/2011 4:18:49 PM
Jetstress Version	14.01.0180.003
Ese Version	14.00.0639.019
Operating System	Windows Server (R) 2008 Enterprise without Hyper-V Service Pack 2 (6.0.6002.131072)
Performance Log	C:\Exchange\7120_5k_i\24hr-stress\Stress_2011_3_8_16_17_27.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	5131.442
Target Transactional I/O per Second	5000
Initial Database Size (bytes)	2858482270208
Final Database Size (bytes)	2965218918400
Database Files (Count)	2

Jetstress System Parameters

Thread Count	40 (per database)
Minimum Database Cache	64.0 MB
Maximum Database Cache	512.0 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

Instance2292.1 Log Path: O:\log1
 Database: M:\db1\Jetstress001001.edb

Instance2292.2 Log Path: P:\log2
 Database: N:\db2\Jetstress002001.edb

Transactional I/O Performance

MSEXCHANGE DB ==> INSTANCES	I/O DB		I/O DB			I/O LOG		I/O LOG				
	READS AVE LATENCY (MSEC)	WRITES AVE LATENCY (MSEC)	I/O DB READS/SEC	I/O DB WRITES/ SEC	I/O DB READS AVE BYTES	I/O DB WRITES AVE BYTES	READS LATENCY (MSEC)	WRITES LATENCY (MSEC)	I/O LOG READS/ SEC	I/O LOG WRITES/ SEC	I/O LOG READS AVE BYTES	I/O LOG WRITES AVE BYTES
Instance2292.1	11.095	13.023	1740.006	826.934	32815.863	33957.325	0.000	3.419	0.000	181.093	0.000	11453.39
Instance2292.2	11.199	12.807	1737.118	827.383	32815.580	33964.903	0.000	3.414	0.000	182.629	0.000	11408.85

Background Database Maintenance I/O Performance

MSEXCHANGE DATABASE ==> INSTANCES	DATABASE MAINTENANCE IO READS/SEC	DATABASE MAINTENANCE IO READS AVERAGE BYTES
Instance2292.1	20.836	261829.467
Instance2292.2	21.385	261831.710

Log Replication I/O Performance

MSEXCHANGE DATABASE ==> INSTANCES	I/O LOG READS/SEC	I/O LOG READS AVERAGE BYTES
Instance2292.1	8.767	232561.156
Instance2292.2	8.807	232560.661

Total I/O Performance

MSEXCHANGE DB ==> INSTANCES	I/O DB		I/O DB			I/O LOG		I/O LOG				
	READS AVE LATENCY (MSEC)	WRITES AVE LATENCY (MSEC)	I/O DB READS/SEC	I/O DB WRITES/ SEC	I/O DB READS AVE BYTES	I/O DB WRITES AVE BYTES	READS LATENCY (MSEC)	WRITES LATENCY (MSEC)	I/O LOG READS/ SEC	I/O LOG WRITES/ SEC	I/O LOG READS AVE BYTES	I/O LOG WRITES AVE BYTES
Instance2292.1	11.095	13.023	1760.843	826.934	35525.836	33957.325	2.943	3.419	8.767	181.093	232561.16	11453.39
Instance2292.2	11.199	12.807	1758.503	827.383	35600.579	33964.903	2.915	3.414	8.807	182.629	232560.661	11408.849

Host System Performance

COUNTER	AVERAGE	MINIMUM	MAXIMUM
% Processor Time	32.387	12.643	38.837
Available MBytes	30101.151	30048.000	30132.000
Free System Page Table Entries	33561574.532	33561200.000	33561752.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	121901118.665	121774080.000	122089472.000
Pool Paged Bytes	135252362.503	134090752.000	174931968.000
Database Page Fault Stalls/sec	0.142	0.000	71.691

Test Log

Test Log 3/8/2011 4:17:22 PM -- Jetstress testing begins ...
 3/8/2011 4:17:22 PM -- Prepare testing begins ...
 3/8/2011 4:17:24 PM -- Attaching databases ...
 3/8/2011 4:17:24 PM -- Prepare testing ends.
 3/8/2011 4:17:24 PM -- Dispatching transactions begins ...
 3/8/2011 4:17:24 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
 3/8/2011 4:17:24 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
 3/8/2011 4:17:27 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 3/8/2011 4:17:27 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 3/8/2011 4:17:29 PM -- Operation mix: Sessions 40, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/8/2011 4:17:29 PM -- Performance logging begins (interval: 15000 ms).
 3/8/2011 4:17:29 PM -- Attaining prerequisites:
 3/8/2011 4:18:55 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 485785600.0 (lower bound: 483183800.0, upper bound: none)
 3/9/2011 4:18:56 PM -- Performance logging ends.
 3/9/2011 4:18:56 PM -- JetInterop batch transaction stats: 3489068 and 3494284.
 3/9/2011 4:18:56 PM -- Dispatching transactions ends.
 3/9/2011 4:18:56 PM -- Shutting down databases ...
 3/9/2011 4:18:59 PM -- Instance2292.1 (complete) and Instance2292.2 (complete)
 3/9/2011 4:18:59 PM -- C:\Exchange\7120_5k_i\24hr-stress\Stress_2011_3_8_16_17_27.blg has 5757 samples.
 3/9/2011 4:18:59 PM -- Creating test report ...
 3/9/2011 4:19:24 PM -- Instance2292.1 has 11.1 for I/O Database Reads Average Latency.

Database Checksum Result Report

Checksum Statistics - All

DATABASE	SEEN PAGES	BAD PAGES	CORRECTABLE PAGES	WRONG PAGE-NUMBER PAGES	FILE LENGTH / SECONDS TAKEN
M:\db1\Jetstress001001.edb	45240658	0	0	0	1413770 MBytes / 22984 sec
N:\db2\Jetstress002001.edb	45250642	0	0	0	1414082 MBytes / 22472 sec
(Sum)	90491300	0	0	0	2827853 MBytes / 22984 sec

Disk Subsystem Performance (of checksum)

LOGICALDISK	AVG. DISK SEC/READ	AVG. DISK SEC/WRITE	DISK READS/SEC	DISK WRITES/SEC	AVG. DISK BYTES/READ
M:	0.051	0.000	982.519	0.000	65536.000
N:	0.051	0.000	1005.664	0.000	65536.000

Memory System Performance (of checksum)

COUNTER	AVERAGE	MINIMUM	MAXIMUM
% Processor Time	19.821	14.286	30.312
Available MBytes	30618.318	30602.000	30629.000
Free System Page Table Entries	33561930.664	33561527.000	33562721.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	121753519.686	121716736.000	122138624.000
Pool Paged Bytes	136955162.437	136757248.000	137416704.000

Test Log

Test Log 3/8/2011 4:17:22 PM -- Jetstress testing begins ...
 3/8/2011 4:17:22 PM -- Prepare testing begins ...
 3/8/2011 4:17:24 PM -- Attaching databases ...
 3/8/2011 4:17:24 PM -- Prepare testing ends.
 3/8/2011 4:17:24 PM -- Dispatching transactions begins ...
 3/8/2011 4:17:24 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
 3/8/2011 4:17:24 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
 3/8/2011 4:17:27 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 3/8/2011 4:17:27 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 3/8/2011 4:17:29 PM -- Operation mix: Sessions 40, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/8/2011 4:17:29 PM -- Performance logging begins (interval: 15000 ms).
 3/8/2011 4:17:29 PM -- Attaining prerequisites:
 3/8/2011 4:18:55 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 485785600.0 (lower bound: 483183800.0, upper bound: none)
 3/9/2011 4:18:56 PM -- Performance logging ends.
 3/9/2011 4:18:56 PM -- JetInterop batch transaction stats: 3489068 and 3494284.
 3/9/2011 4:18:56 PM -- Dispatching transactions ends.

3/9/2011 4:18:56 PM -- Shutting down databases ...
3/9/2011 4:18:59 PM -- Instance2292.1 (complete) and Instance2292.2 (complete)
3/9/2011 4:18:59 PM -- C:\Exchange\7120_5k_i\24hr-stress\Stress_2011_3_8_16_17_27.blg has 5757 samples.
3/9/2011 4:18:59 PM -- Creating test report ...
3/9/2011 4:19:24 PM -- Instance2292.1 has 11.1 for I/O Database Reads Average Latency.
3/9/2011 4:19:24 PM -- Instance2292.1 has 3.4 for I/O Log Writes Average Latency.
3/9/2011 4:19:24 PM -- Instance2292.1 has 3.4 for I/O Log Reads Average Latency.
3/9/2011 4:19:24 PM -- Instance2292.2 has 11.2 for I/O Database Reads Average Latency.
3/9/2011 4:19:24 PM -- Instance2292.2 has 3.4 for I/O Log Writes Average Latency.
3/9/2011 4:19:24 PM -- Instance2292.2 has 3.4 for I/O Log Reads Average Latency.
3/9/2011 4:19:24 PM -- Test has 71.6914789832562 Maximum Database Page Fault Stalls/sec.
3/9/2011 4:19:24 PM -- Test has 539 Database Page Fault Stalls/sec samples higher than 0.
3/9/2011 4:19:24 PM -- C:\Exchange\7120_5k_i\24hr-stress\Stress_2011_3_8_16_17_27.xml has 5751 samples queried.
3/9/2011 4:19:25 PM -- C:\Exchange\7120_5k_i\24hr-stress\Stress_2011_3_8_16_17_27.html is saved.
3/9/2011 4:19:25 PM -- Performance logging begins (interval: 30000 ms).
3/9/2011 4:19:25 PM -- Verifying database checksums ...
3/9/2011 10:42:29 PM -- M: (100% processed) and N: (100% processed)
3/9/2011 10:42:30 PM -- Performance logging ends.
3/9/2011 10:42:30 PM -- C:\Exchange\7120_5k_i\24hr-stress\DBChecksum_2011_3_9_16_19_25.blg has 765 samples.

Test Log 3/1/2011 3:28:30 PM -- Jetstress testing begins ...
3/1/2011 3:28:30 PM -- Prepare testing begins ...
3/1/2011 3:28:33 PM -- Attaching databases ...
3/1/2011 3:28:33 PM -- Prepare testing ends.
3/1/2011 3:28:37 PM -- Performance logging begins (interval: 30000 ms).
3/1/2011 3:28:37 PM -- Backing up databases ...
3/2/2011 6:54:18 PM -- Performance logging ends.
3/2/2011 6:54:18 PM -- Instance2292.1 (100% processed) and Instance2292.2 (100% processed)
3/2/2011 6:54:18 PM -- C:\Exchange\7120_5k_i\database-backup\DatabaseBackup_2011_3_1_15_28_33.blg has 3288 samples.
3/2/2011 6:54:18 PM -- Creating test report ...

Soft Recovery Test Result Report

Test Summary

Overall Test Result	Pass
Machine Name	AIE-4240A
Test Description	Soft Recovery - 5,000 .5 GB Mailboxes, 2 Copies
Test Start Time	3/1/2011 3:11:04 PM
Test End Time	3/1/2011 3:19:43 PM
Collection Start Time	3/1/2011 3:11:25 PM
Collection End Time	3/1/2011 3:19:26 PM
Jetstress Version	14.01.0180.003
Ese Version	14.00.0639.019
Operating System	Windows Server (R) 2008 Enterprise without Hyper-V Service Pack 2 (6.0.6002.131072)
Performance Log	C:\Exchange\7120_5k_!\soft-recovery\Performance_2011_3_1_15_11_9.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	5126.114
Target Transactional I/O per Second	5000
Initial Database Size (bytes)	2820305715200
Final Database Size (bytes)	2820934860800
Database Files (Count)	2

Jetstress System Parameters

Thread Count	40 (per database)
Minimum Database Cache	64.0 MB
Maximum Database Cache	512.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance2292.1 Log Path: O:\log1
 Database: M:\db1\Jetstress001001.edb

Instance2292.2 Log Path: P:\log2
 Database: N:\db2\Jetstress002001.edb

Transactional I/O Performance

MSEXCHANGE DB ==> INSTANCES	I/O DB		I/O DB			I/O LOG		I/O LOG		I/O LOG		I/O LOG	
	READS AVE LATENCY (MSEC)	WRITES AVE LATENCY (MSEC)	I/O DB READS/SEC	I/O DB WRITES/ SEC	I/O DB READS AVE BYTES	I/O DB WRITES AVE BYTES	READS AVE LATENCY (MSEC)	WRITES AVE LATENCY (MSEC)	I/O LOG READS/ SEC	I/O LOG WRITES/ SEC	I/O LOG READS AVE BYTES	I/O LOG WRITES AVE BYTES	
Instance2292.1	9.273	12.176	1737.137	837.901	32793.005	34055.382	0.000	3.287	0.000	188.968	0.000	11165.06	
Instance2292.2	9.458	12.195	1720.796	830.280	32796.796	34054.646	0.000	3.268	0.000	191.132	0.000	11036.9	
Instance880.3	14.872	21.497	290.859	194.964	32811.611	34315.060	0.000	0.936	0.000	100.405	0.000	5010.020	

Host System Performance

COUNTER	AVERAGE	MINIMUM	MAXIMUM
% Processor Time	32.848	16.494	39.174
Available MBytes	30015.030	29945.000	30395.000
Free System Page Table Entries	33559564.576	33559415.000	33559969.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	118756196.848	118628352.000	118878208.000
Pool Paged Bytes	128508524.606	127553536.000	128577536.000
Database Page Fault Stalls/sec	0.114	0.000	2.197

Test Log

Test Log 3/1/2011 3:11:04 PM -- Jetstress testing begins ...
 3/1/2011 3:11:04 PM -- Prepare testing begins ...
 3/1/2011 3:11:07 PM -- Attaching databases ...
 3/1/2011 3:11:07 PM -- Prepare testing ends.
 3/1/2011 3:11:07 PM -- Dispatching transactions begins ...
 3/1/2011 3:11:07 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
 3/1/2011 3:11:07 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
 3/1/2011 3:11:09 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 3/1/2011 3:11:09 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 3/1/2011 3:11:10 PM -- Operation mix: Sessions 40, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/1/2011 3:11:10 PM -- Performance logging begins (interval: 15000 ms).
 3/1/2011 3:11:10 PM -- Generating log files ...

3/1/2011 3:19:40 PM -- O:\log1 (100.2% generated) and P:\log2 (100.2% generated)
3/1/2011 3:19:40 PM -- Performance logging ends.
3/1/2011 3:19:40 PM -- JetInterop batch transaction stats: 20768 and 20725.
3/1/2011 3:19:40 PM -- Dispatching transactions ends.
3/1/2011 3:19:40 PM -- Shutting down databases ...
3/1/2011 3:19:43 PM -- Instance2292.1 (complete) and Instance2292.2 (complete)
3/1/2011 3:19:43 PM -- C:\Exchange\7120_5k_!\soft-recovery\Performance_2011_3_1_15_11_9.blg has 33 samples.
3/1/2011 3:19:43 PM -- Creating test report ...
3/1/2011 3:19:43 PM -- Instance2292.1 has 9.3 for I/O Database Reads Average Latency.
3/1/2011 3:19:43 PM -- Instance2292.1 has 3.3 for I/O Log Writes Average Latency.
3/1/2011 3:19:43 PM -- Instance2292.1 has 3.3 for I/O Log Reads Average Latency.
3/1/2011 3:19:43 PM -- Instance2292.2 has 9.5 for I/O Database Reads Average Latency.
3/1/2011 3:19:43 PM -- Instance2292.2 has 3.3 for I/O Log Writes Average Latency.
3/1/2011 3:19:43 PM -- Instance2292.2 has 3.3 for I/O Log Reads Average Latency.
3/1/2011 3:19:43 PM -- Test has 2.19664162198782 Maximum Database Page Fault Stalls/sec.
3/1/2011 3:19:43 PM -- Test has 2 Database Page Fault Stalls/sec samples higher than 0.
3/1/2011 3:19:43 PM -- C:\Exchange\7120_5k_!\soft-recovery\Performance_2011_3_1_15_11_9.xml has 32 samples queried.

Database Backup Test Result Report

Database Backup Statistics - All

DATABASE INSTANCE	DATABASE SIZE (MBYTES)	ELAPSED BACKUP TIME	MBYTES TRANSFERRED/SEC
Instance2292.1	1345090.59	03:25:41	13.62
Instance2292.2	1345146.59	03:06:59	13.78

Jetstress System Parameters

Thread Count	40 (per database)
Minimum Database Cache	64.0 MB
Maximum Database Cache	512.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance2292.1	Log Path: O:\log1 Database: M:\db1\Jetstress001001.edb
Instance2292.2	Log Path: P:\log2 Database: N:\db2\Jetstress002001.edb

Transactional I/O Performance

MSEXCHANGE DB => INSTANCES	I/O DB		I/O DB			I/O DB		I/O LOG		I/O LOG		I/O LOG	
	READS AVE LATENCY (MSEC)	WRITES AVE LATENCY (MSEC)	I/O DB READS/SEC	I/O DB WRITES/ SEC	I/O DB READS AVE BYTES	I/O DB WRITES AVE BYTES	READS AVE LATENCY (MSEC)	WRITES AVE LATENCY (MSEC)	I/O LOG READS/ SEC	I/O LOG WRITES/ SEC	I/O LOG READS AVE BYTES	I/O LOG WRITES AVE BYTES	
Instance2292.1	30.760	0.000	54.483	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Instance2292.2	30.091	0.000	55.107	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Instance880.3	50.175	0.000	32.997	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Instance880.4	48.194	0.000	33.982	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	4.084	1.960	9.506
Available MBytes	30534.315	30403.000	30691.000
Free System Page Table Entries	33560149.527	33559410.000	33560932.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	120219411.309	120119296.000	120508416.000
Pool Paged Bytes	129394633.187	127614976.000	170422272.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

Test Log 3/1/2011 3:28:30 PM -- Jetstress testing begins ...
3/1/2011 3:28:30 PM -- Prepare testing begins ...
3/1/2011 3:28:33 PM -- Attaching databases ...
3/1/2011 3:28:33 PM -- Prepare testing ends.
3/1/2011 3:28:37 PM -- Performance logging begins (interval: 30000 ms).
3/1/2011 3:28:37 PM -- Backing up databases ...
3/2/2011 6:54:18 PM -- Performance logging ends.
3/2/2011 6:54:18 PM -- Instance2292.1 (100% processed) and Instance2292.2 (100% processed)
3/2/2011 6:54:18 PM -- C:\Exchange\7120_5k_i\database-backup\DatabaseBackup_2011_3_1_15_28_33.blg has 3288 samples.
3/2/2011 6:54:18 PM -- Creating test report ...



Sun ZFS Storage 7120 Appliance 5,000
Mailbox Resiliency Exchange 2010 Storage
Solution

July 2011 Version 1.0

Author: Joe Pichette

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200

oracle.com



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Hardware and Software, Engineered to Work Together