

Hitachi Adaptable Modular Storage 2500 Dynamically Provisioned 68,800 User Exchange 2010 Resiliency Storage Solution

Tested with: ESRP – Storage Version 3.0

Test Date: April 2010

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Overview

This document provides information on a Hitachi Adaptable Modular Storage 2500 Resiliency storage solution using Hitachi Dynamic Provisioning software for Microsoft Exchange Server 2010, 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 68,800 users and 16 servers. This testing used the Hitachi Adaptable Modular Storage 2500 storage system using Hitachi Dynamic Provisioning software in a two pool RAID-1+0 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 the 2500.

This solution includes Exchange 2010 Mailbox Resiliency by using the new Database Availability Group (DAG) feature. This tested configuration utilizes sixteen DAGs, each containing two database copies and two servers. The test configuration was capable of supporting 68,800 users with a 0.12 IOPS per user profile and user mailbox size of 1GB. A 2500 with 480 450GB 15K RPM SAS disks, 32GB of cache and sixteen 4Gbit/s paths was used for these tests. Testing used sixteen Sun Fire 4270 servers with 32GB of RAM, two quad-core Intel E5540 2.53GHz CPUs, thirty two Emulex 4Gbit/s Fibre Channel adapters, and Windows Server 2008 R2 Enterprise.

The Hitachi Adaptable Modular Storage 2500 is a medium-sized, high-performance, highly reliable midrange storage system that can scale to 480 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, the 2500 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 utilizes the 2500 to meet the needs of a large Exchange Server deployment.

This solution uses Hitachi Dynamic Provisioning software, which is enabled on the 2500 via a license key. In the most basic sense, Hitachi Dynamic Provisioning software is similar to the use of a host-based logical volume manager (LVM), but with several additional features available within the 2500 and without the need to install software on the host or incur host processing overhead. Hitachi Dynamic Provisioning software is a superior solution. Hitachi Dynamic Provisioning software provides for one or more pools of wide striping across many RAID groups within a 2500. One or more Dynamic Provisioning virtual volumes (DP-VOLs) of a user-specified logical size (with no initial physical space allocated) are created against each pool.

Primarily, Hitachi Dynamic Provisioning would be 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 software 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 new 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.

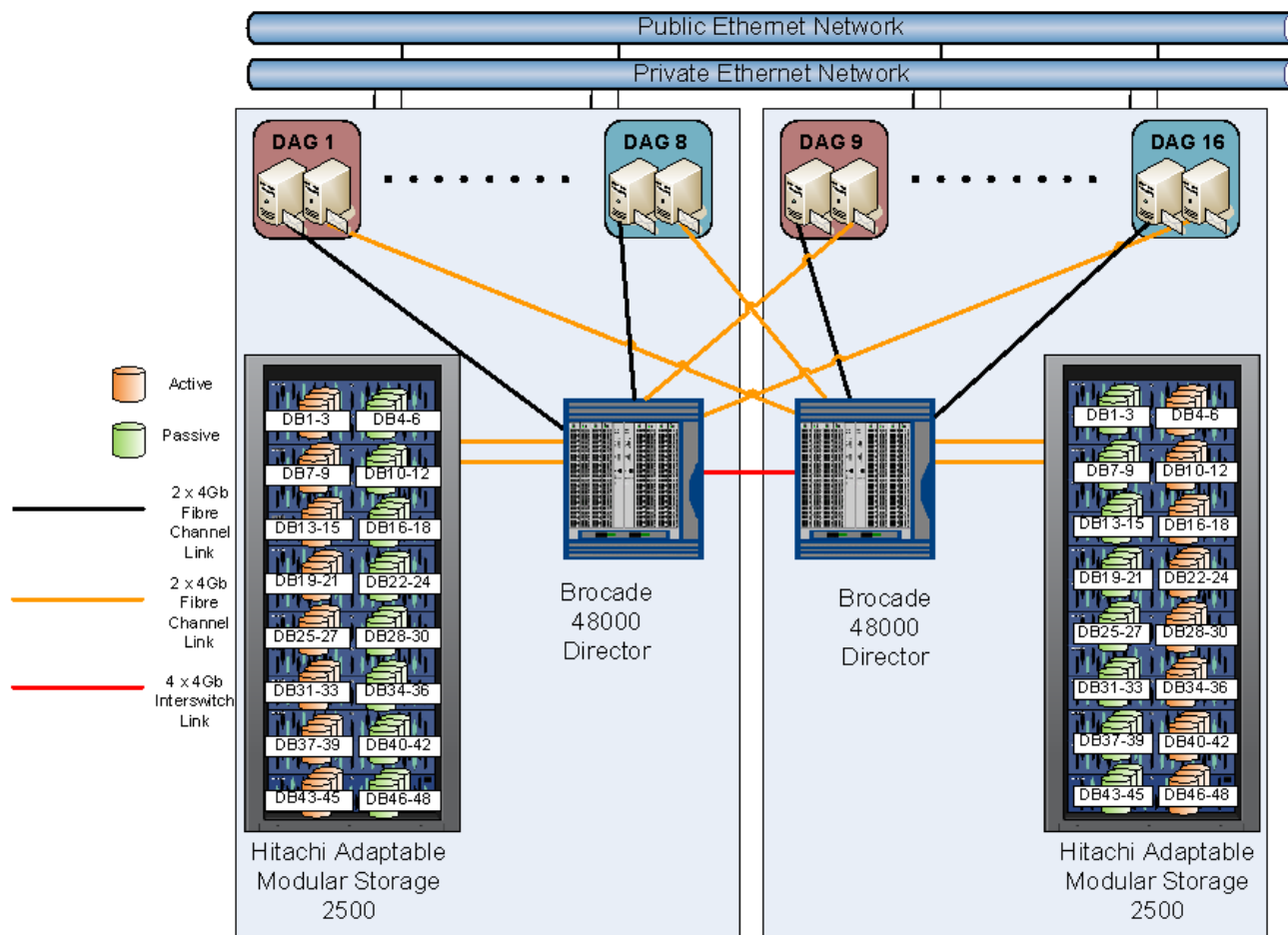
Any server in a DAG can host a copy of a mailbox database from any other server in the DAG. When a server is added to a DAG, it monitors and works with the other servers in the DAG to provide automatic recovery delivering a robust, highly-available Exchange solution without the administrative complexities 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 16 DAGs, each configured with two servers and that host active mailboxes in three databases. To target the 68,800 user resiliency solution, a Hitachi Adaptable Modular Storage 2500 configured with 480 disks (the maximum) and 16 host servers, each configured with 4,300 mailboxes, were used to host the 48 active databases and the simulated database copies for the tests

Each DAG contained two copies of every database; a local, active copy on a server connected to the primary 2500 and the passive copy on another server connected to a second 2500. This recommended configuration can support both high-availability and disaster-recovery scenarios when the active and passive database copies are allocated among both DAG members and dispersed across both 2500s. 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 recommended DAG configuration that was simulated.

Figure 1. Recommended Database Availability Group Configuration

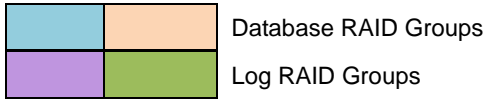


This solution enables organizations to consolidate Exchange Server 2010 DAG deployments on two 2500 storage systems. Using identical hardware and software configurations guarantees that an active database and its replicated copy do not share storage paths, disk spindles or storage controllers, making 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 2500's disks were organized into RAID groups for use by either databases or logs. Each set of colored disks represents a RAID-1+0 (4D+4D) group. Except for RKA-0 (with 15 internal SAS disks), each RKA is an external disk enclosure with 15 SAS disks.

Table 1. Adaptable Modular Storage 2500 RAID Groups by RKA Tray Layout

<i>Drive Slot</i>	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RKA 31	59	59	59	59	59	59	59	60	60	60	60	60	60	60	60
RKA 30	57	57	57	57	57	57	58	58	58	58	58	58	58	58	59
RKA 29	55	55	55	55	55	56	56	56	56	56	56	56	56	57	57
RKA 28	53	53	53	53	54	54	54	54	54	54	54	54	55	55	55
RKA 27	51	51	51	52	52	52	52	52	52	52	52	53	53	53	53
RKA 26	49	49	50	50	50	50	50	50	50	50	51	51	51	51	51
RKA 25	47	48	48	48	48	48	48	48	48	49	49	49	49	49	49
RKA 24	46	46	46	46	46	46	46	46	47	47	47	47	47	47	47
RKA 23	44	44	44	44	44	44	44	45	45	45	45	45	45	45	45
RKA 22	42	42	42	42	42	42	43	43	43	43	43	43	43	43	44
RKA 21	40	40	40	40	40	41	41	41	41	41	41	41	41	42	42
RKA 20	38	38	38	38	39	39	39	39	39	39	39	39	40	40	40
RKA 19	36	36	36	37	37	37	37	37	37	37	37	38	38	38	38
RKA 18	34	34	35	35	35	35	35	35	35	35	36	36	36	36	36
RKA 17	32	33	33	33	33	33	33	33	33	34	34	34	34	34	34
RKA 16	31	31	31	31	31	31	31	31	32	32	32	32	32	32	32
RKA 15	29	29	29	29	29	29	29	30	30	30	30	30	30	30	30
RKA 14	27	27	27	27	27	27	28	28	28	28	28	28	28	28	29
RKA 13	25	25	25	25	25	26	26	26	26	26	26	26	26	27	27
RKA 12	23	23	23	23	24	24	24	24	24	24	24	24	25	25	25
RKA 11	21	21	21	22	22	22	22	22	22	22	22	23	23	23	23
RKA 10	19	19	20	20	20	20	20	20	20	20	21	21	21	21	21
RKA 9	17	18	18	18	18	18	18	18	18	19	19	19	19	19	19
RKA 8	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17
RKA 7	14	14	14	14	14	14	14	15	15	15	15	15	15	15	15
RKA 6	12	12	12	12	12	12	13	13	13	13	13	13	13	13	14
RKA 5	10	10	10	10	10	11	11	11	11	11	11	11	11	12	12
RKA 4	8	8	8	8	9	9	9	9	9	9	9	9	10	10	10
RKA 3	6	6	6	7	7	7	7	7	7	7	7	8	8	8	8
RKA 2	4	4	5	5	5	5	5	5	5	5	6	6	6	6	6
RKA 1	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4
RKA 0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2



Two Dynamic Provisioning pools were created, one for the databases and other for the logs. The database pool was created from 54 RAID-1+0 groups and the log pool was created from six RAID-1+0 groups. From the database pool, 48 DP-VOLs (each specified to have a 1750GB size limit) were created for 48 databases (three per server). From the log pool, 48 DP-VOLs (each specified to have a size limit of 175GB) were created for 48 logs (three per server).

Table 2 outlines the port layout for the servers.

Table 2. Adaptable Modular Storage 2500 Port to Server Layout

<i>Server</i>	<i>Primary Path</i>	<i>Secondary Path</i>
SUN141	0A	1A
SUN142	0B	1B
SUN143	0C	1C
SUN144	0D	1D
SUN145	0E	1E
SUN146	0F	1F
SUN147	0G	1G
SUN148	0H	1H
SUN153	1A	0A
SUN154	1B	0B
SUN155	1C	0C
SUN156	1D	0D
SUN165	1E	0E
SUN166	1F	0F
SUN167	1G	0G
SUN168	1H	0H

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

Table 3. Adaptable Modular Storage 2500 Port to Log DP-VOL Layout

<i>Port</i>	<i>Database</i>	<i>DB DP-VOL</i>
0A	1-3	24-26
0B	4-6	27-29
0C	7-9	30-32
0D	10-12	33-35
0E	13-15	36-38
0F	16-18	39-41
0G	19-21	42-44
0H	22-24	45-47
1A	25-27	0-2
1B	28-30	3-5
1C	31-33	6-8
1D	34-36	9-11
1E	37-39	12-14
1F	40-42	15-17
1G	43-45	18-20
1H	46-48	21-23

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

Table 4. Adaptable Modular Storage 2500 Port to Log DP-VOL Layout

<i>Port</i>	<i>Log</i>	<i>DP-VOL</i>
0A	1-3	72-74
0B	4-6	75-77
0C	7-9	78-80
0D	10-12	81-83
0E	13-15	84-86
0F	16-18	87-89
0G	19-21	90-92
0H	22-24	93-95
1A	25-27	48-50
1B	28-30	51-53
1C	31-33	54-56
1D	34-36	57-59
1E	37-39	60-62
1F	40-42	63-65
1G	43-45	66-68
1H	46-48	69-71

Table 5 provides the detailed specifications for the storage configuration which uses RAID-1+0 (4+4) 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 2500 Configuration Details

<i>Host</i>	<i>Pool</i>	<i>Port</i>	<i>DP-VOL</i>	<i>Size (GB)</i>	<i>Description</i>
SUN141	0	0A/1A	0-2	1750	Databases 1-3
SUN142	0	0B/1B	3-5	1750	Databases 4-6
SUN143	0	0C/1C	6-8	1750	Databases 7-9
SUN144	0	0D/1D	9-11	1750	Databases 10-12
SUN145	0	0E/1E	12-14	1750	Databases 13-15
SUN146	0	0F/1F	15-17	1750	Databases 16-18
SUN147	0	0G/1G	18-20	1750	Databases 19-21
SUN148	0	0H/1H	21-23	1750	Databases 22-24
SUN153	0	1A/0A	24-26	1750	Databases 25-27
SUN154	0	1B/0B	27-29	1750	Databases 28-30
SUN155	0	1C/0C	30-32	1750	Databases 31-33

<i>Host</i>	<i>Pool</i>	<i>Port</i>	<i>DP-VOL</i>	<i>Size (GB)</i>	<i>Description</i>
SUN156	0	1D/0D	33-35	1750	Databases 34-36
SUN165	0	1E/0E	36-38	1750	Databases 37-39
SUN166	0	1F/0F	39-41	1750	Databases 40-42
SUN167	0	1G/0G	42-44	1750	Databases 43-45
SUN168	0	1H/0H	45-47	1750	Databases 46-48
SUN141	1	0A/1A	48-50	175	Log 1-3
SUN142	1	0B/1B	51-53	175	Log 4-6
SUN143	1	0C/1C	54-56	175	Log 7-9
SUN144	1	0D/1D	57-59	175	Log 10-12
SUN145	1	0E/1E	60-62	175	Log 13-15
SUN146	1	0F/1F	63-65	175	Log 16-18
SUN147	1	0G/1G	66-68	175	Log 19-21
SUN148	1	0H/1H	69-71	175	Log 22-24
SUN153	1	1A/0A	72-74	175	Log 25-27
SUN154	1	1B/0B	75-77	175	Log 28-30
SUN155	1	1C/0C	78-80	175	Log 31-33
SUN156	1	1D/0D	81-83	175	Log 34-36
SUN165	1	1E/0E	84-86	175	Log 37-39
SUN166	1	1F/0F	87-89	175	Log 40-42
SUN167	1	1G/0G	90-92	175	Log 43-45
SUN168	1	1H/0H	93-95	175	Log 46-48

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 68,800 Exchange users with the following specifications:

- 32 Exchange Servers (16 tested, simulating 32 for the database copies)
- Two Adaptable Modular Storage 2500 storage systems (one tested)
- 0.1 IOPS per user (0.12 tested for 20% growth)
- 1GB 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

<i>Number of Exchange mailboxes simulated</i>	68,800
<i>Number of database availability groups (DAGs)</i>	16
<i>Number of servers per DAG</i>	2
<i>Number of active mailboxes per server</i>	4,300
<i>Number of databases per host</i>	3
<i>Number of copies per database</i>	2
<i>Number of mailboxes per database</i>	1,433
<i>Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)</i>	0.12
<i>Database LU size</i>	1750GB
<i>Log LU size</i>	175GB
<i>Total database size for performance testing</i>	68,800GB
<i>% storage capacity used by Exchange database**</i>	79.8%

**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 2500 Firmware: 0872/E-H WHQL listing: HDS Adaptable Modular Storage 2500
Storage cache	32GB
Number of storage controllers	2
Number of storage ports	16
Maximum bandwidth of storage connectivity to host	64Gb/s (16 x 4Gbit/s 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 4Gbit/s 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	480
Maximum number of spindles can be hosted in the storage	480

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 Disk 450GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of physical disks in test	432 (Dynamic Provisioning pool)
Total raw storage capacity (GB)	194,400GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID 1+0 (4+4) at storage level
Total formatted capacity	86,184GB (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 Disk 450GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of spindles in test	48 (Dynamic Provisioning pool)
Total raw storage capacity (GB)	21,600GB
Disk slice size (GB)	N/A
Number of slices per LU or number of disks per LU	N/A
RAID level	RAID 1+0 (4+4) at storage level
Total formatted capacity	9,576GB

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 (1Gbps)

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 2500 Firmware: 0872/E-H WHQL listing: HDS Adaptable Modular Storage 2500
Storage cache	32GB
Number of storage controllers	2
Number of storage ports	16
Maximum bandwidth of storage connectivity to host	64Gb/s (16 x 4Gbit/s 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 4Gbit/s 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	480
Maximum number of spindles can be hosted in the storage	480

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 Disk 450GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of physical disks in test	432 (Dynamic Provisioning pool)
Total raw storage capacity (GB)	194,400GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID 1+0 (4+4) at storage level
Total formatted capacity	68,947GB (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 Disk 450GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of spindles in test	48 (Dynamic Provisioning pool)
Total raw storage capacity (GB)	21,600GB
Disk slice size (GB)	N/A
Number of slices per LU or number of disks per LU	N/A
RAID level	RAID 1+0 (4+4) at storage level
Total formatted capacity	7,661GB

Best Practices

Microsoft Exchange Server 2010 is a very 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 2500 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 that for database and log files the ALU is set to 64K and 4K respectively.
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 software 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-1+0 groups for both the database pools and for the log pool. Use of RAID-1+0 allows more writes at a lower response time under heavier loads. RAID-1+0 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 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 2500.
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 (SUN141)

Database I/O	
<i>Database disk transfers per second</i>	873
<i>Database disk reads per second</i>	550
<i>Database disk writes per second</i>	323
<i>Average database disk read latency (ms)</i>	9.1
<i>Average database disk write latency (ms)</i>	3.6
Transaction Log I/O	
<i>Log disk writes per second</i>	245
<i>Average log disk write latency (ms)</i>	1.4

Table 17. Individual Server Metrics for Exchange Server (SUN142)

Database I/O	
<i>Database disk transfers per second</i>	885
<i>Database disk reads per second</i>	558
<i>Database disk writes per second</i>	328
<i>Average database disk read latency (ms)</i>	9.0
<i>Average database disk write latency (ms)</i>	3.5
Transaction Log I/O	
<i>Log disk writes per second</i>	250
<i>Average log disk write latency (ms)</i>	1.4

Table 18. Individual Server Metrics for Exchange Server (SUN143)

Database I/O	
<i>Database disk transfers per second</i>	871
<i>Database disk reads per second</i>	548
<i>Database disk writes per second</i>	322
<i>Average database disk read latency (ms)</i>	9.1
<i>Average database disk write latency (ms)</i>	3.6
Transaction Log I/O	
<i>Log disk writes per second</i>	244
<i>Average log disk write latency (ms)</i>	1.5

Table 19. Individual Server Metrics for Exchange Server (SUN144)

Database I/O	
<i>Database disk transfers per second</i>	808
<i>Database disk reads per second</i>	509
<i>Database disk writes per second</i>	299
<i>Average database disk read latency (ms)</i>	9.5
<i>Average database disk write latency (ms)</i>	3.9
Transaction Log I/O	
<i>Log disk writes per second</i>	223
<i>Average log disk write latency (ms)</i>	1.7

Table 20. Individual Server Metrics for Exchange Server (SUN145)

Database I/O	
<i>Database disk transfers per second</i>	878
<i>Database disk reads per second</i>	553
<i>Database disk writes per second</i>	325
<i>Average database disk read latency (ms)</i>	8.9
<i>Average database disk write latency (ms)</i>	3.6
Transaction Log I/O	
<i>Log disk writes per second</i>	257
<i>Average log disk write latency (ms)</i>	1.5

Table 21. Individual Server Metrics for Exchange Server (SUN146)

Database I/O	
<i>Database disk transfers per second</i>	883
<i>Database disk reads per second</i>	556
<i>Database disk writes per second</i>	327
<i>Average database disk read latency (ms)</i>	8.9
<i>Average database disk write latency (ms)</i>	3.6
Transaction Log I/O	
<i>Log disk writes per second</i>	248
<i>Average log disk write latency (ms)</i>	1.5

Table 22. Individual Server Metrics for Exchange Server (SUN147)

Database I/O	
<i>Database disk transfers per second</i>	815
<i>Database disk reads per second</i>	513
<i>Database disk writes per second</i>	301
<i>Average database disk read latency (ms)</i>	9.4
<i>Average database disk write latency (ms)</i>	3.7
Transaction Log I/O	
<i>Log disk writes per second</i>	225
<i>Average log disk write latency (ms)</i>	1.7

Table 23. Individual Server Metrics for Exchange Server (SUN148)

Database I/O	
<i>Database disk transfers per second</i>	886
<i>Database disk reads per second</i>	558
<i>Database disk writes per second</i>	328
<i>Average database disk read latency (ms)</i>	8.9
<i>Average database disk write latency (ms)</i>	3.4
Transaction Log I/O	
<i>Log disk writes per second</i>	249
<i>Average log disk write latency (ms)</i>	1.4

Table 24. Individual Server Metrics for Exchange Server (SUN153)

Database I/O	
<i>Database disk transfers per second</i>	774
<i>Database disk reads per second</i>	488
<i>Database disk writes per second</i>	286
<i>Average database disk read latency (ms)</i>	9.7
<i>Average database disk write latency (ms)</i>	3.9
Transaction Log I/O	
<i>Log disk writes per second</i>	210
<i>Average log disk write latency (ms)</i>	2.0

Table 25. Individual Server Metrics for Exchange Server (SUN154)

Database I/O	
<i>Database disk transfers per second</i>	801
<i>Database disk reads per second</i>	505
<i>Database disk writes per second</i>	296
<i>Average database disk read latency (ms)</i>	9.6
<i>Average database disk write latency (ms)</i>	3.8
Transaction Log I/O	
<i>Log disk writes per second</i>	223
<i>Average log disk write latency (ms)</i>	1.7

Table 26. Individual Server Metrics for Exchange Server (SUN155)

Database I/O	
<i>Database disk transfers per second</i>	774
<i>Database disk reads per second</i>	487
<i>Database disk writes per second</i>	286
<i>Average database disk read latency (ms)</i>	9.7
<i>Average database disk write latency (ms)</i>	3.9
Transaction Log I/O	
<i>Log disk writes per second</i>	211
<i>Average log disk write latency (ms)</i>	2.0

Table 27. Individual Server Metrics for Exchange Server (SUN156)

Database I/O	
<i>Database disk transfers per second</i>	695
<i>Database disk reads per second</i>	438
<i>Database disk writes per second</i>	257
<i>Average database disk read latency (ms)</i>	10.6
<i>Average database disk write latency (ms)</i>	5.7
Transaction Log I/O	
<i>Log disk writes per second</i>	190
<i>Average log disk write latency (ms)</i>	2.3

Table 28. Individual Server Metrics for Exchange Server (SUN165)

Database I/O	
<i>Database disk transfers per second</i>	861
<i>Database disk reads per second</i>	543
<i>Database disk writes per second</i>	319
<i>Average database disk read latency (ms)</i>	9.1
<i>Average database disk write latency (ms)</i>	3.6
Transaction Log I/O	
<i>Log disk writes per second</i>	242
<i>Average log disk write latency (ms)</i>	1.5

Table 29. Individual Server Metrics for Exchange Server (SUN166)

Database I/O	
<i>Database disk transfers per second</i>	784
<i>Database disk reads per second</i>	494
<i>Database disk writes per second</i>	290
<i>Average database disk read latency (ms)</i>	9.5
<i>Average database disk write latency (ms)</i>	3.8
Transaction Log I/O	
<i>Log disk writes per second</i>	213
<i>Average log disk write latency (ms)</i>	2.0

Table 30. Individual Server Metrics for Exchange Server (SUN167)

Database I/O	
<i>Database disk transfers per second</i>	784
<i>Database disk reads per second</i>	494
<i>Database disk writes per second</i>	290
<i>Average database disk read latency (ms)</i>	9.5
<i>Average database disk write latency (ms)</i>	3.8
Transaction Log I/O	
<i>Log disk writes per second</i>	213
<i>Average log disk write latency (ms)</i>	2.0

Table 31. Individual Server Metrics for Exchange Server (SUN168)

Database I/O	
<i>Database disk transfers per second</i>	874
<i>Database disk reads per second</i>	551
<i>Database disk writes per second</i>	324
<i>Average database disk read latency (ms)</i>	9.0
<i>Average database disk write latency (ms)</i>	3.7
Transaction Log I/O	
<i>Log disk writes per second</i>	245
<i>Average log disk write latency (ms)</i>	0.6

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 32. Aggregate Performance for Exchange Server 2010

Database I/O	
<i>Database disk transfers per second</i>	13,246
<i>Database disk reads per second</i>	8,345
<i>Database disk writes per second</i>	4901
<i>Average database disk read latency (ms)</i>	9.34
<i>Average database disk write latency (ms)</i>	3.82
Transaction Log I/O	
<i>Log disk writes per second</i>	3688
<i>Average log disk write latency (ms)</i>	1.64

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 33. Database Read-only Performance

<i>MB read per second per database</i>	30.8
<i>MB read per second total per server</i>	92.5

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 34. Transaction Log Recovery/Replay Performance

<i>Average time to play one log file (sec)</i>	1.48
--	------

Conclusion

This document details a tested a robust Exchange Server 2010 Resiliency solution capable of supporting 68,800 users with a 0.12 IOPS per user profile and user mailbox size of 1GB using 16 DAGs, each configured with two server nodes. A Hitachi Adaptable Modular Storage 2500, with 32GB of cache and 16 4Gbit/s Fibre Channel host paths, using Hitachi Dynamic Provisioning software (with two pools) and 480 450GB 15K RPM SAS disks in a RAID-1+0 configuration, was used for these tests. Testing confirmed that the 2500 is more than capable of delivering the IOPS and capacity requirements needed to support the active and replicated databases for 68,800 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 protection requirements might affect performance and capacity requirements of the underlying storage configuration, and as such needs to be factored into the storage design accordingly.

For more information 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: SUN141

Test Summary

Overall Test Result	Pass
Machine Name	SUN141
Test Description	
Test Start Time	4/2/2010 5:03:39 PM
Test End Time	4/2/2010 8:38:42 PM
Collection Start Time	4/2/2010 5:04:59 PM
Collection End Time	4/2/2010 7:04:56 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:\ESRP3.0_1GBMB\Perf\Performance_2010_4_2_17_3_46.blg C:\ESRP3.0_1GBMB\Perf\DBChecksum_2010_4_2_20_38_42.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	872.834
Target Transactional I/O per Second	516
Initial Database Size (bytes)	4623265103872
Final Database Size (bytes)	4627685900288
Database Files (Count)	3

Jetstress System Parameters

Thread Count	6 (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

Instance3756.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3756.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3756.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb

Transactional I/O Performance

MSExchange Database => Instance	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
Instance3756.1	9.361	3.681	182.812	107.360	33079.443	35365.390	0.000	1.408	0.000	82.209	0.000	5026.904
Instance3756.2	8.890	3.562	183.016	107.432	33129.818	35369.194	0.000	1.432	0.000	81.578	0.000	5063.845
Instance3756.3	8.893	3.433	183.974	108.241	33156.863	35376.191	0.000	1.478	0.000	81.543	0.000	5104.959

Background Database Maintenance I/O Performance

MSExchange Database => Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3756.1	28.965	261920.858
Instance3756.2	29.203	261899.017
Instance3756.3	29.343	261876.648

Log Replication I/O Performance

MSExchange Database => Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3756.1	1.690	232561.778
Instance3756.2	1.690	232561.778
Instance3756.3	1.705	232561.778

Total I/O Performance

MSExchange => Instance	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 Average Bytes	I/O Database 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
Instance3756.1	9.361	3.681	211.777	107.360	64378.548	35365.390	2.394	1.408	1.690	82.209	232561.778	5026.904
Instance3756.2	8.890	3.562	212.219	107.432	64610.704	35369.194	2.242	1.432	1.690	81.578	232561.778	5063.845
Instance3756.3	8.893	3.433	213.318	108.241	64618.999	35376.191	2.915	1.478	1.705	81.543	232561.778	5104.959

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.957	0.000	3.430
Available MBytes	30054.285	30048.000	30069.000
Free System Page Table Entries	33555131.338	33555123.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70201139.200	70168576.000	70225920.000
Pool Paged Bytes	93369907.200	91148288.000	95006720.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

4/2/2010 5:03:39 PM -- Jetstress testing begins ...
4/2/2010 5:03:39 PM -- Prepare testing begins ...
4/2/2010 5:03:42 PM -- Attaching databases ...
4/2/2010 5:03:42 PM -- Prepare testing ends.
4/2/2010 5:03:42 PM -- Dispatching transactions begins ...
4/2/2010 5:03:42 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
4/2/2010 5:03:42 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/2/2010 5:03:46 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/2/2010 5:03:46 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/2/2010 5:03:51 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/2/2010 5:03:51 PM -- Performance logging begins (interval: 15000 ms).
4/2/2010 5:03:51 PM -- Attaining prerequisites:
4/2/2010 5:04:59 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 727638000.0 (lower bound: 724775700.0, upper bound: none)
4/2/2010 7:04:59 PM -- Performance logging ends.
4/2/2010 8:38:39 PM -- JetInterop batch transaction stats: 105044, 104942 and 105083.
4/2/2010 8:38:40 PM -- Dispatching transactions ends.
4/2/2010 8:38:40 PM -- Shutting down databases ...
4/2/2010 8:38:42 PM -- Instance3756.1 (complete), Instance3756.2 (complete) and

```

Instance3756.3 (complete)
4/2/2010 8:38:43 PM -- Performance Logging begins (interval: 30000 ms).
4/2/2010 8:38:43 PM -- Verifying database checksums ...
4/3/2010 7:51:04 AM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
4/3/2010 7:51:04 AM -- Performance Logging ends.
4/3/2010 7:51:04 AM -- C:\ESRP3.0_1GBMB\Perf\DBChecksum_2010_4_2_20_38_42.blg has 1344 samples.
4/3/2010 7:51:07 AM -- C:\ESRP3.0_1GBMB\Perf\DBChecksum_2010_4_2_20_38_42.html is saved.
4/3/2010 7:51:07 AM -- Verifying log checksums ...
4/3/2010 7:51:14 AM -- C:\alogluns\log1 (11 log(s) processed), C:\alogluns\log2 (11 log(s) processed) and C:\alogluns\log3 (11 log(s) processed)
4/3/2010 7:51:14 AM -- C:\ESRP3.0_1GBMB\Perf\Performance_2010_4_2_17_3_46.blg has 484 samples.
4/3/2010 7:51:14 AM -- Creating test report ...
4/3/2010 7:51:16 AM -- Instance3756.1 has 9.4 for I/O Database Reads Average Latency.
4/3/2010 7:51:16 AM -- Instance3756.1 has 1.4 for I/O Log Writes Average Latency.
4/3/2010 7:51:16 AM -- Instance3756.1 has 1.4 for I/O Log Reads Average Latency.
4/3/2010 7:51:16 AM -- Instance3756.2 has 8.9 for I/O Database Reads Average Latency.
4/3/2010 7:51:16 AM -- Instance3756.2 has 1.4 for I/O Log Writes Average Latency.
4/3/2010 7:51:16 AM -- Instance3756.2 has 1.4 for I/O Log Reads Average Latency.
4/3/2010 7:51:16 AM -- Instance3756.3 has 8.9 for I/O Database Reads Average Latency.
4/3/2010 7:51:16 AM -- Instance3756.3 has 1.5 for I/O Log Writes Average Latency.
4/3/2010 7:51:16 AM -- Instance3756.3 has 1.5 for I/O Log Reads Average Latency.
4/3/2010 7:51:16 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/3/2010 7:51:16 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/3/2010 7:51:16 AM -- C:\ESRP3.0_1GBMB\Perf\Performance_2010_4_2_17_3_46.xml has 479 samples queried.

Performance Test Database Checksums Result: SUN141

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\asgluns\sg1\Jetstress001001.edb	47074914	0	0	0	1471091 MBytes / 40086 sec
C:\asgluns\sg2\Jetstress002001.edb	47075426	0	0	0	1471107 MBytes / 40340 sec
C:\asgluns\sg3\Jetstress003001.edb	47075426	0	0	0	1471107 MBytes / 38384 sec
(Sum)	141225766	0	0	0	4413305 MBytes / 40340 sec

Disk Subsystem Performance of Checksum

Logical Disk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Read
C:\asgluns\sg1	0.111	0.000	587.143	0.000	65536.000
C:\asgluns\sg2	0.112	0.000	583.430	0.000	65536.000
C:\asgluns\sg3	0.110	0.000	612.677	0.000	65536.000

Memory System Performance of Checksum

Counter	Average	Minimum	Maximum
% Processor Time	0.641	0.000	3.397
Available MBytes	30860.010	30846.000	30874.000
Free System Page Table Entries	33555131.408	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70459904.000	70418432.000	70672384.000
Pool Paged Bytes	92162724.571	91004928.000	94846976.000

Test Log

4/2/2010 5:03:39 PM -- Jetstress testing begins ...
 4/2/2010 5:03:39 PM -- Prepare testing begins ...
 4/2/2010 5:03:42 PM -- Attaching databases ...
 4/2/2010 5:03:42 PM -- Prepare testing ends.
 4/2/2010 5:03:42 PM -- Dispatching transactions begins ...
 4/2/2010 5:03:42 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 4/2/2010 5:03:42 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 4/2/2010 5:03:46 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 4/2/2010 5:03:46 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 4/2/2010 5:03:51 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 4/2/2010 5:03:51 PM -- Performance logging begins (interval: 15000 ms).
 4/2/2010 5:03:51 PM -- Attaining prerequisites:
 4/2/2010 5:04:59 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 727638000.0 (lower bound: 724775700.0, upper bound: none)
 4/2/2010 7:04:59 PM -- Performance logging ends.
 4/2/2010 8:38:39 PM -- JetInterop batch transaction stats: 105044, 104942 and 105083.
 4/2/2010 8:38:40 PM -- Dispatching transactions ends.
 4/2/2010 8:38:40 PM -- Shutting down databases ...
 4/2/2010 8:38:42 PM -- Instance3756.1 (complete), Instance3756.2 (complete) and Instance3756.3 (complete)
 4/2/2010 8:38:43 PM -- Performance logging begins (interval: 30000 ms).
 4/2/2010 8:38:43 PM -- Verifying database checksums ...
 4/3/2010 7:51:04 AM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 4/3/2010 7:51:04 AM -- Performance logging ends.
 4/3/2010 7:51:04 AM -- C:\ESRP3.0_1GBMB\Perf\DBChecksum_2010_4_2_20_38_42.blg has 1344 samples.

Stress Test Database Performance Result: SUN141

Test Summary

Overall Test Result	Pass
Machine Name	SUN141
Test Description	
Test Start Time	4/3/2010 10:51:24 AM
Test End Time	4/4/2010 10:59:56 AM
Collection Start Time	4/3/2010 10:52:45 AM
Collection End Time	4/4/2010 10:52:42 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:\ESRP3.0_1GBMB\Stress\Stress_2010_4_3_10_51_31.blg C:\ESRP3.0_1GBMB\Stress\DBChecksum_2010_4_4_10_59_56.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	870.925
Target Transactional I/O per Second	516
Initial Database Size (bytes)	4627685900288
Final Database Size (bytes)	4657364795392
Database Files (Count)	3

Jetstress System Parameters

Thread Count	6 (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

Instance3756.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3756.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3756.3	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
Instance3756.1	9.445	3.666	182.649	107.806	33093.271	34986.155	0.000	1.388	0.000	81.546	0.000	5032.425
Instance3756.2	8.920	3.531	182.471	107.624	33163.255	34974.830	0.000	1.416	0.000	80.648	0.000	5058.012
Instance3756.3	8.912	3.427	182.638	107.738	33167.329	34975.654	0.000	1.447	0.000	80.699	0.000	5062.950

Background Database Maintenance I/O Performance

MSExchange Database => Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3756.1	28.948	261880.284
Instance3756.2	29.213	261884.129
Instance3756.3	29.423	261875.670

Log Replication I/O Performance

MSExchange Database => Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3756.1	1.679	232557.982
Instance3756.2	1.669	232559.953
Instance3756.3	1.672	232558.935

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
--	--	---	--------------------------------	---------------------------------	---	--	---	--	---------------------------	----------------------------	------------------------------------	-------------------------------------

	<i>ge Laten cy (mse c)</i>	<i>ge Laten cy (mse c)</i>			<i>Bytes</i>	<i>ge Bytes</i>	<i>Late ncy (mse c)</i>	<i>Late ncy (mse c)</i>				<i>Byte s</i>
Instance3 756.1	9.445	3.666	211.59 7	107.80 6	64392 .754	34986 .155	2.055	1.388	1.679	81.546	232557 .982	5032. 425
Instance3 756.2	8.920	3.531	211.68 4	107.62 4	64727 .391	34974 .830	2.128	1.416	1.669	80.648	232559 .953	5058. 012
Instance3 756.3	8.912	3.427	212.06 1	107.73 8	64900 .364	34975 .654	2.618	1.447	1.672	80.699	232558 .935	5062. 950

Host System Performance

<i>Counter</i>	<i>Average</i>	<i>Minimum</i>	<i>Maximum</i>
% Processor Time	0.960	0.000	4.080
Available MBytes	30042.050	30029.000	30062.000
Free System Page Table Entries	33555127.938	33555118.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70269820.152	70197248.000	70328320.000
Pool Paged Bytes	92952699.485	91852800.000	97304576.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

4/3/2010 10: 51: 24 AM -- Jetstress testing begins ...
 4/3/2010 10: 51: 24 AM -- Prepare testing begins ...
 4/3/2010 10: 51: 28 AM -- Attaching databases ...
 4/3/2010 10: 51: 28 AM -- Prepare testing ends.
 4/3/2010 10: 51: 28 AM -- Dispatching transactions begins ...
 4/3/2010 10: 51: 28 AM -- Database cache settings: (minimum: 96.0 MB, maximum:
 768.0 MB)
 4/3/2010 10: 51: 28 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 4/3/2010 10: 51: 31 AM -- Database read latency thresholds: (average: 20 msec/read,
 maximum: 200 msec/read).
 4/3/2010 10: 51: 31 AM -- Log write latency thresholds: (average: 10 msec/write,
 maximum: 200 msec/write).
 4/3/2010 10: 51: 36 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%,
 Replaces 5%, Reads 35%, Lazy Commits 70%.
 4/3/2010 10: 51: 36 AM -- Performance logging begins (interval: 15000 ms).
 4/3/2010 10: 51: 36 AM -- Attaining prerequisites:
 4/3/2010 10: 52: 45 AM -- \MSExchange Database(JetstressWin)\Database Cache Size,
 Last: 731373600.0 (lower bound: 724775700.0, upper bound: none)
 4/4/2010 10: 52: 45 AM -- Performance logging ends.
 4/4/2010 10: 59: 54 AM -- JetInterop batch transaction stats: 702762, 701991 and
 702082.
 4/4/2010 10: 59: 55 AM -- Dispatching transactions ends.
 4/4/2010 10: 59: 55 AM -- Shutting down databases ...
 4/4/2010 10: 59: 56 AM -- Instance3756.1 (complete), Instance3756.2 (complete) and
 Instance3756.3 (complete)
 4/4/2010 10: 59: 57 AM -- Performance logging begins (interval: 30000 ms).
 4/4/2010 10: 59: 57 AM -- Verifying database checksums ...
 4/4/2010 10: 38: 50 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100%
 processed) and C:\asgluns\sg3 (100% processed)
 4/4/2010 10: 38: 50 PM -- Performance logging ends.
 4/4/2010 10: 38: 50 PM -- C:\ESRP3.0_1GBMB\Stress\DBChecksum_2010_4_4_10_59_56.blg
 has 1397 samples.

4/4/2010 10:38:54 PM -- C:\ESRP3.0_1GBMB\Stress\DBChecksum_2010_4_4_10_59_56.html is saved.
 4/4/2010 10:38:54 PM -- Verifying log checksums ...
 4/4/2010 10:39:02 PM -- C:\alogluns\log1 (11 log(s) processed), C:\alogluns\log2 (11 log(s) processed) and C:\alogluns\log3 (13 log(s) processed)
 4/4/2010 10:39:02 PM -- C:\ESRP3.0_1GBMB\Stress\Stress_2010_4_3_10_51_31.blg has 5759 samples.
 4/4/2010 10:39:02 PM -- Creating test report ...
 4/4/2010 10:39:22 PM -- Instance3756.1 has 9.4 for I/O Database Reads Average Latency.
 4/4/2010 10:39:22 PM -- Instance3756.1 has 1.4 for I/O Log Writes Average Latency.
 4/4/2010 10:39:22 PM -- Instance3756.1 has 1.4 for I/O Log Reads Average Latency.
 4/4/2010 10:39:22 PM -- Instance3756.2 has 8.9 for I/O Database Reads Average Latency.
 4/4/2010 10:39:22 PM -- Instance3756.2 has 1.4 for I/O Log Writes Average Latency.
 4/4/2010 10:39:22 PM -- Instance3756.2 has 1.4 for I/O Log Reads Average Latency.
 4/4/2010 10:39:22 PM -- Instance3756.3 has 8.9 for I/O Database Reads Average Latency.
 4/4/2010 10:39:22 PM -- Instance3756.3 has 1.4 for I/O Log Writes Average Latency.
 4/4/2010 10:39:22 PM -- Instance3756.3 has 1.4 for I/O Log Reads Average Latency.
 4/4/2010 10:39:22 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 4/4/2010 10:39:22 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 4/4/2010 10:39:22 PM -- C:\ESRP3.0_1GBMB\Stress\Stress_2010_4_3_10_51_31.xml has 5754 samples queried.

Stress Test Database Checksums Result: SUN141

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\asgluns\sg1\Jetstress001001.edb	47377762	0	0	0	1480555 MBytes / 40546 sec
C:\asgluns\sg2\Jetstress002001.edb	47376482	0	0	0	1480515 MBytes / 41933 sec
C:\asgluns\sg3\Jetstress003001.edb	47377250	0	0	0	1480539 MBytes / 38388 sec
(Sum)	142131494	0	0	0	4441609 MBytes / 41933 sec

Disk Subsystem Performance of Checksum

Logical Disk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Read
C:\asgluns\sg1	0.111	0.000	583.713	0.000	65536.000
C:\asgluns\sg2	0.112	0.000	564.895	0.000	65536.000
C:\asgluns\sg3	0.110	0.000	617.062	0.000	65536.000

Memory System Performance of Checksum

Counter	Average	Minimum	Maximum
% Processor Time	0.617	0.000	3.241
Available MBytes	30850.925	30835.000	30863.000
Free System Page Table Entries	33555131.208	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70619704.807	70504448.000	70762496.000
Pool Paged Bytes	92617860.673	91602944.000	95313920.000

Test Log

```

4/3/2010 10:51:24 AM -- Jetstress testing begins ...
4/3/2010 10:51:24 AM -- Prepare testing begins ...
4/3/2010 10:51:28 AM -- Attaching databases ...
4/3/2010 10:51:28 AM -- Prepare testing ends.
4/3/2010 10:51:28 AM -- Dispatching transactions begins ...
4/3/2010 10:51:28 AM -- Database cache settings: (minimum: 96.0 MB, maximum:
768.0 MB)
4/3/2010 10:51:28 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/3/2010 10:51:31 AM -- Database read latency thresholds: (average: 20 msec/read,
maximum: 200 msec/read).
4/3/2010 10:51:31 AM -- Log write latency thresholds: (average: 10 msec/write,
maximum: 200 msec/write).
4/3/2010 10:51:36 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%,
Replaces 5%, Reads 35%, Lazy Commits 70%.
4/3/2010 10:51:36 AM -- Performance logging begins (interval: 15000 ms).
4/3/2010 10:51:36 AM -- Attaining prerequisites:
4/3/2010 10:52:45 AM -- \MSExchange Database(JetstressWin)\Database Cache Size,
Last: 731373600.0 (lower bound: 724775700.0, upper bound: none)
4/4/2010 10:52:45 AM -- Performance logging ends.
4/4/2010 10:59:54 AM -- JetInterop batch transaction stats: 702762, 701991 and
702082.
4/4/2010 10:59:55 AM -- Dispatching transactions ends.
4/4/2010 10:59:55 AM -- Shutting down databases ...
4/4/2010 10:59:56 AM -- Instance3756.1 (complete), Instance3756.2 (complete) and
Instance3756.3 (complete)
4/4/2010 10:59:57 AM -- Performance logging begins (interval: 30000 ms).
4/4/2010 10:59:57 AM -- Verifying database checksums ...
4/4/2010 10:38:50 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100%
processed) and C:\asgluns\sg3 (100% processed)
4/4/2010 10:38:50 PM -- Performance logging ends.
4/4/2010 10:38:50 PM -- C:\ESRP3.0_1GBMB\Stress\DBChecksum_2010_4_4_10_59_56.blg
has 1397 samples.

```

Database Backup Test Result: SUN141

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance3756.1	1480547.09	12:20:48	33.31
Instance3756.2	1480507.09	14:01:31	29.32
Instance3756.3	1480531.09	13:57:29	29.46

Jetstress System Parameters

Thread Count	6 (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

Instance3756.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3756.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3756.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb

Transactional I/O Performance

MSExchange Database => Instance	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
Instance3756.1	11.179	0.000	133.254	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3756.2	14.525	0.000	117.238	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3756.3	14.098	0.000	117.851	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	0.366	0.000	2.576
Available MBytes	30864.292	30851.000	30869.000
Free System Page Table Entries	33555131.040	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70285767.382	70270976.000	70385664.000
Pool Paged Bytes	95090449.351	94269440.000	97300480.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

4/5/2010 2:19:19 AM -- Jetstress testing begins ...
4/5/2010 2:19:19 AM -- Prepare testing begins ...
4/5/2010 2:19:23 AM -- Attaching databases ...
4/5/2010 2:19:23 AM -- Prepare testing ends.
4/5/2010 2:19:29 AM -- Performance logging begins (interval: 30000 ms).
4/5/2010 2:19:29 AM -- Backing up databases ...
4/5/2010 4:21:01 PM -- Performance logging ends.
4/5/2010 4:21:01 PM -- Instance3756.1 (100% processed), Instance3756.2 (100% processed) and Instance3756.3 (100% processed)
4/5/2010 4:21:01 PM --
C:\ESRP3.0_1GBMB\DatabaseBackup\DatabaseBackup_2010_4_5_2_19_23.blg has 1682 samples.
4/5/2010 4:21:01 PM -- Creating test report ...

Soft Recovery Test Result: SUN141

Soft Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance3756.1	502	669.8963767
Instance3756.2	511	675.9959874
Instance3756.3	500	682.8911995

Database Configuration

Instance3756.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3756.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3756.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb

Transactional I/O Performance

MSExchange Database => Instance	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
Instance3756.1	26.545	15.997	793.031	4.495	36428.781	31382.042	11.324	0.000	6.742	0.000	218968.426	0.000
Instance3756.2	26.885	16.508	802.734	4.543	36069.006	31789.851	14.085	0.005	6.822	0.018	220961.212	1.528
Instance3756.3	25.446	15.825	781.545	4.387	36367.001	31604.639	12.943	0.000	6.589	0.000	216717.801	0.000

Background Database Maintenance I/O Performance

MSExchange Database => Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3756.1	25.155	261853.627
Instance3756.2	25.359	261800.846
Instance3756.3	25.749	261977.233

Total I/O Performance

MSExchange Database => Instance	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
Instance3756.1	26.545	15.997	818.186	4.495	43359.523	31382.042	11.324	0.000	6.742	0.000	218968.426	0.000
Instance3756.2	26.885	16.508	828.093	4.543	42981.763	31789.851	14.085	0.005	6.822	0.018	220961.212	1.528
Instance3756.3	25.446	15.825	807.294	4.387	43562.884	31604.639	12.943	0.000	6.589	0.000	216717.801	0.000

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	3.028	0.000	24.709
Available MBytes	30039.094	30015.000	30759.000
Free System Page Table Entries	33555131.855	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	74925844.389	71077888.000	75444224.000
Pool Paged Bytes	95241194.855	95227904.000	95264768.000
Database Page Fault Stalls/sec	0.007	0.000	0.994

Test Log

```
4/5/2010 7:03:23 PM -- Jetstress testing begins ...
4/5/2010 7:03:23 PM -- Prepare testing begins ...
4/5/2010 7:03:26 PM -- Attaching databases ...
4/5/2010 7:03:26 PM -- Prepare testing ends.
4/5/2010 7:03:26 PM -- Dispatching transactions begins ...
4/5/2010 7:03:26 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0
MB)
4/5/2010 7:03:26 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/5/2010 7:03:30 PM -- Database read latency thresholds: (average: 20 msec/read,
maximum: 100 msec/read).
4/5/2010 7:03:30 PM -- Log write latency thresholds: (average: 10 msec/write,
maximum: 100 msec/write).
4/5/2010 7:03:33 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%,
Replaces 5%, Reads 35%, Lazy Commits 70%.
4/5/2010 7:03:33 PM -- Performance logging begins (interval: 15000 ms).
4/5/2010 7:03:33 PM -- Generating log files ...
4/5/2010 7:45:19 PM -- C:\al o g l u n s \ l o g 1 (100.6% generated), C:\al o g l u n s \ l o g 2
(102.4% generated) and C:\al o g l u n s \ l o g 3 (100.2% generated)
4/5/2010 7:45:19 PM -- Performance logging ends.
4/5/2010 7:45:19 PM -- JetInterop batch transaction stats: 21965, 21967 and
21792.
4/5/2010 7:45:19 PM -- Dispatching transactions ends.
4/5/2010 7:45:19 PM -- Shutting down databases ...
4/5/2010 7:45:20 PM -- Instance3756.1 (complete), Instance3756.2 (complete) and
Instance3756.3 (complete)
4/5/2010 7:45:20 PM --
C:\ESRP3.0_1GBMB\SoftRecovery\Performance_2010_4_5_19_3_30.blg has 166 samples.
4/5/2010 7:45:20 PM -- Creating test report ...
4/5/2010 7:45:20 PM -- Instance3756.1 has 7.3 for I/O Database Reads Average
Latency.
4/5/2010 7:45:20 PM -- Instance3756.1 has 1.4 for I/O Log Writes Average Latency.
4/5/2010 7:45:20 PM -- Instance3756.1 has 1.4 for I/O Log Reads Average Latency.
4/5/2010 7:45:20 PM -- Instance3756.2 has 6.8 for I/O Database Reads Average
Latency.
4/5/2010 7:45:20 PM -- Instance3756.2 has 1.4 for I/O Log Writes Average Latency.
4/5/2010 7:45:20 PM -- Instance3756.2 has 1.4 for I/O Log Reads Average Latency.
4/5/2010 7:45:20 PM -- Instance3756.3 has 6.8 for I/O Database Reads Average
Latency.
4/5/2010 7:45:20 PM -- Instance3756.3 has 1.4 for I/O Log Writes Average Latency.
4/5/2010 7:45:20 PM -- Instance3756.3 has 1.4 for I/O Log Reads Average Latency.
4/5/2010 7:45:20 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/5/2010 7:45:20 PM -- Test has 0 Database Page Fault Stalls/sec samples higher
than 0.
4/5/2010 7:45:20 PM --
C:\ESRP3.0_1GBMB\SoftRecovery\Performance_2010_4_5_19_3_30.xml has 165 samples
queried.
4/5/2010 7:45:20 PM --
C:\ESRP3.0_1GBMB\SoftRecovery\Performance_2010_4_5_19_3_30.html is saved.
```

4/5/2010 8:25:42 PM -- Performance Logging begins (interval: 2000 ms).
 4/5/2010 8:25:42 PM -- Recovering databases ...
 4/5/2010 8:37:05 PM -- Performance Logging ends.
 4/5/2010 8:37:05 PM -- Instance3756.1 (669.8963767), Instance3756.2 (675.9959874)
 and Instance3756.3 (682.8911995)
 4/5/2010 8:37:05 PM --
 C:\ESRP3.0_1GBMB\SoftRecovery\SoftRecovery_2010_4_5_20_25_39.blg has 339 samples.
 4/5/2010 8:37:05 PM -- Creating test report ...

Soft Recovery Test Performance Result: SUN141

Test Summary

Overall Test Result	Pass
Machine Name	SUN141
Test Description	
Test Start Time	4/5/2010 7:03:23 PM
Test End Time	4/5/2010 7:45:20 PM
Collection Start Time	4/5/2010 7:03:48 PM
Collection End Time	4/5/2010 7:45:04 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:\ESRP3.0_1GBMB\SoftRecovery\Performance_2010_4_5_19_3_30.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1305.987
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	4657364795392
Final Database Size (bytes)	4658295930880
Database Files (Count)	3

Jetstress System Parameters

Thread Count	6 (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

Instance3756.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3756.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3756.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb

Transactional I/O Performance

MSExchange Database => Instance	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
Instance3756.1	7.270	4.266	263.313	168.467	32793.500	34311.022	0.000	1.396	0.000	90.674	0.000	4829.740
Instance3756.2	6.767	4.052	265.674	171.354	32790.588	34298.914	0.000	1.409	0.000	90.976	0.000	4905.287
Instance3756.3	6.831	3.801	266.684	170.494	32787.263	34289.399	0.000	1.388	0.000	90.575	0.000	4830.622

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.191	0.000	4.645
Available MBytes	30038.217	30019.000	30554.000
Free System Page Table Entries	33555132.880	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70679885.108	70356992.000	70864896.000
Pool Paged Bytes	95164983.518	95145984.000	95223808.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

4/5/2010 7:03:23 PM -- Jetstress testing begins ...
4/5/2010 7:03:23 PM -- Prepare testing begins ...
4/5/2010 7:03:26 PM -- Attaching databases ...
4/5/2010 7:03:26 PM -- Prepare testing ends.
4/5/2010 7:03:26 PM -- Dispatching transactions begins ...
4/5/2010 7:03:26 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
4/5/2010 7:03:26 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/5/2010 7:03:30 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

```

4/5/2010 7:03:30 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 4/5/2010 7:03:33 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 4/5/2010 7:03:33 PM -- Performance logging begins (interval: 15000 ms).
 4/5/2010 7:03:33 PM -- Generating log files ...
 4/5/2010 7:45:19 PM -- C:\alogluns\log1 (100.6% generated), C:\alogluns\log2 (102.4% generated) and C:\alogluns\log3 (100.2% generated)
 4/5/2010 7:45:19 PM -- Performance logging ends.
 4/5/2010 7:45:19 PM -- JetInterop batch transaction stats: 21965, 21967 and 21792.
 4/5/2010 7:45:19 PM -- Dispatching transactions ends.
 4/5/2010 7:45:19 PM -- Shutting down databases ...
 4/5/2010 7:45:20 PM -- Instance3756.1 (complete), Instance3756.2 (complete) and Instance3756.3 (complete)
 4/5/2010 7:45:20 PM --
 C:\ESRP3.0_1GBMB\SoftRecovery\Performance_2010_4_5_19_3_30.blg has 166 samples.
 4/5/2010 7:45:20 PM -- Creating test report ...
 4/5/2010 7:45:20 PM -- Instance3756.1 has 7.3 for I/O Database Reads Average Latency.
 4/5/2010 7:45:20 PM -- Instance3756.1 has 1.4 for I/O Log Writes Average Latency.
 4/5/2010 7:45:20 PM -- Instance3756.1 has 1.4 for I/O Log Reads Average Latency.
 4/5/2010 7:45:20 PM -- Instance3756.2 has 6.8 for I/O Database Reads Average Latency.
 4/5/2010 7:45:20 PM -- Instance3756.2 has 1.4 for I/O Log Writes Average Latency.
 4/5/2010 7:45:20 PM -- Instance3756.2 has 1.4 for I/O Log Reads Average Latency.
 4/5/2010 7:45:20 PM -- Instance3756.3 has 6.8 for I/O Database Reads Average Latency.
 4/5/2010 7:45:20 PM -- Instance3756.3 has 1.4 for I/O Log Writes Average Latency.
 4/5/2010 7:45:20 PM -- Instance3756.3 has 1.4 for I/O Log Reads Average Latency.
 4/5/2010 7:45:20 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 4/5/2010 7:45:20 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 4/5/2010 7:45:20 PM --
 C:\ESRP3.0_1GBMB\SoftRecovery\Performance_2010_4_5_19_3_30.xml has 165 samples queried.



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