

Hitachi Adaptable Modular Storage 2300 Dynamically Provisioned 11,600 Mailbox Exchange 2010 Mailbox Resiliency Storage Solution

Tested with: ESRP – Storage Version 3.0

Test Date: June 2010

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Overview

This document provides information on a Hitachi Adaptable Modular Storage 2300 Mailbox Resiliency storage solution using Hitachi Dynamic Provisioning for Microsoft Exchange Server 2010. This solution is based on the Microsoft Exchange Solution Reviewed Program (ESRP) – Storage program. For more information about the contents of this document or Hitachi Data Systems best practice recommendations for Microsoft Exchange Server 2010 storage design, see Hitachi Data Systems Microsoft Exchange Solutions Web page.

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 information about the Microsoft ESRP – Storage program, see TechNet's overview of the program.

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Features

The purpose of this testing was to measure the ESRP 3.0 results on a Microsoft Exchange 2010 environment with 11,600 users and eight servers. This testing used a Hitachi Adaptable Modular Storage 2300 (AMS 2300) storage system using Hitachi Dynamic Provisioning in a two-pool RAID-10 (2D+2D) configuration (one for databases and one for logs) in a resiliency configuration.. These results help answer questions about the kind of performance capabilities to expect with a large-scale Exchange deployment on an AMS 2300.

Testing used eight Sun Fire 4270 servers, each with the following:

- 32GB of RAM
- Two quad-core Intel E5540 2.53GHz CPUs
- Two Emulex 4Gb/sec Fibre Channel adapters
- Microsoft Windows Server 2008 R2 Enterprise

This solution includes Exchange 2010 Mailbox Resiliency by using the Database Availability Group (DAG) feature. This tested configuration uses eight DAGs, each containing two database copies and two servers (one simulated). The test configuration was capable of supporting 11,600 users with a 0.18 IOPS per user profile and user mailbox size of 3GB.

An AMS 2300 with the following was used for these tests:

- 240 450GB 15k RPM SAS disks
- 16GB of cache
- Eight 4Gb/sec paths

Hitachi Adaptable Modular Storage 2300 is a high-performance, highly reliable midrange storage system that can scale to 240 disks while maintaining 99.999% availability. It is highly suitable for a variety of applications and host platforms and is modular in scale. With the option of in-system and cross-system replication functionality, AMS 2300 is fully capable of being used as the core underlying storage platform for high-performance Exchange Server 2010 architectures.

Solution Description

Deploying Microsoft Exchange Server 2010 requires careful consideration of all aspects of the solution architecture. Host servers need to be configured so that they are robust enough to handle the required Exchange load. The storage solution must be designed to provide the necessary performance while also being reliable and easy to administer. Of course, an effective backup and recovery plan should be incorporated into the solution as well. The aim of this solution report is to provide a tested configuration that uses an AMS 2300 to meet the needs of a large Exchange Server deployment.

This solution uses Hitachi Dynamic Provisioning, which is enabled on AMS 2300 via a license key. In the most basic sense, Hitachi Dynamic Provisioning is similar to the use of a host-based logical volume manager (LVM), but with several additional features available within AMS 2300 and without the need to install software on the host or incur host processing overhead. Hitachi Dynamic Provisioning is a superior solution by providing for one or more pools of wide striping across many RAID groups within an AMS 2300. One or more dynamic provisioning virtual volumes (DP-VOLs) of a user-specified logical size (with no initial physical space allocated) are created and associated with a single pool..

Primarily, Hitachi Dynamic Provisioning is deployed to avoid the routine issue of hot spots that occur on logical units (LUs) from individual RAID groups when the host workload exceeds the IOPS or throughput capacity of that RAID group. By using many RAID groups as members of a striped dynamic provisioning pool underneath the virtual or logical volumes seen by the hosts, a host workload will be distributed across many RAID groups which provides a smoothing effect that dramatically reduces hot spots and results in fewer mailbox moves for the Exchange administrator.

Hitachi Dynamic Provisioning also carries the side benefit of thin provisioning, where physical space is only assigned from the pool to the DP-VOL as needed using 1GB chunks, up to the logical size specified for each DP-VOL. A pool can also be dynamically expanded by adding more RAID groups without disruption or requiring downtime. Upon expansion a pool can easily be rebalanced so that the data and workload is wide striped evenly across the current and newly added RAID groups that make up the pool.

High availability is also a part of this solution with the use of the database availability group (DAG) feature, which is the base component of the high availability and site resilience framework built into Microsoft Exchange Server 2010. A DAG is a group of up to 16 mailbox servers that host a set of databases and logs and uses continuous replication to provide automatic database-level recovery from failures that affect individual servers or databases.

Any server in a DAG can host a copy of a mailbox database from any other server in the DAG. When a server is added to a DAG, it monitors and works with the other servers in the DAG to provide automatic recovery delivering a robust, highly-available Exchange solution without the administrative complexities of traditional failover clustering. For additional information about the DAG feature in Exchange Server 2010 see <http://technet.microsoft.com/en-us/library/dd979799.aspx>

This solution includes two copies of each Exchange database using eight DAGs, with each DAG configured with two servers (one simulated) to host active mailboxes in three databases.

To target the 11,600-user resiliency solution, a Hitachi Adaptable Modular Storage 2300 (AMS 2300) was configured with 240 disks. Eight servers (one per DAG) were used, with each server configured with 1,450 mailboxes. There were 24 active databases and the simulated database copies for the tests

Each DAG contained two copies of the five databases hosted by that DAG;

- A local, active copy on a server connected to the primary AMS 2300
- A passive copy (simulated) on another server connected to a second AMS 2300 (simulated)

This recommended configuration can support high-availability and disaster-recovery scenarios when the active and passive database copies are allocated among both DAG members and dispersed across both storage systems. Each simulated DAG server node in this solution maintains a mirrored configuration and possesses adequate capacity and performance capabilities to support the second set of replicated databases.

Figure 1 illustrates the two systems that make up the simulated DAG configuration. For more information, see the Hitachi Data Systems [Storage Systems web page](#).

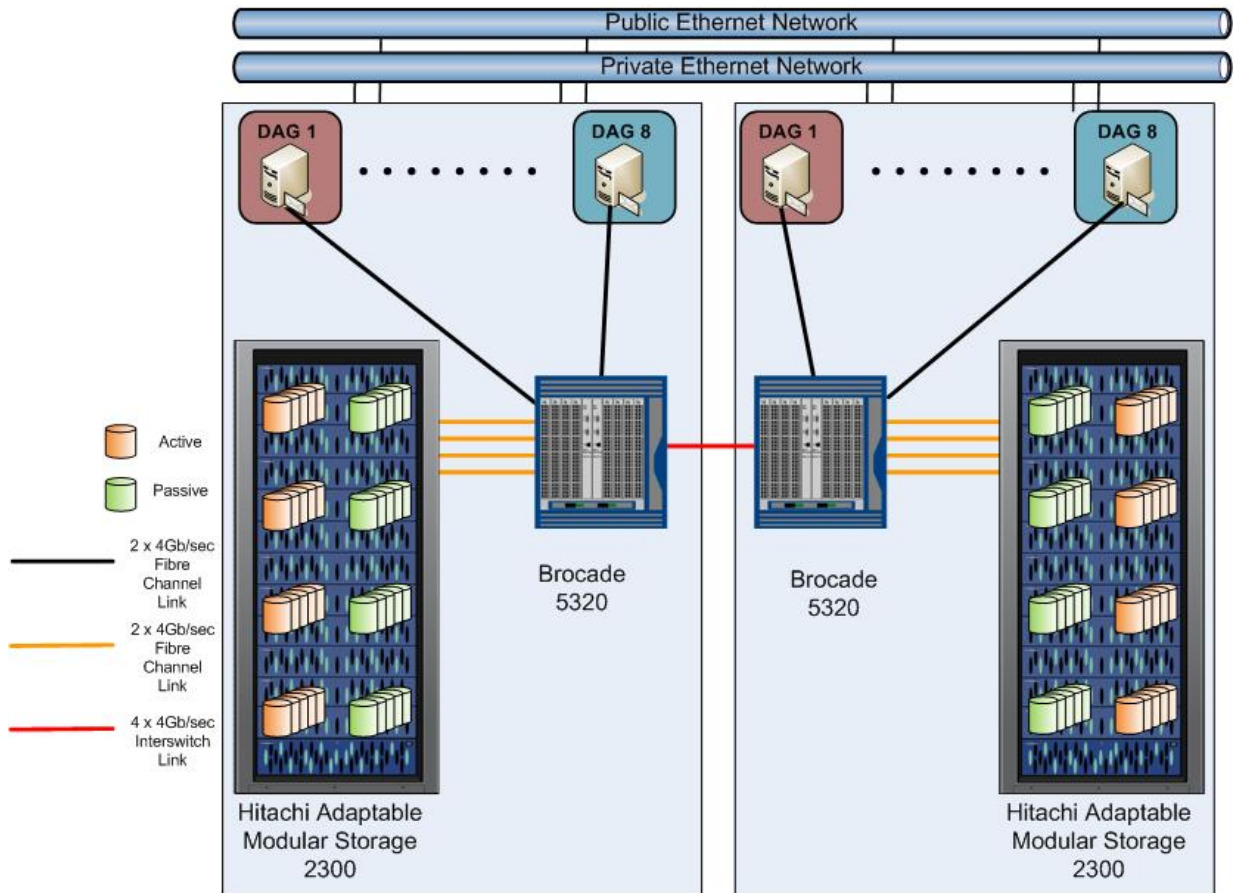


Figure 1

This solution enables organizations to consolidate Exchange Server 2010 DAG deployments on two AMS 2300 storage systems. Using identical hardware and software configurations guarantees that an active database and its replicated copy do not share storage paths, disk spindles or storage controllers, making it a very reliable, high-performing, highly available Exchange Server 2010 solution that is cost effective and easy to manage. This helps ensure that performance and service levels related to storage are maintained regardless of which server is hosting the active database. If further protection is needed in a production environment, additional Exchange Server 2010 mailbox servers can be easily added to support these failover scenarios.

Table 1 illustrates how the disks in an AMS 2300 were organized into RAID groups for use by the databases or logs. Each set of colored disks represents a RAID-10 (2D+2D) group. Except for RKA-0 (with 15 internal SAS disks), each RKA is an external disk enclosure with 15 SAS disks. There were 240 disks used in these tests configured as 60 RAID groups, using RAID-10 2D+2D, for the Exchange databases and logs.

Table 1. Adaptable Modular Storage 2300 RAID Groups by RKA Tray Layout

Drive Slot #:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RKA 15	56	56	56	57	57	57	57	58	58	58	58	59	59	59	59
RKA 14	52	52	53	53	53	53	54	54	54	54	55	55	55	55	56
RKA 13	48	49	49	49	49	50	50	50	50	51	51	51	51	52	52
RKA 12	45	45	45	45	46	46	46	46	47	47	47	47	48	48	48
RKA 11	41	41	41	42	42	42	42	43	43	43	43	44	44	44	44
RKA 10	37	37	38	38	38	38	39	39	39	39	40	40	40	40	41
RKA 9	33	34	34	34	34	35	35	35	35	36	36	36	36	37	37
RKA 8	30	30	30	30	31	31	31	31	32	32	32	32	33	33	33
RKA 7	26	26	26	27	27	27	27	28	28	28	28	29	29	29	29
RKA 6	22	22	23	23	23	23	24	24	24	24	25	25	25	25	26
RKA 5	18	19	19	19	19	20	20	20	20	21	21	21	21	22	22
RKA 4	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18
RKA 3	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14
RKA 2	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11
RKA 1	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7
RKA 0	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3



Two dynamic provisioning pools were created, one for the databases and the other for the logs. The database pool was created from 54 RAID-10 (2D+2D) RAID groups and the log pool was created from six RAID-10 (2D+2D) RAID groups. From the database pool, 24 DP-VOLs (each specified to have a 1,750GB size limit) were created for 24 Database (three per server). From the log pool, 24 DP-VOLs (each specified to have a size limit of 175GB) were created for 24 Logs (three per server).

Table 2 outlines the port layout for the primary storage and servers. An identical configuration would be deployed on the replicated storage and servers for this solution.

Table 2. Adaptable Modular Storage 2300 Port to Server Layout

Server	Primary path	Secondary path
SUN170	0A	1A
SUN169	0B	1B
SUN164	0C	1C
SUN163	0D	1D
SUN161	1A	0A
SUN160	1B	0B
SUN159	1C	0C
SUN158	1D	0D

Table 3 outlines the port layout with the database DP-VOL assignments for the primary storage and servers. An identical configuration would be deployed on the replicated storage and servers for this solution.

Table 3. Adaptable Modular Storage 2300 Port to Database DP-VOL Layout

Port	Database	DP-VOL
0A	1-3	0-2
0B	4-6	3-5
0C	7-9	6-8
0D	10-12	9-11
1A	13-15	12-14
1B	16-18	15-17
1C	19-21	18-20
1D	22-24	21-23

Table 4 outlines the port layout with the database DP-VOL assignments for the primary storage and servers. An identical configuration would be deployed on the replicated storage and servers for this solution.

Table 4. Adaptable Modular Storage 2300 Port to Log DP-VOL Layout

Port	Log	DPVOL
0A	1-3	24-26
0B	4-6	27-29
0C	7-9	30-32
0D	10-12	33-35
1A	13-15	36-38
1B	16-18	39-41
1C	19-21	42-44
1D	22-24	45-47

Table 5 provides the detailed specifications for the storage configuration which uses RAID-10 (2D+2D) groups and 450GB 15K disks. Dynamic provisioning pool 0 is dedicated for the database and dynamic provisioning pool 1 is dedicated for the logs.

Table 5. Adaptable Modular Storage 2300 Configuration Details

Host	HDP POOL	Port	LU	Size (GB)	RAID Level	RAID Type	Disk Spec	Description
SUN170	0	0A/1A	0 - 2	1750	RAID-10	2+2	450GB 15K	Databases 1-3
SUN169	0	0B/1B	3 - 5	1750	RAID-10	2+2	450GB 15K	Databases 4-6
SUN164	0	0C/1C	6 - 8	1750	RAID-10	2+2	450GB 15K	Databases 7-9
SUN163	0	0D/1D	9 - 11	1750	RAID-10	2+2	450GB 15K	Databases 10-12
SUN161	0	1A/0A	12 - 14	1750	RAID-10	2+2	450GB 15K	Databases 13-15
SUN160	0	1B/0B	15 - 17	1750	RAID-10	2+2	450GB 15K	Databases 16-18
SUN159	0	1C/0C	18 - 20	1750	RAID-10	2+2	450GB 15K	Databases 19-21
SUN158	0	1D/0D	20 - 23	1750	RAID-10	2+2	450GB 15K	Databases 22-24
SUN170	1	0A/1A	24 - 26	175	RAID-10	2+2	450GB 15K	Logs 1-3
SUN169	1	0B/1B	27 - 29	175	RAID-10	2+2	450GB 15K	Logs 4-6
SUN164	1	0C/1C	30 - 32	175	RAID-10	2+2	450GB 15K	Logs 7-9
SUN163	1	0D/1D	33 - 35	175	RAID-10	2+2	450GB 15K	Logs 10-12
SUN161	1	1A/0A	36 - 38	175	RAID-10	2+2	450GB 15K	Logs 13-15
SUN160	1	1B/0B	39 - 41	175	RAID-10	2+2	450GB 15K	Logs 16-18
SUN159	1	1C/0C	42 - 44	175	RAID-10	2+2	450GB 15K	Logs 19-21
SUN158	1	1D/0D	45 - 47	175	RAID-10	2+2	450GB 15K	Logs 22-24

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. These factors also affect server scalability:

- 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

These factors are all beyond the scope of the ESRP – Storage program. Therefore, the number of mailboxes hosted per server as part of the tested configuration might not necessarily be viable for some customer deployments.

For more information about identifying and addressing performance bottlenecks in an Exchange system, see Microsoft's [Troubleshooting Microsoft Exchange Server Performance](#).

Targeted Customer Profile

This solution is designed for medium to large organizations that plan to consolidate their Exchange Server 2010 storage on high-performance, high-reliability storage systems. This configuration is designed to support 11,600 Exchange users with the following specifications:

- 16 Exchange servers (eight servers tested, eight servers simulated for the database copies)
- 8 Database Availability Groups each with two servers (one simulated) and two copies per database
- 2 Adaptable Modular Storage 2300s (one tested, using 8 8Gb/sec paths operated at 4Gbps)
- 0.15 IOPS per user(0.18 tested for 20 percent growth)
- 3GB mailbox size
- Mailbox resiliency provides high-availability and used as primary data protection mechanism.
- Adaptable Modular Storage RAID protection against physical failure or loss.
- 24x7 background database maintenance enabled

Tested Deployment

The following tables summarize the testing environment.

Table 6. Simulated Exchange Configuration

Number of Exchange mailboxes simulated	11,600
Number of database availability groups (DAGs)	8
Number of servers per DAG	2 (1 simulated)
Number of active mailboxes per server	1,450
Number of databases per host	3
Number of copies per database	2
Number of mailboxes per database	483
Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)	0.18
Database LU size	1750GB
Log LU size	175GB
Total database size for performance testing	34,800GB
% storage capacity used by Exchange database**	80.8%

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

Table 7. Primary Storage Hardware

Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	Fibre Channel
Storage model and OS/firmware revision	1 Hitachi Adaptable Modular Storage 2300 Firmware: 0890/B-Y WHQL listing: HDS AMS2300
Storage cache	16GB
Number of storage controllers	2
Number of storage ports	8
Maximum bandwidth of storage connectivity to host	32Gb/sec (8 x 4Gb/sec ports)
Switch type/model/firmware revision	Brocade 5320, Fabric OS v6.3.0b
HBA model and firmware	Emulex LPe11002, FW:2.82A3
Number of HBAs per host	2 dual-ported HBA per host, 1 4Gb/sec port used per HBA
Host server type	Sun Fire 4270 2 2.54 GHz quad-core Intel Xeon CPUs, 32 GB memory
Total number of disks tested in solution	240
Maximum number of spindles can be hosted in the storage	240

Table 8. Primary Storage Software

HBA Driver	STOR Miniport 7.2.0.12
HBA QueueTarget Setting	0
HBA QueueDepth Setting	32
Multipathing	Hitachi Dynamic Link Manager v6.2.0
Host OS	Microsoft Windows Server 2008 R2 Enterprise
ESE.dll file version	14.00.0639.019
Replication solution name/version	N/A

Table 9. Storage Disk Configuration (Mailbox Store Disks)

Disk type, speed and firmware revision	SAS 4540GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of physical disks in test	216 (dynamic provisioning pool)
Total raw storage capacity (GB)	97,200GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID-10(2D+2D) at storage level
Total formatted capacity	34,474GB (dynamic provisioning database pool)
Storage capacity utilization	44.3%
Database capacity utilization	43.2%

Table 10. Primary Storage Disk Configuration (Transaction Log Disks)

Disk type, speed and firmware revision	SAS 4540GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of spindles in test	24 (dynamic provisioning pool)
Total raw storage capacity (GB)	10,800GB
Disk slice size (GB)	N/A
Number of slices per LU or number of disks per LU	N/A
RAID level	RAID-10 (2D+2D) at storage level
Total formatted capacity	3,830GB

Replication Configuration

The following tables summarize the replication environment.

Table 11. Replicated Configuration

Replication mechanism	Exchange Server 2010 Database Availability Group (DAG)
Number of links	2
Simulated link distance	N/A
Link type	IP
Link bandwidth	GigE (1Gb/sec)

Table 12. Replicated Storage Hardware

Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	Fibre Channel
Storage model and OS/firmware revision	1 Hitachi Adaptable Modular Storage 2300 Firmware: 0890/B-Y WHQL listing: HDS AMS2300
Storage cache	16GB
Number of storage controllers	2
Number of storage ports	8
Maximum bandwidth of storage connectivity to host	32Gb/sec (8 x 4Gb/sec ports)
Switch type/model/firmware revision	Brocade 5320, Fabric OS v6.3.0b
HBA model and firmware	Emulex LPe11002, FW:2.82A3
Number of HBAs per host	2 dual-ported HBA per host, 1 4Gb/sec port used per HBA
Host server type	Sun Fire 4270 2 2.54 GHz quad-core Intel Xeon CPUs, 32 GB memory
Total number of disks tested in solution	240
Maximum number of spindles can be hosted in the storage	240

Table 13. Replicated Storage Software

HBA Driver	STOR Miniport 7.2.0.12
HBA QueueTarget Setting	0
HBA QueueDepth Setting	32
Multipathing	Hitachi Dynamic Link Manager v6.2.0
Host OS	Microsoft Windows Server 2008 R2 Enterprise
ESE.dll file version	14.00.0639.019
Replication solution name/version	Exchange Server 2010 Database Availability Group (DAG)

Table 14. Replicated Storage Disk Configuration (Mailbox Store Disks)

Disk type, speed and firmware revision	SAS 4540GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of physical disks in test	216 (dynamic provisioning pool)
Total raw storage capacity (GB)	97,200 GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID-10(2D+2D) at storage level
Total formatted capacity	34,474GB (dynamic provisioning database pool)
Storage capacity utilization	44.3%
Database capacity utilization	43.2%

Table 15. Replicated Storage Disk Configuration (Transaction Log Disks)

Disk type, speed and firmware revision	SAS 4540GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of spindles in test	24 (dynamic provisioning pool)
Total raw storage capacity (GB)	10,800GB
Disk slice size (GB)	N/A
Number of slices per LU or number of disks per LU	N/A
RAID level	RAID-10 (2D+2D) at storage level
Total formatted capacity	3,830GB

Best Practices

Microsoft Exchange Server 2010 is a disk-intensive application. It presents two distinct workload patterns to the storage, with 32KB random read/write operations to the databases, and sequential write operations of varying size (between 512 bytes up to the log buffer size) to the transaction logs. For this reason, designing an optimal storage configuration can prove challenging in practice. Based on the testing run using the ESRP framework, Hitachi Data Systems recommends these best practices to improve the performance of the Hitachi Adaptable Modular Storage 2300 running Exchange 2010.

For more information about Exchange 2010 best practices for storage design, see the Microsoft TechNet article “Mailbox Server Storage Design.”

Core Storage

1. When formatting a newly partitioned LU, Hitachi Data Systems recommends setting the ALU to 64K for the database files and 4K for the log files.
2. Disk alignment is no longer required when using Microsoft Windows Server 2008.
3. Keep the Exchange workload isolated from other applications. Mixing another I/O intensive application whose workload differs from Exchange can cause the performance for both applications to degrade.
4. Use Hitachi Dynamic Link Manager Multipathing software to provide fault tolerance and high availability for host connectivity.
5. Use Hitachi Dynamic Provisioning to simplify storage management of the Exchange database and log volumes.
6. Due to the difference in I/O patterns, isolate the Exchange database from the log groups. Create a dedicated Dynamic Provisioning pool for the databases and a separate pool for the logs.
7. Hitachi Data Systems recommends RAID-5 or RAID-10 groups for both the database pools and for the log pool. Use of RAID-10 allows more writes at a lower response time under heavier loads. RAID-10 also supports a shorter RAID group rebuild time on failure of a disk.
8. The log LUs should be at least 10 percent of the size of the database LUs.
9. Hitachi Data Systems does not recommend using LU concatenation.
10. Hitachi Data Systems recommends implementing Mailbox Resiliency using the Exchange Server 2010 Database Availability Group feature.
11. Ensure that each DAG maintains at least two database copies to provide high availability.
12. Isolate active databases and their replicated copies in separate Dynamic Provisioning pools or ensure that they are located on a separate 2300.
13. Use fewer, larger LUs for Exchange 2010 databases (up to 2TB) with Background Database Maintenance (24x7) enabled.
14. Size storage solutions for Exchange based primarily on performance criteria. The number of disks, RAID level and percent utilization of each disk directly affect the level of achievable performance. Factor in capacity requirements only after performance is addressed.

15. Disk size is unrelated to performance with regards to IOPS or throughput rates. Disk size is related to the usable capacity of all of the LUs from a RAID group, which is a choice users make.
16. The number of spindles, coupled with the RAID level, determines the physical IOPS capacity of the RAID group and all of its LUs. If the disk has too few spindles, the response times grow to large values very quickly.

Storage-based Replication

N/A

Backup Strategy

N/A

Test Result Summary

This section provides a high-level summary of the test data from ESRP and the link to the detailed HTML reports that are generated by ESRP testing framework.

Reliability

A number of tests in the framework check reliability spanning a 24-hour window. The goal is to verify the storage can handle high I/O load for a long period of time. Following these stress tests, both log and database files are analyzed for integrity to ensure that no database or log corruption occurs.

- No errors were reported in the event log file for the storage reliability testing
- No errors were reported for the [database](#) and [log](#) checksum process
- Backup to disk test is N/A
- Database checksum on the remote storage database is N/A

Storage [Performance](#) Results

Primary storage performance testing exercises the storage with maximum sustainable Exchange type of I/O for two hours. The test shows how long it takes for the storage to respond to an I/O under load. The following data is the sum of all of the logical disk I/Os and average of all the logical disks I/O latency in the two-hour test duration.

Individual Server Metrics

Individual server metrics show the sum of I/Os across database and the average latency across all databases on a per-server basis.

Table 16. Individual Server Metrics for Exchange Server (SUN170)

Database I/O	
Database disk transfers per second	1231
Database disk reads per second	770
Database disk writes per second	461
Average database disk read latency (ms)	6.7
Average database disk write latency (ms)	2.9
Transaction Log I/O	
Log disk writes per second	263
Average log disk write latency (ms)	1.4

Table 17. Individual Server Metrics for Exchange Server (SUN169)

Database I/O	
Database disk transfers per second	692
Database disk reads per second	439
Database disk writes per second	253
Average database disk read latency (ms)	9.4
Average database disk write latency (ms)	4.0
Transaction Log I/O	
Log disk writes per second	194
Average log disk write latency (ms)	2.3

Table 18. Individual Server Metrics for Exchange Server (SUN164)

Database I/O	
Database disk transfers per second	718
Database disk reads per second	455
Database disk writes per second	263
Average database disk read latency (ms)	9.2
Average database disk write latency (ms)	3.7
Transaction Log I/O	
Log disk writes per second	203
Average log disk write latency (ms)	2.2

Table 19. Individual Server Metrics for Exchange Server (SUN163)

Database I/O	
Database disk transfers per second	1300
Database disk reads per second	814
Database disk writes per second	486
Average database disk read latency (ms)	6.4
Average database disk write latency (ms)	3.0
Transaction Log I/O	
Log disk writes per second	275
Average log disk write latency (ms)	1.3

Table 20. Individual Server Metrics for Exchange Server (SUN161)

Database I/O	
Database disk transfers per second	1344
Database disk reads per second	842
Database disk writes per second	502
Average database disk read latency (ms)	6.3
Average database disk write latency (ms)	2.9
Transaction Log I/O	
Log disk writes per second	291
Average log disk write latency (ms)	1.1

Table 21. Individual Server Metrics for Exchange Server (SUN160)

Database I/O	
Database disk transfers per second	862
Database disk reads per second	547
Database disk writes per second	315
Average database disk read latency (ms)	8.2
Average database disk write latency (ms)	2.8
Transaction Log I/O	
Log disk writes per second	253
Average log disk write latency (ms)	1.3

Table 22. Individual Server Metrics for Exchange Server (SUN159)

Database I/O	
Database disk transfers per second	719
Database disk reads per second	456
Database disk writes per second	263
Average database disk read latency (ms)	9.4
Average database disk write latency (ms)	5.2
Transaction Log I/O	
Log disk writes per second	210
Average log disk write latency (ms)	1.9

Table 23. Individual Server Metrics for Exchange Server (SUN158)

Database I/O	
Database disk transfers per second	1316
Database disk reads per second	825
Database disk writes per second	491
Average database disk read latency (ms)	6.4
Average database disk write latency (ms)	2.9
Transaction Log I/O	
Log disk writes per second	286
Average log disk write latency (ms)	1.1

Aggregate Performance Across All Servers Metrics

The aggregate performance across all server metrics shows the sum of I/Os across all servers in the solution and the average latency across all servers in the solution.

Table 24. Aggregate Performance for Exchange Server 2010

Database I/O	
Database disk transfers per second	8182
Database disk reads per second	5148
Database disk writes per second	3034
Average database disk read latency (ms)	7.7
Average database disk write latency (ms)	3.4
Transaction Log I/O	
Log disk writes per second	1975
Average log disk write latency (ms)	1.6

Database Backup and Recovery Performance

This section has two tests: The first measures the sequential read rate of the database files and the second measures 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. The following tables show the average rate for a single database file.

Table 25. Database Read-only Performance

MB read per second per database	63.4
MB read per second total per server	190.4

Transaction Log Recovery/Replay Performance

This test measures 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 Database. Each log file is 1MB in size.

Table 26. Transaction Log Recovery/Replay Performance

Average time to play one log file (sec)	1.2
---	-----

Conclusion

This document details a tested and robust Exchange Server 2010 Resiliency solution capable of supporting 11,600 users with a 0.18 IOPS per user profile and user mailbox size of 3GB using eight DAG's each configured with two server nodes (one simulated).

A Hitachi Adaptable Modular Storage 2300 (AMS 2300), with 16GB of cache and eight 4Gb/sec Fibre Channel host paths, using Hitachi Dynamic Provisioning (with two pools) and 240 450GB 15K RPM SAS disks in a RAID-10 (2D+2D) configuration was used for these tests.

Testing confirmed that an AMS 2300 is more than capable of delivering the IOPS and capacity requirements needed to support the active and replicated databases for 11,600 Exchange mailboxes configured with the specified user profile, while maintaining additional headroom to support peak throughput.

The solution outlined in this document does not include data protection components, such as VSS snapshot or clone backups, and relies on the built-in Mailbox Resiliency features of Exchange Server 2010 coupled with Adaptable Modular Storage RAID technology to provide high-availability and protection from logical and physical failures. Adding additional protection requirements may affect performance and capacity requirements of the underlying storage configuration, and as such need to be factored into the storage design accordingly.

For more information to about planning Exchange Server 2010 storage architectures for the Hitachi Adaptable Modular Storage 2000 family, see <http://www.hds.com/assets/pdf/hitachi-ams-2000-family.pdf>.

This document is developed by Hitachi Data Systems and reviewed by Microsoft Exchange Product team. The test results and data presented in this document are based on the tests introduced in the ESRP test framework. Do not quote the data directly for pre-deployment verification. It is still necessary to validate the storage design for a specific customer environment.

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

Appendix A – Test Reports

Performance Test Result: Sun170

Test Summary

Overall Test Result	Pass
Machine Name	SUN170
Test Description	
Test Start Time	6/25/2010 9:30:11 AM
Test End Time	6/25/2010 11:55:59 AM
Collection Start Time	6/25/2010 9:31:33 AM
Collection End Time	6/25/2010 11:31:27 AM
Jetstress Version	14.01.0043.000
Ese Version	14.00.0639.019
Operating System	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance Log	C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Performance\Performance_2010_6_25_9_30_18.blg C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Performance\DBCchecksum_2010_6_25_11_55_59.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1231.479
Target Transactional I/O per Second	261
Initial Database Size (bytes)	4670786568192
Final Database Size (bytes)	4673823244288
Database Files (Count)	3

Jetstress System Parameters

Thread Count	4 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 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

Instance2728.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance2728.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance2728.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.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
Instance2728.1	6.894	3.353	257.767	154.048	33186.216	35573.894	0.000	1.426	0.000	87.737	0.000	4829.824
Instance2728.2	6.657	2.777	255.415	152.879	33276.582	35576.658	0.000	1.418	0.000	87.705	0.000	4852.697
Instance2728.3	6.553	2.770	257.443	153.928	33234.492	35575.423	0.000	1.419	0.000	87.900	0.000	4851.972

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2728.1	29.925	261843.332
Instance2728.2	29.949	261897.671
Instance2728.3	30.128	261797.856

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2728.1	1.735	232550.542
Instance2728.2	1.743	232555.553
Instance2728.3	1.748	232562.772

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
Instance2728.1	6.894	3.353	287.693	154.048	56970.823	35573.894	2.406	1.426	1.735	87.737	232550.542	4829.824
Instance2728.2	6.657	2.777	285.363	152.879	57270.378	35576.658	2.493	1.418	1.743	87.705	232555.553	4852.697
Instance2728.3	6.553	2.770	287.571	153.928	57180.621	35575.423	2.571	1.419	1.748	87.900	232562.772	4851.972

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.078	0.000	4.885
Available MBytes	30017.404	30011.000	30047.000
Free System Page Table Entries	33555644.490	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	66388505.600	65691648.000	66666496.000
Pool Paged Bytes	97794491.733	97542144.000	97861632.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log6/25/2010 9:30:11 AM -- Jetstress testing begins ...
 6/25/2010 9:30:11 AM -- Prepare testing begins ...
 6/25/2010 9:30:15 AM -- Attaching databases ...
 6/25/2010 9:30:15 AM -- Prepare testing ends.
 6/25/2010 9:30:15 AM -- Dispatching transactions begins ...
 6/25/2010 9:30:15 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 6/25/2010 9:30:15 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 6/25/2010 9:30:18 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 6/25/2010 9:30:18 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 6/25/2010 9:30:23 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 6/25/2010 9:30:23 AM -- Performance logging begins (interval: 15000 ms).
 6/25/2010 9:30:23 AM -- Attaining prerequisites:
 6/25/2010 9:31:33 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 731295700.0 (lower bound: 724775700.0, upper bound: none)
 6/25/2010 11:31:34 AM -- Performance logging ends.
 6/25/2010 11:55:58 AM -- JetInterop batch transaction stats: 72584, 72831 and 73086.
 6/25/2010 11:55:58 AM -- Dispatching transactions ends.
 6/25/2010 11:55:58 AM -- Shutting down databases ...
 6/25/2010 11:55:59 AM -- Instance2728.1 (complete), Instance2728.2 (complete) and Instance2728.3 (complete)
 6/25/2010 11:56:00 AM -- Performance logging begins (interval: 30000 ms).
 6/25/2010 11:56:00 AM -- Verifying database checksums ...
 6/25/2010 9:02:27 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 6/25/2010 9:02:27 PM -- Performance logging ends.
 6/25/2010 9:02:27 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Performance\DBChecksum_2010_6_25_11_55_59.blg has 1092 samples.
 6/25/2010 9:02:31 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Performance\DBChecksum_2010_6_25_11_55_59.html is saved.
 6/25/2010 9:02:31 PM -- Verifying log checksums ...
 6/25/2010 9:02:34 PM -- C:\alogluns\log1 (12 log(s) processed), C:\alogluns\log2 (14 log(s) processed) and C:\alogluns\log3 (13 log(s) processed)
 6/25/2010 9:02:34 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Performance\Performance_2010_6_25_9_30_18.blg has 484 samples.

6/25/2010 9:02:34 PM -- Creating test report ...
6/25/2010 9:02:37 PM -- Instance2728.1 has 6.9 for I/O Database Reads Average Latency.
6/25/2010 9:02:37 PM -- Instance2728.1 has 1.4 for I/O Log Writes Average Latency.
6/25/2010 9:02:37 PM -- Instance2728.1 has 1.4 for I/O Log Reads Average Latency.
6/25/2010 9:02:37 PM -- Instance2728.2 has 6.7 for I/O Database Reads Average Latency.
6/25/2010 9:02:37 PM -- Instance2728.2 has 1.4 for I/O Log Writes Average Latency.
6/25/2010 9:02:37 PM -- Instance2728.2 has 1.4 for I/O Log Reads Average Latency.
6/25/2010 9:02:37 PM -- Instance2728.3 has 6.6 for I/O Database Reads Average Latency.
6/25/2010 9:02:37 PM -- Instance2728.3 has 1.4 for I/O Log Writes Average Latency.
6/25/2010 9:02:37 PM -- Instance2728.3 has 1.4 for I/O Log Reads Average Latency.
6/25/2010 9:02:37 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/25/2010 9:02:37 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/25/2010 9:02:37 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Performance\Performance_2010_6_25_9_30_18.xml has 479 samples queried.

Performance Test Database Checksums: Sun170

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\asgluns\sg1\Jetstress001001.edb	47544418	0	0	0	1485763 MBytes / 32787 sec
C:\asgluns\sg2\Jetstress002001.edb	47544674	0	0	0	1485771 MBytes / 28767 sec
C:\asgluns\sg3\Jetstress003001.edb	47544674	0	0	0	1485771 MBytes / 32449 sec
(Sum)	142633766	0	0	0	4457305 MBytes / 32787 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
C:\asgluns\sg1	0.085	0.000	725.093	0.000	65536.000
C:\asgluns\sg2	0.078	0.000	826.507	0.000	65536.000
C:\asgluns\sg3	0.084	0.000	732.606	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	0.883	0.000	3.303
Available MBytes	30828.140	30812.000	30841.000
Free System Page Table Entries	33555644.557	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	66935961.788	66678784.000	67465216.000
Pool Paged Bytes	97165462.037	96141312.000	100757504.000

Test Log6/25/2010 9:30:11 AM -- Jetstress testing begins ...
 6/25/2010 9:30:11 AM -- Prepare testing begins ...
 6/25/2010 9:30:15 AM -- Attaching databases ...
 6/25/2010 9:30:15 AM -- Prepare testing ends.
 6/25/2010 9:30:15 AM -- Dispatching transactions begins ...
 6/25/2010 9:30:15 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 6/25/2010 9:30:15 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 6/25/2010 9:30:18 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 6/25/2010 9:30:18 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 6/25/2010 9:30:23 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 6/25/2010 9:30:23 AM -- Performance logging begins (interval: 15000 ms).
 6/25/2010 9:30:23 AM -- Attaining prerequisites:
 6/25/2010 9:31:33 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 731295700.0 (lower bound: 724775700.0, upper bound: none)
 6/25/2010 11:31:34 AM -- Performance logging ends.
 6/25/2010 11:55:58 AM -- JetInterop batch transaction stats: 72584, 72831 and 73086.
 6/25/2010 11:55:58 AM -- Dispatching transactions ends.
 6/25/2010 11:55:58 AM -- Shutting down databases ...
 6/25/2010 11:55:59 AM -- Instance2728.1 (complete), Instance2728.2 (complete) and Instance2728.3 (complete)
 6/25/2010 11:56:00 AM -- Performance logging begins (interval: 30000 ms).
 6/25/2010 11:56:00 AM -- Verifying database checksums ...
 6/25/2010 9:02:27 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 6/25/2010 9:02:27 PM -- Performance logging ends.
 6/25/2010 9:02:27 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Performance\DBChecksum_2010_6_25_11_55_59.blg has 1092 samples.

Stress Test Database Performance Result: Sun170

Test Summary

Overall Test Result	Pass
Machine Name	SUN170
Test Description	
Test Start Time	6/26/2010 10:31:23 PM
Test End Time	6/28/2010 4:17:29 AM
Collection Start Time	6/26/2010 10:32:44 PM
Collection End Time	6/27/2010 10:32:38 PM
Jetstress Version	14.01.0043.000
Ese Version	14.00.0639.019
Operating System	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance Log	C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Stress\Stress_2010_6_26_22_31_30.blg C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Stress\DBChecksum_2010_6_28_4_17_29.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	854.536
Target Transactional I/O per Second	261
Initial Database Size (bytes)	4673823244288
Final Database Size (bytes)	4709265113088
Database Files (Count)	3

Jetstress System Parameters

Thread Count	4 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 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

Instance2728.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance2728.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance2728.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.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
Instance2728.1	8.892	3.353	179.126	105.798	33222.172	35112.457	0.000	1.365	0.000	79.003	0.000	5033.574
Instance2728.2	8.186	2.547	179.053	105.783	33302.118	35106.135	0.000	1.443	0.000	77.994	0.000	5093.538
Instance2728.3	8.397	2.748	179.046	105.731	33297.622	35118.150	0.000	1.351	0.000	78.617	0.000	5061.249

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2728.1	29.555	261890.990
Instance2728.2	30.126	261885.577
Instance2728.3	29.838	261877.059

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2728.1	1.627	232560.509
Instance2728.2	1.627	232558.814
Instance2728.3	1.629	232559.886

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
Instance2728.1	8.892	3.353	208.681	105.798	65608.453	35112.457	2.763	1.365	1.627	79.003	232560.509	5033.574
Instance2728.2	8.186	2.547	209.180	105.783	66222.964	35106.135	3.030	1.443	1.627	77.994	232558.814	5093.538
Instance2728.3	8.397	2.748	208.884	105.731	65949.547	35118.150	2.663	1.351	1.629	78.617	232559.886	5061.249

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.970	0.000	5.003
Available MBytes	29996.631	29988.000	30003.000
Free System Page Table Entries	33555642.754	33555634.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	66790486.816	66621440.000	67022848.000
Pool Paged Bytes	99315800.951	97202176.000	102199296.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log6/26/2010 10:31:23 PM -- Jetstress testing begins ...

6/26/2010 10:31:24 PM -- Prepare testing begins ...

6/26/2010 10:31:27 PM -- Attaching databases ...

6/26/2010 10:31:27 PM -- Prepare testing ends.

6/26/2010 10:31:27 PM -- Dispatching transactions begins ...

6/26/2010 10:31:27 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)

6/26/2010 10:31:27 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)

6/26/2010 10:31:30 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).

6/26/2010 10:31:30 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).

6/26/2010 10:31:35 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

6/26/2010 10:31:35 PM -- Performance logging begins (interval: 15000 ms).

6/26/2010 10:31:35 PM -- Attaining prerequisites:

6/26/2010 10:32:44 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 734773200.0 (lower bound: 724775700.0, upper bound: none)

6/27/2010 10:32:44 PM -- Performance logging ends.

6/28/2010 4:17:28 AM -- JetInterop batch transaction stats: 840765, 841217 and 840154.

6/28/2010 4:17:28 AM -- Dispatching transactions ends.

6/28/2010 4:17:28 AM -- Shutting down databases ...

6/28/2010 4:17:29 AM -- Instance2728.1 (complete), Instance2728.2 (complete) and Instance2728.3 (complete)

6/28/2010 4:17:30 AM -- Performance logging begins (interval: 30000 ms).

6/28/2010 4:17:30 AM -- Verifying database checksums ...

6/28/2010 1:48:27 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)

6/28/2010 1:48:27 PM -- Performance logging ends.

6/28/2010 1:48:27 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Stress\DBChecksum_2010_6_28_4_17_29.blg has 1141 samples.

6/28/2010 1:48:31 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Stress\DBChecksum_2010_6_28_4_17_29.html is saved.

6/28/2010 1:48:31 PM -- Verifying log checksums ...

6/28/2010 1:48:31 PM -- C:\alogluns\log1 (12 log(s) processed), C:\alogluns\log2 (12 log(s) processed) and C:\alogluns\log3 (12 log(s) processed)

6/28/2010 1:48:31 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Stress\Stress_2010_6_26_22_31_30.blg has 5760 samples.

6/28/2010 1:48:31 PM -- Creating test report ...
6/28/2010 1:48:54 PM -- Instance2728.1 has 8.9 for I/O Database Reads Average Latency.
6/28/2010 1:48:54 PM -- Instance2728.1 has 1.4 for I/O Log Writes Average Latency.
6/28/2010 1:48:54 PM -- Instance2728.1 has 1.4 for I/O Log Reads Average Latency.
6/28/2010 1:48:55 PM -- Instance2728.2 has 8.2 for I/O Database Reads Average Latency.
6/28/2010 1:48:55 PM -- Instance2728.2 has 1.4 for I/O Log Writes Average Latency.
6/28/2010 1:48:55 PM -- Instance2728.2 has 1.4 for I/O Log Reads Average Latency.
6/28/2010 1:48:55 PM -- Instance2728.3 has 8.4 for I/O Database Reads Average Latency.
6/28/2010 1:48:55 PM -- Instance2728.3 has 1.4 for I/O Log Writes Average Latency.
6/28/2010 1:48:55 PM -- Instance2728.3 has 1.4 for I/O Log Reads Average Latency.
6/28/2010 1:48:55 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/28/2010 1:48:55 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/28/2010 1:48:55 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Stress\Stress_2010_6_26_22_31_30.xml has 5755 samples queried.

Stress Test Database Checksums Result: Sun170

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\asgluns\sg1\Jetstress001001.edb	47905122	0	0	0	1497035 MBytes / 34257 sec
C:\asgluns\sg2\Jetstress002001.edb	47904866	0	0	0	1497027 MBytes / 26972 sec
C:\asgluns\sg3\Jetstress003001.edb	47905378	0	0	0	1497043 MBytes / 34228 sec
(Sum)	143715366	0	0	0	4491105 MBytes / 34257 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
C:\asgluns\sg1	0.087	0.000	698.313	0.000	65536.000
C:\asgluns\sg2	0.077	0.000	887.437	0.000	65536.000
C:\asgluns\sg3	0.086	0.000	699.232	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	0.857	0.000	3.430
Available MBytes	30808.062	30793.000	30816.000
Free System Page Table Entries	33555644.415	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	67296870.759	67158016.000	67563520.000
Pool Paged Bytes	99787154.061	97894400.000	102141952.000

Test Log6/26/2010 10:31:23 PM -- Jetstress testing begins ...
 6/26/2010 10:31:24 PM -- Prepare testing begins ...
 6/26/2010 10:31:27 PM -- Attaching databases ...
 6/26/2010 10:31:27 PM -- Prepare testing ends.
 6/26/2010 10:31:27 PM -- Dispatching transactions begins ...
 6/26/2010 10:31:27 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 6/26/2010 10:31:27 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 6/26/2010 10:31:30 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 6/26/2010 10:31:30 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 6/26/2010 10:31:35 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 6/26/2010 10:31:35 PM -- Performance logging begins (interval: 15000 ms).
 6/26/2010 10:31:35 PM -- Attaining prerequisites:
 6/26/2010 10:32:44 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 734773200.0 (lower bound: 724775700.0, upper bound: none)
 6/27/2010 10:32:44 PM -- Performance logging ends.
 6/28/2010 4:17:28 AM -- JetInterop batch transaction stats: 840765, 841217 and 840154.
 6/28/2010 4:17:28 AM -- Dispatching transactions ends.
 6/28/2010 4:17:28 AM -- Shutting down databases ...
 6/28/2010 4:17:29 AM -- Instance2728.1 (complete), Instance2728.2 (complete) and Instance2728.3 (complete)
 6/28/2010 4:17:30 AM -- Performance logging begins (interval: 30000 ms).
 6/28/2010 4:17:30 AM -- Verifying database checksums ...
 6/28/2010 1:48:27 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 6/28/2010 1:48:27 PM -- Performance logging ends.
 6/28/2010 1:48:27 PM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\Stress\DBChecksum_2010_6_28_4_17_29.blg has 1141 samples.

Database Backup Test Result: Sun170

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance3320.1	1497027.09	08:08:49	51.04
Instance3320.2	1497019.09	06:48:30	61.08
Instance3320.3	1497035.09	08:22:21	49.67

Jetstress System Parameters

Thread Count	4 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance3320.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3320.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3320.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.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
Instance3320.1	6.949	0.000	204.146	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3320.2	7.441	0.000	244.117	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3320.3	7.834	0.000	198.522	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	0.455	0.000	1.884
Available MBytes	30880.069	30867.000	30885.000
Free System Page Table Entries	33555643.755	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	67120772.590	67112960.000	67141632.000
Pool Paged Bytes	102188913.211	100597760.000	104894464.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log6/28/2010 3:51:11 PM -- Jetstress testing begins ...
6/28/2010 3:51:11 PM -- Prepare testing begins ...
6/28/2010 3:51:15 PM -- Attaching databases ...
6/28/2010 3:51:15 PM -- Prepare testing ends.
6/28/2010 3:51:21 PM -- Performance logging begins (interval: 30000 ms).
6/28/2010 3:51:21 PM -- Backing up databases ...
6/29/2010 12:13:43 AM -- Performance logging ends.
6/29/2010 12:13:43 AM -- Instance3320.1 (100% processed), Instance3320.2 (100% processed)
and Instance3320.3 (100% processed)
6/29/2010 12:13:43 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\DatabaseBackup_2010_6_28_15_51_15_15.blg has 1004 samples.
6/29/2010 12:13:43 AM -- Creating test report ...

Soft Recovery Test Result: Sun170

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance3320.1	500	489.2948594
Instance3320.2	503	634.8899152
Instance3320.3	506	469.139624

Database Configuration

Instance3320.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3320.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3320.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.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
Instance3320.1	17.929	14.357	1082.288	6.139	36049.439	32632.595	5.107	0.000	9.209	0.000	230653.470	0.000
Instance3320.2	23.145	15.492	807.965	4.747	36278.563	31828.790	13.854	0.000	7.121	0.000	223544.533	0.000
Instance3320.3	17.798	13.384	1115.749	6.496	36100.752	32485.517	5.346	0.003	9.753	0.026	230483.148	2.207

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3320.1	28.145	262035.652
Instance3320.2	21.675	261759.502
Instance3320.3	28.131	262017.739

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
Instance3320.1	17.929	14.357	1110.434	6.139	41777.376	32632.595	5.107	0.000	9.209	0.000	230653.470	0.000
Instance3320.2	23.145	15.492	829.640	4.747	42169.390	31828.790	13.854	0.000	7.121	0.000	223544.533	0.000
Instance3320.3	17.798	13.384	1143.881	6.496	41656.718	32485.517	5.346	0.003	9.753	0.026	230483.148	2.207

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	4.989	0.000	33.042
Available MBytes	30050.308	30028.000	30778.000
Free System Page Table Entries	33555644.333	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71870028.394	67743744.000	72597504.000
Pool Paged Bytes	102657956.978	102617088.000	102699008.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 6/28/2010 3:51:11 PM -- Jetstress testing begins ...
6/28/2010 3:51:11 PM -- Prepare testing begins ...
6/28/2010 3:51:15 PM -- Attaching databases ...
6/28/2010 3:51:15 PM -- Prepare testing ends.
6/28/2010 3:51:21 PM -- Performance logging begins (interval: 30000 ms).
6/28/2010 3:51:21 PM -- Backing up databases ...
6/29/2010 12:13:43 AM -- Performance logging ends.
6/29/2010 12:13:43 AM -- Instance3320.1 (100% processed), Instance3320.2 (100% processed)
and Instance3320.3 (100% processed)
6/29/2010 12:13:43 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\DatabaseBackup_2010_6_28_15_51_15.blg has 1004 samples.
6/29/2010 12:13:43 AM -- Creating test report ...
6/29/2010 12:13:47 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\DatabaseBackup_2010_6_28_15_51_15.html is saved.
6/29/2010 12:13:47 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\Application_2010_6_29_0_13_47.evt is saved.
6/29/2010 12:13:47 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\System_2010_6_29_0_13_47.evt is saved.
6/29/2010 12:13:47 AM -- Jetstress testing ends.
6/29/2010 8:55:23 AM -- Jetstress testing begins ...
6/29/2010 8:55:23 AM -- Prepare testing begins ...
6/29/2010 8:55:27 AM -- Attaching databases ...
6/29/2010 8:55:27 AM -- Prepare testing ends.
6/29/2010 8:55:27 AM -- Dispatching transactions begins ...
6/29/2010 8:55:27 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
6/29/2010 8:55:27 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
6/29/2010 8:55:30 AM -- Database read latency thresholds: (average: 20 msec/read, maximum:
100 msec/read).
6/29/2010 8:55:30 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100
msec/write).
6/29/2010 8:55:34 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%,
Reads 35%, Lazy Commits 70%.
6/29/2010 8:55:34 AM -- Performance logging begins (interval: 15000 ms).
6/29/2010 8:55:34 AM -- Generating log files ...
6/29/2010 9:37:36 AM -- C:\alogluns\log1 (100.2% generated), C:\alogluns\log2 (100.8%
generated) and C:\alogluns\log3 (101.4% generated)
6/29/2010 9:37:36 AM -- Performance logging ends.

6/29/2010 9:37:36 AM -- JetInterop batch transaction stats: 21814, 21865 and 21870.
6/29/2010 9:37:36 AM -- Dispatching transactions ends.
6/29/2010 9:37:36 AM -- Shutting down databases ...
6/29/2010 9:37:37 AM -- Instance3320.1 (complete), Instance3320.2 (complete) and Instance3320.3 (complete)
6/29/2010 9:37:37 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\SoftRecovery\Performance_2010_6_29_8_55_30.blg has 168 samples.
6/29/2010 9:37:37 AM -- Creating test report ...
6/29/2010 9:37:38 AM -- Instance3320.1 has 6.7 for I/O Database Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.1 has 0.9 for I/O Log Writes Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.1 has 0.9 for I/O Log Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.2 has 6.9 for I/O Database Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.2 has 1.1 for I/O Log Writes Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.2 has 1.1 for I/O Log Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.3 has 6.3 for I/O Database Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.3 has 0.9 for I/O Log Writes Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.3 has 0.9 for I/O Log Reads Average Latency.
6/29/2010 9:37:38 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/29/2010 9:37:38 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/29/2010 9:37:38 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\SoftRecovery\Performance_2010_6_29_8_55_30.xml has 167 samples queried.
6/29/2010 9:37:38 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\SoftRecovery\Performance_2010_6_29_8_55_30.html is saved.
6/29/2010 11:45:43 AM -- Performance logging begins (interval: 2000 ms).
6/29/2010 11:45:43 AM -- Recovering databases ...
6/29/2010 11:56:18 AM -- Performance logging ends.
6/29/2010 11:56:18 AM -- Instance3320.1 (489.2948594), Instance3320.2 (634.8899152) and Instance3320.3 (469.139624)
6/29/2010 11:56:19 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\SoftRecovery\SoftRecovery_2010_6_29_11_45_40.blg has 315 samples.
6/29/2010 11:56:19 AM -- Creating test report ...

Soft Recovery Test Performance Result: Sun170

Test Summary

Overall Test Result	Pass
Machine Name	SUN170
Test Description	
Test Start Time	6/29/2010 8:55:23 AM
Test End Time	6/29/2010 9:37:37 AM
Collection Start Time	6/29/2010 8:55:49 AM
Collection End Time	6/29/2010 9:37:35 AM
Jetstress Version	14.01.0043.000
Ese Version	14.00.0639.019
Operating System	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance Log	C:\Exchange 2010\SUN170\RAID10\3GB\1450 users\SoftRecovery\Performance_2010_6_29_8_55_30.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1291.856
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	4709265113088
Final Database Size (bytes)	4710204637184
Database Files (Count)	3

Jetstress System Parameters

Thread Count	4 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance3320.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3320.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3320.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.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
Instance3320.1	6.650	3.730	262.649	168.268	32799.133	34292.808	0.000	0.936	0.000	93.406	0.000	4674.088
Instance3320.2	6.853	3.446	262.187	168.434	32796.881	34285.625	0.000	1.150	0.000	92.023	0.000	4762.559
Instance3320.3	6.264	2.717	262.370	167.949	32799.580	34268.520	0.000	0.932	0.000	93.600	0.000	4717.686

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.133	0.000	3.352
Available MBytes	30046.899	30034.000	30605.000
Free System Page Table Entries	33555645.000	33555645.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	67635151.238	67117056.000	67891200.000
Pool Paged Bytes	103499166.476	103428096.000	103575552.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log6/28/2010 3:51:11 PM -- Jetstress testing begins ...
6/28/2010 3:51:11 PM -- Prepare testing begins ...
6/28/2010 3:51:15 PM -- Attaching databases ...
6/28/2010 3:51:15 PM -- Prepare testing ends.
6/28/2010 3:51:21 PM -- Performance logging begins (interval: 30000 ms).
6/28/2010 3:51:21 PM -- Backing up databases ...
6/29/2010 12:13:43 AM -- Performance logging ends.
6/29/2010 12:13:43 AM -- Instance3320.1 (100% processed), Instance3320.2 (100% processed)
and Instance3320.3 (100% processed)
6/29/2010 12:13:43 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\DatabaseBackup_2010_6_28_15_51_15.blg has 1004 samples.
6/29/2010 12:13:43 AM -- Creating test report ...
6/29/2010 12:13:47 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\DatabaseBackup_2010_6_28_15_51_15.html is saved.
6/29/2010 12:13:47 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\Application_2010_6_29_0_13_47.evt is saved.
6/29/2010 12:13:47 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\Backup\System_2010_6_29_0_13_47.evt is saved.
6/29/2010 12:13:47 AM -- Jetstress testing ends.
6/29/2010 8:55:23 AM -- Jetstress testing begins ...
6/29/2010 8:55:23 AM -- Prepare testing begins ...
6/29/2010 8:55:27 AM -- Attaching databases ...
6/29/2010 8:55:27 AM -- Prepare testing ends.
6/29/2010 8:55:27 AM -- Dispatching transactions begins ...
6/29/2010 8:55:27 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
6/29/2010 8:55:27 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
6/29/2010 8:55:30 AM -- Database read latency thresholds: (average: 20 msec/read, maximum:
100 msec/read).
6/29/2010 8:55:30 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100
msec/write).
6/29/2010 8:55:34 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%,
Reads 35%, Lazy Commits 70%.
6/29/2010 8:55:34 AM -- Performance logging begins (interval: 15000 ms).
6/29/2010 8:55:34 AM -- Generating log files ...
6/29/2010 9:37:36 AM -- C:\alogluns\log1 (100.2% generated), C:\alogluns\log2 (100.8%
generated) and C:\alogluns\log3 (101.4% generated)
6/29/2010 9:37:36 AM -- Performance logging ends.

6/29/2010 9:37:36 AM -- JetInterop batch transaction stats: 21814, 21865 and 21870.
6/29/2010 9:37:36 AM -- Dispatching transactions ends.
6/29/2010 9:37:36 AM -- Shutting down databases ...
6/29/2010 9:37:37 AM -- Instance3320.1 (complete), Instance3320.2 (complete) and
Instance3320.3 (complete)
6/29/2010 9:37:37 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\SoftRecovery\Performance_2010_6_29_8_55_30.blg has 168 samples.
6/29/2010 9:37:37 AM -- Creating test report ...
6/29/2010 9:37:38 AM -- Instance3320.1 has 6.7 for I/O Database Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.1 has 0.9 for I/O Log Writes Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.1 has 0.9 for I/O Log Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.2 has 6.9 for I/O Database Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.2 has 1.1 for I/O Log Writes Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.2 has 1.1 for I/O Log Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.3 has 6.3 for I/O Database Reads Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.3 has 0.9 for I/O Log Writes Average Latency.
6/29/2010 9:37:38 AM -- Instance3320.3 has 0.9 for I/O Log Reads Average Latency.
6/29/2010 9:37:38 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/29/2010 9:37:38 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/29/2010 9:37:38 AM -- C:\Exchange 2010\SUN170\RAID10\3GB\1450
users\SoftRecovery\Performance_2010_6_29_8_55_30.xml has 167 samples queried.

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Corporate Headquarters

750 Central Expressway,
Santa Clara, California 95050-2627 USA
www.HDS.com

Regional Contact Information

Americas: +1 408 970 1000 or info@hds.com
Europe, Middle East and Africa: +44 (0) 1753 618000 or info.emea@hds.com
Asia Pacific: +852 3189 7900 or hds.marketing.apac@hds.com