

# Hitachi Adaptable Modular Storage 2500 Dynamically Provisioned 100,800 User Exchange 2010 Mailbox 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 100,800 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-5 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 100,800 users with a 0.12 IOPS per user profile and user mailbox size of 1GB. A 2500 with 477 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.

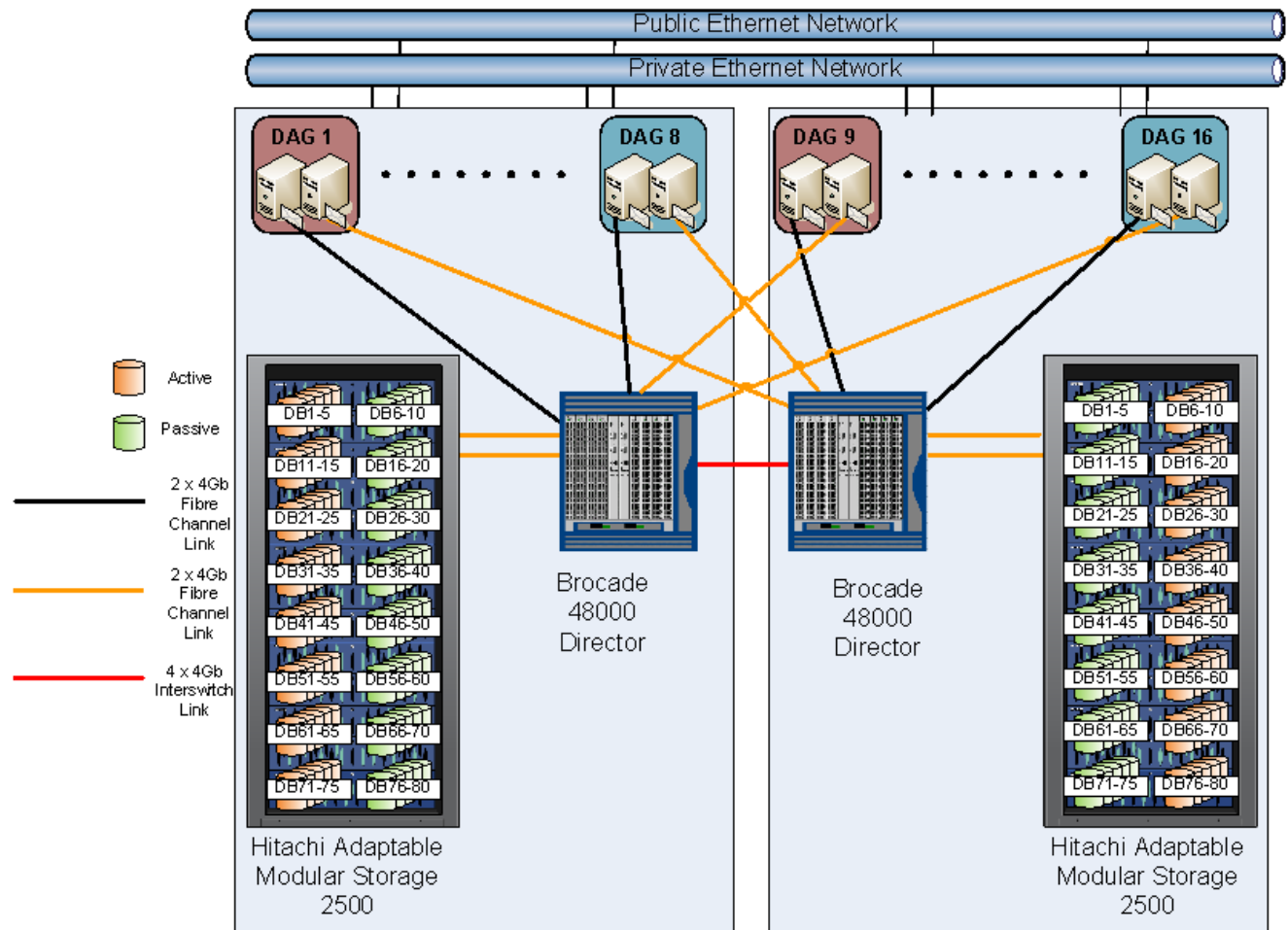
Any server in a DAG can host a copy of a mailbox database from any other server in the DAG. When a server is added to a DAG, it monitors and works with the other servers in the DAG to provide automatic recovery delivering a robust, highly-available Exchange solution without the administrative complexities 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 five databases. To target the 100,800 user resiliency solution, a Hitachi Adaptable Modular Storage 2500 configured with 477 disks (480 is the maximum) and 16 host servers, each configured with 6,300 mailboxes, were used to host the 80 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 storage system's disks were organized into RAID groups for use by either databases or logs. Each set of colored disks represents a RAID-5 (8D+1P) 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**

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

		Database RAID Groups
		Log RAID Groups

Two Dynamic Provisioning pools were created, one for the databases and other for the logs. The database pool was created from 47 RAID-5 groups and the log pool was created from six RAID-5 groups. From the database pool, 80 DP-VOLs (each specified to have a 1750GB size limit) were created for 80 databases (six per server). From the log pool, 80 DP-VOLs (each specified to have a size limit of 175GB) were created for 80 logs (five 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	1-5	0-4
0B	6-10	5-9
0C	11-15	10-14.
0D	16-20	15-19.
0E	21-25	20-14.
0F	26-30	24-29
0G	31-35	30-34
0H	36-40	35-39
1A	41-45	40-44
1B	46-50	45-49
1C	51-55	50-54
1D	56-60	55-59
1E	61-65	60-64
1F	66-70	65-69
1G	71-75	70-74
1H	76-80	75-79

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	1-5	80-84
0B	6-10	85-89
0C	11-15	90-94
0D	16-20	94-99
0E	21-25	100-104
0F	26-30	105-109
0G	31-35	110-114
0H	36-40	115-119
1A	41-45	120-124
1B	46-50	125-129
1C	51-55	130-134
1D	56-60	135-139
1E	61-65	140-144
1F	66-70	145-149
1G	71-75	150-154
1H	76-80	155-159

Table 5 provides the detailed specifications for the storage configuration which uses RAID-5 (8D+1P) 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	0-4	1750	Databases 1-5
SUN142	0	0B/1B	5-9	1750	Databases 6-10
SUN143	0	0C/1C	10-14.	1750	Databases 11-15
SUN144	0	0D/1D	15-19.	1750	Databases 16-20
SUN145	0	0E/1E	20-14.	1750	Databases 21-25
SUN146	0	0F/1F	24-29	1750	Databases 26-30
SUN147	0	0G/1G	30-34	1750	Databases 31-35
SUN148	0	0H/1H	35-39	1750	Databases 36-40
SUN153	0	1A/0A	40-44	1750	Databases 41-45
SUN154	0	1B/0B	45-49	1750	Databases 46-50
SUN155	0	1C/0C	50-54	1750	Databases 51-55
SUN156	0	1D/0D	55-59	1750	Databases 56-60
SUN165	0	1E/0E	60-64	1750	Databases 61-65
SUN166	0	1F/0F	65-69	1750	Databases 66-70
SUN167	0	1G/0G	70-74	1750	Databases 71-75
SUN168	0	1H/0H	75-79	1750	Databases 76-80
SUN141	1	0A/1A	80-84	175	Logs 1-5
SUN142	1	0B/1B	85-89	175	Logs 6-10
SUN143	1	0C/1C	90-94	175	Logs 11-15
SUN144	1	0D/1D	94-99	175	Logs 16-20
SUN145	1	0E/1E	100-104	175	Logs 21-25
SUN146	1	0F/1F	105-109	175	Logs 26-30
SUN147	1	0G/1G	110-114	175	Logs 31-35
SUN148	1	0H/1H	115-119	175	Logs 36-40
SUN153	1	1A/0A	120-124	175	Logs 41-45
SUN154	1	1B/0B	125-129	175	Logs 46-50
SUN155	1	1C/0C	130-134	175	Logs 51-55
SUN156	1	1D/0D	135-139	175	Logs 56-60
SUN165	1	1E/0E	140-144	175	Logs 61-65
SUN166	1	1F/0F	145-149	175	Logs 66-70
SUN167	1	1G/0G	150-154	175	Logs 71-75
SUN168	1	1H/0H	155-159	175	Logs 76-80

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 100,800 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**

<b>Number of Exchange mailboxes simulated</b>	100,800
<b>Number of database availability groups (DAGs)</b>	16
<b>Number of servers per DAG</b>	2
<b>Number of active mailboxes per server</b>	6,300
<b>Number of databases per host</b>	5
<b>Number of copies per database</b>	2
<b>Number of mailboxes per database</b>	1,260
<b>Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)</b>	0.12
<b>Database LU size</b>	1750GB
<b>Log LU size</b>	175GB
<b>Total database size for performance testing</b>	100,800GB
<b>% storage capacity used by Exchange database**</b>	67.2%

\*\*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**

<b>Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)</b>	Fibre Channel
<b>Storage model and OS/firmware revision</b>	1 Hitachi Adaptable Modular Storage 2500 Firmware: 0890/B-Z WHQL listing: <a href="#">Hitachi Adaptable Modular Storage 2500</a>
<b>Storage cache</b>	32GB
<b>Number of storage controllers</b>	2
<b>Number of storage ports</b>	16
<b>Maximum bandwidth of storage connectivity to host</b>	64Gb/s (16 x 4Gbit/s ports)
<b>Switch type/model/firmware revision</b>	Brocade 5320, Fabric OS v6.3.0b
<b>HBA model and firmware</b>	Emulex LPe11002, FW:2.82A3
<b>Number of HBAs per host</b>	2 dual-ported HBA per host, 1 4Gbit/s port used per HBA
<b>Host server type</b>	Sun Fire 4270 2 2.54 GHz quad-core Intel Xeon CPUs, 32 GB memory
<b>Total number of disks tested in solution</b>	477
<b>Maximum number of spindles can be hosted in the storage</b>	480

**Table 8. Primary Storage Software**

<b>HBA Driver</b>	STOR Miniport 7.2.30.16
<b>HBA QueueTarget Setting</b>	0
<b>HBA QueueDepth Setting</b>	32
<b>Multipathing</b>	Hitachi Dynamic Link Manager v6.2.0
<b>Host OS</b>	Microsoft Windows Server 2008 R2 Enterprise
<b>ESE.dll file version</b>	14.00.0639.019
<b>Replication solution name/version</b>	N/A

**Table 9. Storage Disk Configuration (Mailbox Store Disks)**

<b>Disk type, speed and firmware revision</b>	SAS Disk 450GB 15K 4C57
<b>Raw capacity per disk (GB)</b>	450GB
<b>Number of physical disks in test</b>	432 (Dynamic Provisioning pool)
<b>Total raw storage capacity (GB)</b>	190,350GB
<b>Disk slice size (GB)</b>	N/A
<b>Number of slices per LUN or number of disks per LUN</b>	N/A
<b>RAID level</b>	RAID 5 (8D+1P) at storage level
<b>Total formatted capacity</b>	150,024GB (Dynamic Provisioning database pool)
<b>Storage capacity utilization</b>	78.8%
<b>Database capacity utilization</b>	73.5%

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

<b>Disk type, speed and firmware revision</b>	SAS Disk 450GB 15K 4C57
<b>Raw capacity per disk (GB)</b>	450GB
<b>Number of spindles in test</b>	54 (Dynamic Provisioning pool)
<b>Total raw storage capacity (GB)</b>	24,300GB
<b>Disk slice size (GB)</b>	N/A
<b>Number of slices per LU or number of disks per LU</b>	N/A
<b>RAID level</b>	RAID 5 (8D+1P) at storage level
<b>Total formatted capacity</b>	19,152GB (Dynamic Provisioning log pool)

# Replication Configuration

The following tables summarize the replication environment.

**Table 11. Replicated Configuration**

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

**Table 12. Replicated Storage Hardware**

<b>Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)</b>	Fibre Channel
<b>Storage model and OS/firmware revision</b>	1 Hitachi Adaptable Modular Storage 2500 Firmware: 0890/B-Z WHQL listing: <a href="#">Hitachi Adaptable Modular Storage 2500</a>
<b>Storage cache</b>	32GB
<b>Number of storage controllers</b>	2
<b>Number of storage ports</b>	16
<b>Maximum bandwidth of storage connectivity to host</b>	64Gb/s (16 x 4Gbit/s ports)
<b>Switch type/model/firmware revision</b>	Brocade 5320, Fabric OS v6.3.0b
<b>HBA model and firmware</b>	Emulex LPe11002, FW:2.82A3
<b>Number of HBAs per host</b>	2 dual-ported HBA per host, 1 4Gbit/s port used per HBA
<b>Host server type</b>	Sun Fire 4270 2 2.54 GHz quad-core Intel Xeon CPUs, 32 GB memory
<b>Total number of disks tested in solution</b>	477
<b>Maximum number of spindles can be hosted in the storage</b>	480

**Table 13. Replicated Storage Software**

<b>HBA Driver</b>	STOR Miniport 7.2.30.16
<b>HBA QueueTarget Setting</b>	0
<b>HBA QueueDepth Setting</b>	32
<b>Multipathing</b>	Hitachi Dynamic Link Manager v6.2.0
<b>Host OS</b>	Microsoft Windows Server 2008 R2 Enterprise
<b>ESE.dll file version</b>	14.00.0639.019
<b>Replication solution name/version</b>	Exchange Server 2010 Database Availability Group (DAG)

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

<b>Disk type, speed and firmware revision</b>	SAS Disk 450GB 15K 4C57
<b>Raw capacity per disk (GB)</b>	450GB
<b>Number of physical disks in test</b>	432 (Dynamic Provisioning pool)
<b>Total raw storage capacity (GB)</b>	190,350GB
<b>Disk slice size (GB)</b>	N/A
<b>Number of slices per LUN or number of disks per LUN</b>	N/A
<b>RAID level</b>	RAID 5 (8D+1P) at storage level
<b>Total formatted capacity</b>	120,019GB (Dynamic Provisioning database pool)
<b>Storage capacity utilization</b>	78.8%
<b>Database capacity utilization</b>	73.5%

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

<b>Disk type, speed and firmware revision</b>	SAS Disk 450GB 15K 4C57
<b>Raw capacity per disk (GB)</b>	450GB
<b>Number of spindles in test</b>	54 (Dynamic Provisioning pool)
<b>Total raw storage capacity (GB)</b>	24,300GB
<b>Disk slice size (GB)</b>	N/A
<b>Number of slices per LU or number of disks per LU</b>	N/A
<b>RAID level</b>	RAID 5 (8D+1P) at storage level
<b>Total formatted capacity</b>	15,322GB (Dynamic Provisioning log pool)

## 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. 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.
17. For more information about RAID-5 drive failure and rebuild, see Appendix A.

## 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.

Database I/O	
<i>Database disk transfers per second</i>	829
<i>Database disk reads per second</i>	519
<i>Database disk writes per second</i>	310
<i>Average database disk read latency (ms)</i>	16.3
<i>Average database disk write latency (ms)</i>	7.3
Transaction Log I/O	
<i>Log disk writes per second</i>	209
<i>Average log disk write latency (ms)</i>	4.8

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

Database I/O	
<i>Database disk transfers per second</i>	772
<i>Database disk reads per second</i>	483
<i>Database disk writes per second</i>	289
<i>Average database disk read latency (ms)</i>	16.4
<i>Average database disk write latency (ms)</i>	7.6
Transaction Log I/O	
<i>Log disk writes per second</i>	200
<i>Average log disk write latency (ms)</i>	4.7

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	758
<i>Database disk reads per second</i>	474
<i>Database disk writes per second</i>	284
<i>Average database disk read latency (ms)</i>	17.4
<i>Average database disk write latency (ms)</i>	8.1
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	191
<i>Average log disk write latency (ms)</i>	4.8

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	826
<i>Database disk reads per second</i>	517
<i>Database disk writes per second</i>	309
<i>Average database disk read latency (ms)</i>	15.9
<i>Average database disk write latency (ms)</i>	6.4
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	212
<i>Average log disk write latency (ms)</i>	4.3

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	892
<i>Database disk reads per second</i>	558
<i>Database disk writes per second</i>	334
<i>Average database disk read latency (ms)</i>	15.2
<i>Average database disk write latency (ms)</i>	6.3
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	234
<i>Average log disk write latency (ms)</i>	3.8

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	813
<i>Database disk reads per second</i>	509
<i>Database disk writes per second</i>	304
<i>Average database disk read latency (ms)</i>	15.6
<i>Average database disk write latency (ms)</i>	6.4
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	211
<i>Average log disk write latency (ms)</i>	4.4

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	884
<i>Database disk reads per second</i>	554
<i>Database disk writes per second</i>	330
<i>Average database disk read latency (ms)</i>	15.7
<i>Average database disk write latency (ms)</i>	6.5
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	229
<i>Average log disk write latency (ms)</i>	4.0

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	838
<i>Database disk reads per second</i>	524
<i>Database disk writes per second</i>	314
<i>Average database disk read latency (ms)</i>	15.9
<i>Average database disk write latency (ms)</i>	6.6
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	216
<i>Average log disk write latency (ms)</i>	4.2

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

Database I/O	
<i>Database disk transfers per second</i>	845
<i>Database disk reads per second</i>	529
<i>Database disk writes per second</i>	316
<i>Average database disk read latency (ms)</i>	15.8
<i>Average database disk write latency (ms)</i>	6.3
Transaction Log I/O	
<i>Log disk writes per second</i>	220
<i>Average log disk write latency (ms)</i>	3.9

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

Database I/O	
<i>Database disk transfers per second</i>	804
<i>Database disk reads per second</i>	503
<i>Database disk writes per second</i>	301
<i>Average database disk read latency (ms)</i>	16.1
<i>Average database disk write latency (ms)</i>	6.5
Transaction Log I/O	
<i>Log disk writes per second</i>	207
<i>Average log disk write latency (ms)</i>	4.7

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

Database I/O	
<i>Database disk transfers per second</i>	845
<i>Database disk reads per second</i>	529
<i>Database disk writes per second</i>	316
<i>Average database disk read latency (ms)</i>	16.1
<i>Average database disk write latency (ms)</i>	6.3
Transaction Log I/O	
<i>Log disk writes per second</i>	218
<i>Average log disk write latency (ms)</i>	4.2

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	827
<i>Database disk reads per second</i>	518
<i>Database disk writes per second</i>	309
<i>Average database disk read latency (ms)</i>	16.5
<i>Average database disk write latency (ms)</i>	7.2
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	208
<i>Average log disk write latency (ms)</i>	4.9

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	840
<i>Database disk reads per second</i>	526
<i>Database disk writes per second</i>	314
<i>Average database disk read latency (ms)</i>	15.6
<i>Average database disk write latency (ms)</i>	6.4
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	218
<i>Average log disk write latency (ms)</i>	4.0

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	861
<i>Database disk reads per second</i>	539
<i>Database disk writes per second</i>	322
<i>Average database disk read latency (ms)</i>	15.3
<i>Average database disk write latency (ms)</i>	6.3
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	227
<i>Average log disk write latency (ms)</i>	4.1

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	863
<i>Database disk reads per second</i>	541
<i>Database disk writes per second</i>	322
<i>Average database disk read latency (ms)</i>	15.8
<i>Average database disk write latency (ms)</i>	6.5
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	221
<i>Average log disk write latency (ms)</i>	4.2

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

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	853
<i>Database disk reads per second</i>	534
<i>Database disk writes per second</i>	319
<i>Average database disk read latency (ms)</i>	16.4
<i>Average database disk write latency (ms)</i>	7.3
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	216
<i>Average log disk write latency (ms)</i>	4.6

*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**

<b>Database I/O</b>	
<i>Database disk transfers per second</i>	13,350
<i>Database disk reads per second</i>	8,357
<i>Database disk writes per second</i>	4,993
<i>Average database disk read latency (ms)</i>	16.0
<i>Average database disk write latency (ms)</i>	6.7
<b>Transaction Log I/O</b>	
<i>Log disk writes per second</i>	3,447
<i>Average log disk write latency (ms)</i>	4.3

## 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>	27.2
<i>MB read per second total per server</i>	135.9

### 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>	1.78
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## Conclusion

This document details a tested a robust Exchange Server 2010 Resiliency solution capable of supporting 100,800 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 sixteen 4Gbit/s Fibre Channel host paths, using Hitachi Dynamic Provisioning (with two pools) and 477 450GB 15K RPM SAS disks in a RAID-5 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 100,800 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 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 — RAID-5 Drive Failure and Rebuild

These ESRP tests used RAID-5 (8D+1P) rather than RAID-6 (for example, 4D+2P) or RAID-1+0 (for example, 4D+4D). RAID-5 is a much more capacity-efficient RAID level than the others, losing only 12.5 percent of the usable space (using 8D+1P) instead of 33 percent (4D+2P) or 50 percent (4D+4D). One downside with the use of parity RAID instead of mirrored and striped (RAID-1+0) is that for *writes*, the internal disk write penalty is higher. For SAS or Fibre Channel disks, RAID-5 requires four physical disk I/Os on the backend for every host write, whereas RAID-1+0 consumes two physical I/Os. RAID-6 requires six physical I/Os for each host write.

The other downside is the RAID group rebuild time after a sudden disk failure. The Hitachi Adaptable Modular Storage 2000 family is always scanning the storage system looking for *soft fails*, because excessive soft fails often predict a hard failure. If the number of soft fails exceeds the failure threshold in a 24-hour period (user parameter driven), the 2000 family storage system first executes a disk-to-disk copy to a global hot spare (thus avoiding a RAID-5 or RAID-6 rebuild), and then marks the disk as *failed* and replaces it.

If hard fail does occur, for RAID-1+0, the contents of the good disk are mirrored onto a spare disk (these 'hot spares' are user defined to be in several disk enclosures on a storage system). For RAID-5 and RAID-6, all disks in the RAID group must be read to recreate the missing data and parity that was on the failed disk onto the spare disk. This rebuild mode is called *Corrective Copy*. An associated array setting called *[Drive] Restore Options* determines how aggressive the rebuild operation is in the face of ongoing host I/Os. This setting has three levels: aggressive, moderate and background.

Lab tests show that, on a RAID-6 group using Fibre Channel disks (the only sample available), and an *aggressive* Restore Option setting, a RAID-6 (8D+2P) group Corrective Copy operation requires about 30 minutes to complete in the absence of host workloads on LUs from that RAID group. In the presence of sustained 100 percent sequential write workloads to LUs from that RAID group, this rebuild time increased to 18 hours. The host performance on a LU from that RAID group was measured at 154MB/s (normal state) and 95MB/s (Corrective Copy state). Had this been RAID-5, the Corrective Copy times would have been reduced.

## Appendix B — Test Reports

This appendix contains Jetstress test results for one of the servers used in testing this storage solution. These test results are representative of the results obtained for all of the servers tested.

### Performance Test Result: SUN141

#### Test Summary

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<b>Overall Test Result</b>	Pass
<b>Machine Name</b>	SUN141
<b>Test Description</b>	
<b>Test Start Time</b>	4/14/2010 9:53:23 PM
<b>Test End Time</b>	4/15/2010 12:06:17 AM
<b>Collection Start Time</b>	4/14/2010 9:55:46 PM
<b>Collection End Time</b>	4/14/2010 11:55:38 PM
<b>Jetstress Version</b>	14.01.0043.000
<b>Ese Version</b>	14.00.0639.019
<b>Operating System</b>	Windows Server 2008 R2 Enterprise (6.1.7600.0)
<b>Performance Log</b>	C:\ESRP3.0_Raid5\Perf\Performance_2010_4_14_21_53_36.blg C:\ESRP3.0_Raid5\Perf\DBChecksum_2010_4_15_0_6_17.blg

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#### Database Sizing and Throughput

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<b>Achieved Transactional I/O per Second</b>	829.407
<b>Target Transactional I/O per Second</b>	756
<b>Initial Database Size (bytes)</b>	8106297065472
<b>Final Database Size (bytes)</b>	8108956254208
<b>Database Files (Count)</b>	5

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#### Jetstress System Parameters

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<b>Thread Count</b>	6 (per database)
<b>Minimum Database Cache</b>	160.0 MB
<b>Maximum Database Cache</b>	1280.0 MB
<b>Insert Operations</b>	40%
<b>Delete Operations</b>	20%
<b>Replace Operations</b>	5%
<b>Read Operations</b>	35%
<b>Lazy Commits</b>	70%
<b>Run Background Database Maintenance</b>	True
<b>Number of Copies per Database</b>	2

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## Database Configuration

<b>Instance640.1</b>	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
<b>Instance640.2</b>	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
<b>Instance640.3</b>	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb
<b>Instance640.4</b>	Log Path: C:\alogluns\log4 Database: C:\asgluns\sg4\Jetstress004001.edb
<b>Instance640.5</b>	Log Path: C:\alogluns\log5 Database: C:\asgluns\sg5\Jetstress005001.edb

## Transactional I/O Performance

<b>MSExchange Database =&gt; Instance</b>	<b>I/O Database Reads Average Latency (msec)</b>	<b>I/O Database Writes Average Latency (msec)</b>	<b>I/O Database Reads/sec</b>	<b>I/O Database Writes/sec</b>	<b>I/O Database Reads Average Bytes</b>	<b>I/O Database Writes Average Bytes</b>	<b>I/O Log Reads Average Latency (msec)</b>	<b>I/O Log Writes Average Latency (msec)</b>	<b>I/O Log Reads/sec</b>	<b>I/O Log Writes/sec</b>	<b>I/O Log Reads Average Bytes</b>	<b>I/O Log Writes Average Bytes</b>
Instance 640.1	15.917	8.009	104.187	62.444	34929.424	35004.168	0.000	3.989	0.000	42.370	0.000	5556.203
Instance 640.2	16.315	7.602	104.595	62.460	34332.823	35076.556	0.000	7.103	0.000	41.216	0.000	5850.789
Instance 640.3	16.822	7.122	102.956	61.536	34811.061	35057.663	0.000	4.366	0.000	41.411	0.000	5599.127
Instance 640.4	16.872	7.200	103.479	61.834	34790.631	35069.783	0.000	4.681	0.000	41.516	0.000	5660.498
Instance 640.5	15.339	6.600	103.750	62.166	34911.794	35026.143	0.000	4.014	0.000	41.988	0.000	5556.033

## Background Database Maintenance I/O Performance

<b>MSExchange Database =&gt; Instances</b>	<b>Database Maintenance IO Reads/sec</b>	<b>Database Maintenance IO Reads Average Bytes</b>
Instance640.1	23.002	261914.428
Instance640.2	20.342	261869.329
Instance640.3	20.336	261944.311
Instance640.4	20.328	261900.594
Instance640.5	22.268	261799.830

### Log Replication I/O Performance

<i>MSExchange Database =&gt; Instances</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Reads Average Bytes</i>
Instance640.1	0.973	230572.232
Instance640.2	0.993	229419.712
Instance640.3	0.958	230069.053
Instance640.4	0.973	230578.688
Instance640.5	0.964	230617.850

### Total I/O Performance

<i>MSExchange Database =&gt; Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads /sec</i>	<i>I/O Database Writes /sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads /sec</i>	<i>I/O Log Writes /sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance 640.1	15.917	8.009	127.189	62.444	75979.401	35004.168	9.548	3.989	0.973	42.370	230572.232	5556.203
Instance 640.2	16.315	7.602	124.937	62.460	71379.966	35076.556	39.041	7.103	0.993	41.216	229419.712	5850.789
Instance 640.3	16.822	7.122	123.292	61.536	72274.886	35057.663	13.415	4.366	0.958	41.411	230069.053	5599.127
Instance 640.4	16.872	7.200	123.807	61.834	72079.685	35069.783	13.221	4.681	0.973	41.516	230578.688	5660.498
Instance 640.5	15.339	6.600	126.018	62.166	75003.941	35026.143	9.276	4.014	0.964	41.988	230617.850	5556.033

### Host System Performance

<i>Counter</i>	<i>Average</i>	<i>Minimum</i>	<i>Maximum</i>
% Processor Time	0.960	0.000	3.959
Available MBytes	29367.104	29353.000	29424.000
Free System Page Table Entries	33555642.925	33555637.000	33555643.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72426053.478	72249344.000	72609792.000
Pool Paged Bytes	96926581.044	96522240.000	97034240.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

## Test Log

4/14/2010 9:53:23 PM -- Jetstress testing begins ...  
4/14/2010 9:53:23 PM -- Prepare testing begins ...  
4/14/2010 9:53:29 PM -- Attaching databases ...  
4/14/2010 9:53:29 PM -- Prepare testing ends.  
4/14/2010 9:53:29 PM -- Dispatching transactions begins ...  
4/14/2010 9:53:29 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)  
4/14/2010 9:53:29 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)  
4/14/2010 9:53:36 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).  
4/14/2010 9:53:36 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).  
4/14/2010 9:53:42 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.  
4/14/2010 9:53:42 PM -- Performance logging begins (interval: 15000 ms).  
4/14/2010 9:53:42 PM -- Attaining prerequisites:  
4/14/2010 9:55:46 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1209901000.0 (lower bound: 1207960000.0, upper bound: none)  
4/14/2010 11:55:46 PM -- Performance logging ends.  
4/15/2010 12:06:05 AM -- JetInterop batch transaction stats: 37488, 37836, 37226, 37519 and 37315.  
4/15/2010 12:06:08 AM -- Dispatching transactions ends.  
4/15/2010 12:06:08 AM -- Shutting down databases ...  
4/15/2010 12:06:17 AM -- Instance640.1 (complete), Instance640.2 (complete), Instance640.3 (complete), Instance640.4 (complete) and Instance640.5 (complete)  
4/15/2010 12:06:18 AM -- Performance logging begins (interval: 30000 ms).  
4/15/2010 12:06:18 AM -- Verifying database checksums ...  
4/15/2010 7:12:58 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed), C:\asgluns\sg3 (100% processed), C:\asgluns\sg4 (100% processed) and C:\asgluns\sg5 (100% processed)  
4/15/2010 7:12:58 PM -- Performance logging ends.  
4/15/2010 7:12:58 PM -- C:\ESRP3.0\_Raid5\Perf\DBChecksum\_2010\_4\_15\_0\_6\_17.blg has 2291 samples.  
4/15/2010 7:13:08 PM -- C:\ESRP3.0\_Raid5\Perf\DBChecksum\_2010\_4\_15\_0\_6\_17.html is saved.  
4/15/2010 7:13:08 PM -- Verifying log checksums ...  
4/15/2010 7:13:12 PM -- C:\alogluns\log1 (11 log(s) processed), C:\alogluns\log2 (12 log(s) processed), C:\alogluns\log3 (11 log(s) processed), C:\alogluns\log4 (11 log(s) processed) and C:\alogluns\log5 (11 log(s) processed)  
4/15/2010 7:13:12 PM -- C:\ESRP3.0\_Raid5\Perf\Performance\_2010\_4\_14\_21\_53\_36.blg has 487 samples.  
4/15/2010 7:13:12 PM -- Creating test report ...  
4/15/2010 7:13:14 PM -- Instance640.1 has 15.9 for I/O Database Reads Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.1 has 4.0 for I/O Log Writes Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.1 has 4.0 for I/O Log Reads Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.2 has 16.3 for I/O Database Reads Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.2 has 7.1 for I/O Log Writes Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.2 has 7.1 for I/O Log Reads Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.3 has 16.8 for I/O Database Reads Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.3 has 4.4 for I/O Log Writes Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.3 has 4.4 for I/O Log Reads Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.4 has 16.9 for I/O Database Reads Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.4 has 4.7 for I/O Log Writes Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.4 has 4.7 for I/O Log Reads Average Latency.  
4/15/2010 7:13:14 PM -- Instance640.5 has 15.3 for I/O Database Reads Average Latency.

4/15/2010 7:13:14 PM -- Instance640.5 has 4.0 for I/O Log Writes Average Latency.  
 4/15/2010 7:13:14 PM -- Instance640.5 has 4.0 for I/O Log Reads Average Latency.  
 4/15/2010 7:13:14 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.  
 4/15/2010 7:13:14 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.  
 4/15/2010 7:13:14 PM -- C:\ESRP3.0\_Raid5\Perf\Performance\_2010\_4\_14\_21\_53\_36.xml has 478 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	49493090	0	0	0	1546659 MBytes / 68800 sec
C:\asgluns\sg2\Jetstress002001.edb	49494114	0	0	0	1546691 MBytes / 54316 sec
C:\asgluns\sg3\Jetstress003001.edb	49492322	0	0	0	1546635 MBytes / 58146 sec
C:\asgluns\sg4\Jetstress004001.edb	49493090	0	0	0	1546659 MBytes / 55364 sec
C:\asgluns\sg5\Jetstress005001.edb	49493090	0	0	0	1546659 MBytes / 68692 sec
(Sum)	247465706	0	0	0	7733303 MBytes / 68800 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	0.154	0.000	358.617	0.000	65536.000
C:\asgluns\sg2	0.120	0.000	455.486	0.000	65536.000
C:\asgluns\sg3	0.127	0.000	425.513	0.000	65536.000
C:\asgluns\sg4	0.122	0.000	446.990	0.000	65536.000
C:\asgluns\sg5	0.154	0.000	359.893	0.000	65536.000

### Memory System Performance of Checksum

Counter	Average	Minimum	Maximum
% Processor Time	0.767	0.000	3.667
Available MBytes	30733.347	30720.000	30746.000
Free System Page Table Entries	33555640.702	33555633.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72504711.990	72417280.000	72654848.000
Pool Paged Bytes	98256653.744	96681984.000	100663296.000

## Test Log

4/14/2010 9:53:23 PM -- Jetstress testing begins ...  
4/14/2010 9:53:23 PM -- Prepare testing begins ...  
4/14/2010 9:53:29 PM -- Attaching databases ...  
4/14/2010 9:53:29 PM -- Prepare testing ends.  
4/14/2010 9:53:29 PM -- Dispatching transactions begins ...  
4/14/2010 9:53:29 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)  
4/14/2010 9:53:29 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)  
4/14/2010 9:53:36 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).  
4/14/2010 9:53:36 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).  
4/14/2010 9:53:42 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.  
4/14/2010 9:53:42 PM -- Performance logging begins (interval: 15000 ms).  
4/14/2010 9:53:42 PM -- Attaining prerequisites:  
4/14/2010 9:55:46 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1209901000.0 (lower bound: 1207960000.0, upper bound: none)  
4/14/2010 11:55:46 PM -- Performance logging ends.  
4/15/2010 12:06:05 AM -- JetInterop batch transaction stats: 37488, 37836, 37226, 37519 and 37315.  
4/15/2010 12:06:08 AM -- Dispatching transactions ends.  
4/15/2010 12:06:08 AM -- Shutting down databases ...  
4/15/2010 12:06:17 AM -- Instance640.1 (complete), Instance640.2 (complete), Instance640.3 (complete), Instance640.4 (complete) and Instance640.5 (complete)  
4/15/2010 12:06:18 AM -- Performance logging begins (interval: 30000 ms).  
4/15/2010 12:06:18 AM -- Verifying database checksums ...  
4/15/2010 7:12:58 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed), C:\asgluns\sg3 (100% processed), C:\asgluns\sg4 (100% processed) and C:\asgluns\sg5 (100% processed)  
4/15/2010 7:12:58 PM -- Performance logging ends.  
4/15/2010 7:12:58 PM -- C:\ESRP3.0\_Raid5\Perf\DBChecksum\_2010\_4\_15\_0\_6\_17.blg has 2291 samples.

## Stress Test Database Performance Result: SUN141

### Test Summary

<b>Overall Test Result</b>	Pass
<b>Machine Name</b>	SUN141
<b>Test Description</b>	
<b>Test Start Time</b>	4/16/2010 11:00:56 AM
<b>Test End Time</b>	4/17/2010 11:16:50 AM
<b>Collection Start Time</b>	4/16/2010 11:03:08 AM
<b>Collection End Time</b>	4/17/2010 11:02:58 AM
<b>Jetstress Version</b>	14.01.0043.000
<b>Ese Version</b>	14.00.0639.019
<b>Operating System</b>	Windows Server 2008 R2 Enterprise (6.1.7600.0)
<b>Performance Log</b>	C:\ESRP3.0_Raid5\Stress\Stress_2010_4_16_11_1_8.blg C:\ESRP3.0_Raid5\Stress\DBChecksum_2010_4_17_11_16_50.blg

### Database Sizing and Throughput

---

<b>Achieved Transactional I/O per Second</b>	832.076
<b>Target Transactional I/O per Second</b>	756
<b>Initial Database Size (bytes)</b>	8109543456768
<b>Final Database Size (bytes)</b>	8138475765760
<b>Database Files (Count)</b>	5

---

### Jetstress System Parameters

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<b>Thread Count</b>	6 (per database)
<b>Minimum Database Cache</b>	160.0 MB
<b>Maximum Database Cache</b>	1280.0 MB
<b>Insert Operations</b>	40%
<b>Delete Operations</b>	20%
<b>Replace Operations</b>	5%
<b>Read Operations</b>	35%
<b>Lazy Commits</b>	70%
<b>Run Background Database Maintenance</b>	True
<b>Number of Copies per Database</b>	2

---

### Database Configuration

---

<b>Instance640.1</b>	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
<b>Instance640.2</b>	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
<b>Instance640.3</b>	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb
<b>Instance640.4</b>	Log Path: C:\alogluns\log4 Database: C:\asgluns\sg4\Jetstress004001.edb
<b>Instance640.5</b>	Log Path: C:\alogluns\log5 Database: C:\asgluns\sg5\Jetstress005001.edb

---

### Transactional I/O Performance

<b>MSExchange Database =&gt; Instance</b>	<b>I/O Database Reads Average Latency (msec)</b>	<b>I/O Database Writes Average Latency (msec)</b>	<b>I/O Database Reads/sec</b>	<b>I/O Database Writes/sec</b>	<b>I/O Database Reads Average Bytes</b>	<b>I/O Database Writes Average Bytes</b>	<b>I/O Log Reads Average Latency (msec)</b>	<b>I/O Log Writes Average Latency (msec)</b>	<b>I/O Log Reads/sec</b>	<b>I/O Log Writes/sec</b>	<b>I/O Log Reads Average Bytes</b>	<b>I/O Log Writes Average Bytes</b>
Instance 640.1	16.865	8.299	104.008	62.168	34643.146	35013.480	0.000	4.449	0.000	41.827	0.000	5617.379
Instance 640.2	17.649	8.920	104.211	62.273	34296.484	35018.937	0.000	6.785	0.000	40.825	0.000	5760.675
Instance 640.3	16.154	6.840	104.267	62.363	34714.451	35003.822	0.000	4.071	0.000	42.223	0.000	5571.343
Instance 640.4	17.404	7.710	103.900	62.085	34577.159	35003.512	0.000	4.918	0.000	40.975	0.000	5688.104
Instance 640.5	16.350	7.094	104.370	62.432	34674.104	35007.643	0.000	4.566	0.000	41.615	0.000	5652.220

### Background Database Maintenance I/O Performance

<b>MSExchange Database =&gt; Instances</b>	<b>Database Maintenance IO Reads/sec</b>	<b>Database Maintenance IO Reads Average Bytes</b>
Instance640.1	21.136	261875.968
Instance640.2	19.156	261869.116
Instance640.3	21.283	261866.417
Instance640.4	19.387	261851.031
Instance640.5	20.265	261851.747

### Log Replication I/O Performance

<b>MSExchange Database =&gt; Instances</b>	<b>I/O Log Reads/sec</b>	<b>I/O Log Reads Average Bytes</b>
Instance640.1	0.969	229984.312
Instance640.2	0.969	231069.824
Instance640.3	0.969	230519.721
Instance640.4	0.963	231006.708
Instance640.5	0.971	231268.109

### 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 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
Instance 640.1	16.865	8.299	125.144	62.168	73021.912	35013.480	13.002	4.449	0.969	41.827	229984.312	5617.379
Instance 640.2	17.649	8.920	123.367	62.273	69633.814	35018.937	34.292	6.785	0.969	40.825	231069.824	5760.675
Instance 640.3	16.154	6.840	125.550	62.363	73220.892	35003.822	11.280	4.071	0.969	42.223	230519.721	5571.343
Instance 640.4	17.404	7.710	123.287	62.085	70316.585	35003.512	15.172	4.918	0.963	40.975	231006.708	5688.104
Instance 640.5	16.350	7.094	124.634	62.432	71611.425	35007.643	11.730	4.566	0.971	41.615	231268.109	5652.220

### Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.892	0.000	7.661
Available MBytes	29360.125	29352.000	29441.000
Free System Page Table Entries	33555642.964	33555635.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72607524.991	72409088.000	72966144.000
Pool Paged Bytes	99495451.688	98263040.000	104591360.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

### Test Log

```

4/16/2010 10:10:51 AM -- Jetstress testing begins ...
4/16/2010 10:10:51 AM -- Prepare testing begins ...
4/16/2010 10:10:56 AM -- Attaching databases ...
4/16/2010 10:10:56 AM -- Prepare testing ends.
4/16/2010 10:10:56 AM -- Dispatching transactions begins ...
4/16/2010 10:10:56 AM -- Database cache settings: (minimum: 160.0 MB, maximum:
1.2 GB)
4/16/2010 10:10:56 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6
MB)
4/16/2010 10:11:03 AM -- Database read latency thresholds: (average: 20
msec/read, maximum: 200 msec/read).
4/16/2010 10:11:03 AM -- Log write latency thresholds: (average: 10 msec/write,
maximum: 200 msec/write).
4/16/2010 10:11:09 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%,
Replaces 5%, Reads 35%, Lazy Commits 70%.
4/16/2010 10:11:09 AM -- Performance logging begins (interval: 15000 ms).
4/16/2010 10:11:09 AM -- Attaining prerequisites:
4/16/2010 10:13:01 AM -- \MSExchange Database(JetstressWin)\Database Cache Size,

```

Last: 1210290000.0 (lower bound: 1207960000.0, upper bound: none)  
4/16/2010 10:54:28 AM -- Performance logging ends.  
4/16/2010 10:54:34 AM -- JetInterop batch transaction stats: 8323, 8471, 8227, 8335 and 8358.  
4/16/2010 10:54:34 AM -- Dispatching transactions ends.  
4/16/2010 10:54:34 AM -- Shutting down databases ...  
4/16/2010 10:54:43 AM -- Instance640.1 (complete), Instance640.2 (complete), Instance640.3 (complete), Instance640.4 (complete) and Instance640.5 (complete)  
4/16/2010 10:54:44 AM -- Performance logging begins (interval: 30000 ms).  
4/16/2010 10:54:44 AM -- Verifying database checksums ...  
4/16/2010 10:58:36 AM -- C:\asgluns\sg1 (0% processed), C:\asgluns\sg2 (0% processed), C:\asgluns\sg3 (0% processed), C:\asgluns\sg4 (0% processed) and C:\asgluns\sg5 (0% processed)  
4/16/2010 10:58:37 AM -- Verifying log checksums ...  
4/16/2010 10:58:37 AM -- C:\alogluns\log1 (0 log(s) processed), C:\alogluns\log2 (0 log(s) processed), C:\alogluns\log3 (0 log(s) processed), C:\alogluns\log4 (0 log(s) processed) and C:\alogluns\log5 (0 log(s) processed)  
4/16/2010 10:58:37 AM -- C:\ESRP3.0\_Raid5\Stress\Stress\_2010\_4\_16\_10\_11\_3.blg has 172 samples.  
4/16/2010 10:58:37 AM -- Creating test report ...  
4/16/2010 10:58:37 AM -- Instance640.1 has 37.0 for I/O Database Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.1 has 13.5 for I/O Log Writes Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.1 has 13.5 for I/O Log Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.2 has 45.4 for I/O Database Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.2 has 21.2 for I/O Log Writes Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.2 has 21.2 for I/O Log Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.3 has 27.0 for I/O Database Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.3 has 8.6 for I/O Log Writes Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.3 has 8.6 for I/O Log Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.4 has 26.3 for I/O Database Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.4 has 8.2 for I/O Log Writes Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.4 has 8.2 for I/O Log Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.5 has 35.2 for I/O Database Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.5 has 14.6 for I/O Log Writes Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.5 has 14.6 for I/O Log Reads Average Latency.  
4/16/2010 10:58:37 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.  
4/16/2010 10:58:37 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.  
4/16/2010 10:58:37 AM -- C:\ESRP3.0\_Raid5\Stress\Stress\_2010\_4\_16\_10\_11\_3.xml has 164 samples queried.  
4/16/2010 10:58:38 AM -- C:\ESRP3.0\_Raid5\Stress\Stress\_2010\_4\_16\_10\_11\_3.html is saved.  
4/16/2010 10:58:38 AM -- C:\ESRP3.0\_Raid5\Stress\Appl icati on\_2010\_4\_16\_10\_58\_38.evt is saved.  
4/16/2010 10:58:38 AM -- C:\ESRP3.0\_Raid5\Stress\System\_2010\_4\_16\_10\_58\_38.evt is saved.  
4/16/2010 10:58:38 AM -- Jetstress testing ends.  
4/16/2010 11:00:56 AM -- Jetstress testing begins ...  
4/16/2010 11:00:56 AM -- Prepare testing begins ...  
4/16/2010 11:01:01 AM -- Attaching databases ...  
4/16/2010 11:01:01 AM -- Prepare testing ends.  
4/16/2010 11:01:01 AM -- Dispatching transactions begins ...  
4/16/2010 11:01:01 AM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)  
4/16/2010 11:01:01 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6

MB)

4/16/2010 11:01:08 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).  
4/16/2010 11:01:08 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).  
4/16/2010 11:01:15 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.  
4/16/2010 11:01:15 AM -- Performance logging begins (interval: 15000 ms).  
4/16/2010 11:01:15 AM -- Attaining prerequisites:  
4/16/2010 11:03:08 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1210757000.0 (lower bound: 1207960000.0, upper bound: none)  
4/17/2010 11:03:09 AM -- Performance logging ends.  
4/17/2010 11:16:34 AM -- JetInterop batch transaction stats: 409055, 410495, 409233, 408905 and 410360.  
4/17/2010 11:16:36 AM -- Dispatching transactions ends.  
4/17/2010 11:16:36 AM -- Shutting down databases ...  
4/17/2010 11:16:50 AM -- Instance640.1 (complete), Instance640.2 (complete), Instance640.3 (complete), Instance640.4 (complete) and Instance640.5 (complete)  
4/17/2010 11:16:51 AM -- Performance logging begins (interval: 30000 ms).  
4/17/2010 11:16:51 AM -- Verifying database checksums ...  
4/18/2010 6:41:25 AM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed), C:\asgluns\sg3 (100% processed), C:\asgluns\sg4 (100% processed) and C:\asgluns\sg5 (100% processed)  
4/18/2010 6:41:25 AM -- Performance logging ends.  
4/18/2010 6:41:25 AM -- C:\ESRP3.0\_Raid5\Stress\DBChecksum\_2010\_4\_17\_11\_16\_50.blg has 2328 samples.  
4/18/2010 6:41:35 AM -- C:\ESRP3.0\_Raid5\Stress\DBChecksum\_2010\_4\_17\_11\_16\_50.html is saved.  
4/18/2010 6:41:35 AM -- Verifying log checksums ...  
4/18/2010 6:41:36 AM -- C:\alogluns\log1 (11 log(s) processed), C:\alogluns\log2 (11 log(s) processed), C:\alogluns\log3 (11 log(s) processed), C:\alogluns\log4 (10 log(s) processed) and C:\alogluns\log5 (10 log(s) processed)  
4/18/2010 6:41:36 AM -- C:\ESRP3.0\_Raid5\Stress\Stress\_2010\_4\_16\_11\_1\_8.blg has 5758 samples.  
4/18/2010 6:41:36 AM -- Creating test report ...  
4/18/2010 6:42:05 AM -- Instance640.1 has 16.9 for I/O Database Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.1 has 4.4 for I/O Log Writes Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.1 has 4.4 for I/O Log Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.2 has 17.6 for I/O Database Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.2 has 6.8 for I/O Log Writes Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.2 has 6.8 for I/O Log Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.3 has 16.2 for I/O Database Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.3 has 4.1 for I/O Log Writes Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.3 has 4.1 for I/O Log Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.4 has 17.4 for I/O Database Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.4 has 4.9 for I/O Log Writes Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.4 has 4.9 for I/O Log Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.5 has 16.4 for I/O Database Reads Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.5 has 4.6 for I/O Log Writes Average Latency.  
4/18/2010 6:42:05 AM -- Instance640.5 has 4.6 for I/O Log Reads Average Latency.  
4/18/2010 6:42:05 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.  
4/18/2010 6:42:05 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.  
4/18/2010 6:42:05 AM -- C:\ESRP3.0\_Raid5\Stress\Stress\_2010\_4\_16\_11\_1\_8.xml has 5750 samples queried.

## Stress Test Database Checksums Result: SUN141

### Checksum Statistics - All

<i>Database</i>	<i>Seen pages</i>	<i>Bad pages</i>	<i>Correctable pages</i>	<i>Wrong page-number pages</i>	<i>File length / seconds taken</i>
C:\asgluns\sg1\Jetstress001001.edb	49673570	0	0	0	1552299 MBytes / 68736 sec
C:\asgluns\sg2\Jetstress002001.edb	49674594	0	0	0	1552331 MBytes / 69298 sec
C:\asgluns\sg3\Jetstress003001.edb	49672546	0	0	0	1552267 MBytes / 58670 sec
C:\asgluns\sg4\Jetstress004001.edb	49672034	0	0	0	1552251 MBytes / 69874 sec
C:\asgluns\sg5\Jetstress005001.edb	49673826	0	0	0	1552307 MBytes / 67878 sec
(Sum)	248366570	0	0	0	7761455 MBytes / 69874 sec

### Disk Subsystem Performance of Checksum

<i>Logical Disk</i>	<i>Avg. Disk sec/Read</i>	<i>Avg. Disk sec/Write</i>	<i>Disk Reads/sec</i>	<i>Disk Writes/sec</i>	<i>Avg. Disk Bytes/Read</i>
C:\asgluns\sg1	0.172	0.000	361.321	0.000	65536.000
C:\asgluns\sg2	0.187	0.000	358.071	0.000	65536.000
C:\asgluns\sg3	0.129	0.000	423.180	0.000	65536.000
C:\asgluns\sg4	0.172	0.000	355.474	0.000	65536.000
C:\asgluns\sg5	0.184	0.000	365.712	0.000	65536.000

### Memory System Performance of Checksum

<i>Counter</i>	<i>Average</i>	<i>Minimum</i>	<i>Maximum</i>
% Processor Time	0.759	0.000	3.739
Available MBytes	30722.796	30704.000	30739.000
Free System Page Table Entries	33555643.087	33555641.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72937304.852	72802304.000	73203712.000
Pool Paged Bytes	99148235.216	98086912.000	101662720.000

## Test Log

4/16/2010 10:10:51 AM -- Jetstress testing begins ...  
4/16/2010 10:10:51 AM -- Prepare testing begins ...  
4/16/2010 10:10:56 AM -- Attaching databases ...  
4/16/2010 10:10:56 AM -- Prepare testing ends.  
4/16/2010 10:10:56 AM -- Dispatching transactions begins ...  
4/16/2010 10:10:56 AM -- Database cache settings: (minimum: 160.0 MB, maximum:  
1.2 GB)  
4/16/2010 10:10:56 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6  
MB)  
4/16/2010 10:11:03 AM -- Database read latency thresholds: (average: 20  
msec/read, maximum: 200 msec/read).  
4/16/2010 10:11:03 AM -- Log write latency thresholds: (average: 10 msec/write,  
maximum: 200 msec/write).  
4/16/2010 10:11:09 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%,  
Replaces 5%, Reads 35%, Lazy Commits 70%.  
4/16/2010 10:11:09 AM -- Performance logging begins (interval: 15000 ms).  
4/16/2010 10:11:09 AM -- Attaining prerequisites:  
4/16/2010 10:13:01 AM -- \MSExchange Database(JetstressWin)\Database Cache Size,  
Last: 1210290000.0 (lower bound: 1207960000.0, upper bound: none)  
4/16/2010 10:54:28 AM -- Performance logging ends.  
4/16/2010 10:54:34 AM -- JetInterop batch transaction stats: 8323, 8471, 8227,  
8335 and 8358.  
4/16/2010 10:54:34 AM -- Dispatching transactions ends.  
4/16/2010 10:54:34 AM -- Shutting down databases ...  
4/16/2010 10:54:43 AM -- Instance640.1 (complete), Instance640.2 (complete),  
Instance640.3 (complete), Instance640.4 (complete) and Instance640.5 (complete)  
4/16/2010 10:54:44 AM -- Performance logging begins (interval: 30000 ms).  
4/16/2010 10:54:44 AM -- Verifying database checksums ...  
4/16/2010 10:58:36 AM -- C:\asgluns\sg1 (0% processed), C:\asgluns\sg2 (0%  
processed), C:\asgluns\sg3 (0% processed), C:\asgluns\sg4 (0% processed) and  
C:\asgluns\sg5 (0% processed)  
4/16/2010 10:58:37 AM -- Verifying log checksums ...  
4/16/2010 10:58:37 AM -- C:\alogluns\log1 (0 log(s) processed), C:\alogluns\log2  
(0 log(s) processed), C:\alogluns\log3 (0 log(s) processed), C:\alogluns\log4 (0  
log(s) processed) and C:\alogluns\log5 (0 log(s) processed)  
4/16/2010 10:58:37 AM -- C:\ESRP3.0\_Raid5\Stress\Stress\_2010\_4\_16\_10\_11\_3.blg has  
172 samples.  
4/16/2010 10:58:37 AM -- Creating test report ...  
4/16/2010 10:58:37 AM -- Instance640.1 has 37.0 for I/O Database Reads Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.1 has 13.5 for I/O Log Writes Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.1 has 13.5 for I/O Log Reads Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.2 has 45.4 for I/O Database Reads Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.2 has 21.2 for I/O Log Writes Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.2 has 21.2 for I/O Log Reads Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.3 has 27.0 for I/O Database Reads Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.3 has 8.6 for I/O Log Writes Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.3 has 8.6 for I/O Log Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.4 has 26.3 for I/O Database Reads Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.4 has 8.2 for I/O Log Writes Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.4 has 8.2 for I/O Log Reads Average Latency.  
4/16/2010 10:58:37 AM -- Instance640.5 has 35.2 for I/O Database Reads Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.5 has 14.6 for I/O Log Writes Average  
Latency.  
4/16/2010 10:58:37 AM -- Instance640.5 has 14.6 for I/O Log Reads Average  
Latency.

4/16/2010 10:58:37 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.  
 4/16/2010 10:58:37 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.  
 4/16/2010 10:58:37 AM -- C:\ESRP3.0\_Raid5\Stress\Stress\_2010\_4\_16\_10\_11\_3.xml has 164 samples queried.  
 4/16/2010 10:58:38 AM -- C:\ESRP3.0\_Raid5\Stress\Stress\_2010\_4\_16\_10\_11\_3.html is saved.  
 4/16/2010 10:58:38 AM -- C:\ESRP3.0\_Raid5\Stress\Application\_2010\_4\_16\_10\_58\_38.evt is saved.  
 4/16/2010 10:58:38 AM -- C:\ESRP3.0\_Raid5\Stress\System\_2010\_4\_16\_10\_58\_38.evt is saved.  
 4/16/2010 10:58:38 AM -- Jetstress testing ends.  
 4/16/2010 11:00:56 AM -- Jetstress testing begins ...  
 4/16/2010 11:00:56 AM -- Prepare testing begins ...  
 4/16/2010 11:01:01 AM -- Attaching databases ...  
 4/16/2010 11:01:01 AM -- Prepare testing ends.  
 4/16/2010 11:01:01 AM -- Dispatching transactions begins ...  
 4/16/2010 11:01:01 AM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)  
 4/16/2010 11:01:01 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)  
 4/16/2010 11:01:08 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).  
 4/16/2010 11:01:08 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).  
 4/16/2010 11:01:15 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.  
 4/16/2010 11:01:15 AM -- Performance logging begins (interval: 15000 ms).  
 4/16/2010 11:01:15 AM -- Attaining prerequisites:  
 4/16/2010 11:03:08 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1210757000.0 (lower bound: 1207960000.0, upper bound: none)  
 4/17/2010 11:03:09 AM -- Performance logging ends.  
 4/17/2010 11:16:34 AM -- JetInterop batch transaction stats: 409055, 410495, 409233, 408905 and 410360.  
 4/17/2010 11:16:36 AM -- Dispatching transactions ends.  
 4/17/2010 11:16:36 AM -- Shutting down databases ...  
 4/17/2010 11:16:50 AM -- Instance640.1 (complete), Instance640.2 (complete), Instance640.3 (complete), Instance640.4 (complete) and Instance640.5 (complete)  
 4/17/2010 11:16:51 AM -- Performance logging begins (interval: 30000 ms).  
 4/17/2010 11:16:51 AM -- Verifying database checksums ...  
 4/18/2010 6:41:25 AM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed), C:\asgluns\sg3 (100% processed), C:\asgluns\sg4 (100% processed) and C:\asgluns\sg5 (100% processed)  
 4/18/2010 6:41:25 AM -- Performance logging ends.  
 4/18/2010 6:41:25 AM -- C:\ESRP3.0\_Raid5\Stress\DBChecksum\_2010\_4\_17\_11\_16\_50.blg has 2328 samples.

## Database Backup Test Result: SUN141

### *Database Backup Statistics - All*

<i>Database Instance</i>	<i>Database Size (MBytes)</i>	<i>Elapsed Backup Time</i>	<i>MBytes Transferred/sec</i>
Instance640.1	1552291.09	16:11:47	26.62
Instance640.2	1552323.09	16:08:09	26.72
Instance640.3	1552259.09	16:07:17	26.75
Instance640.4	1552243.09	16:10:17	26.66
Instance640.5	1552299.09	16:03:32	26.85

## Jetstress System Parameters

<b>Thread Count</b>	6 (per database)
<b>Minimum Database Cache</b>	160.0 MB
<b>Maximum Database Cache</b>	1280.0 MB
<b>Insert Operations</b>	40%
<b>Delete Operations</b>	20%
<b>Replace Operations</b>	5%
<b>Read Operations</b>	35%
<b>Lazy Commits</b>	70%

## Database Configuration

<b>Instance640.1</b>	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
<b>Instance640.2</b>	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
<b>Instance640.3</b>	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb
<b>Instance640.4</b>	Log Path: C:\alogluns\log4 Database: C:\asgluns\sg4\Jetstress004001.edb
<b>Instance640.5</b>	Log Path: C:\alogluns\log5 Database: C:\asgluns\sg5\Jetstress005001.edb

## Transactional I/O Performance

<b>MSExchange Databases Instance</b>	<b>I/O Datab ase Read s Avera ge Laten cy (msec )</b>	<b>I/O Datab ase Write s Avera ge Laten cy (msec )</b>	<b>I/O Datab ase Reads/ sec</b>	<b>I/O Datab ase Writes /sec</b>	<b>I/O Datab ase Reads Averag e Bytes</b>	<b>I/O Datab ase Write s Avera ge Bytes</b>	<b>I/O Log Read s Aver age Laten cy (msec )</b>	<b>I/O Log Write s Aver age Laten cy (msec )</b>	<b>I/O Log Reads/ sec</b>	<b>I/O Log Writes /sec</b>	<b>I/O Log Read s Aver age Byte s</b>	<b>I/O Log Write s Aver age Byte s</b>
Instance 640.1	16.205	0.000	106.425	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance 640.2	15.480	0.000	106.778	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance 640.3	15.429	0.000	106.875	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance 640.4	15.784	0.000	106.561	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance 640.5	15.215	0.000	107.392	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

## Host System Performance

<b>Counter</b>	<b>Average</b>	<b>Minimum</b>	<b>Maximum</b>
% Processor Time	0.393	0.000	2.980
Available MBytes	30733.703	30717.000	30739.000
Free System Page Table Entries	33555643.106	33555635.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72676385.236	72663040.000	72790016.000
Pool Paged Bytes	103228147.470	102465536.000	105136128.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

## Test Log

4/18/2010 9:36:47 PM -- Jetstress testing begins ...  
4/18/2010 9:36:47 PM -- Prepare testing begins ...  
4/18/2010 9:36:53 PM -- Attaching databases ...  
4/18/2010 9:36:53 PM -- Prepare testing ends.  
4/18/2010 9:37:02 PM -- Performance Logging begins (interval: 30000 ms).  
4/18/2010 9:37:02 PM -- Backing up databases ...  
4/19/2010 1:48:50 PM -- Performance Logging ends.  
4/19/2010 1:48:50 PM -- Instance640.1 (100% processed), Instance640.2 (100% processed), Instance640.3 (100% processed), Instance640.4 (100% processed) and Instance640.5 (100% processed)  
4/19/2010 1:48:50 PM -- C:\ESRP3.0\_Raid5\BackupTest\DatabaseBackup\_2010\_4\_18\_21\_36\_53.blg has 1941 samples.  
4/19/2010 1:48:50 PM -- Creating test report ...

## Soft Recovery Test Result: SUN141

### Soft Recovery Statistics - All

<b>Database Instance</b>	<b>Log files replayed</b>	<b>Elapsed seconds</b>
Instance640.1	517	914.4112061
Instance640.2	509	907.2507935
Instance640.3	500	886.2999567
Instance640.4	507	913.8808051
Instance640.5	502	878.3439427

## Database Configuration

<b>Instance640.1</b>	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
<b>Instance640.2</b>	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
<b>Instance640.3</b>	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb
<b>Instance640.4</b>	Log Path: C:\alogluns\log4 Database: C:\asgluns\sg4\Jetstress004001.edb
<b>Instance640.5</b>	Log Path: C:\alogluns\log5 Database: C:\asgluns\sg5\Jetstress005001.edb

## Transactional I/O Performance

<b>MSExchange Database =&gt; Instance</b>	<b>I/O Database Reads Average Latency (msec)</b>	<b>I/O Database Writes Average Latency (msec)</b>	<b>I/O Database Reads /sec</b>	<b>I/O Database Writes /sec</b>	<b>I/O Database Average Reads Bytes</b>	<b>I/O Database Average Writes Bytes</b>	<b>I/O Log Reads Average Latency (msec)</b>	<b>I/O Log Writes Average Latency (msec)</b>	<b>I/O Log Reads /sec</b>	<b>I/O Log Writes /sec</b>	<b>I/O Log Reads Average Bytes</b>	<b>I/O Log Writes Average Bytes</b>
Instance 640.1	19.916	11.913	646.853	3.401	36017.939	32478.018	16.099	0.000	5.101	0.000	229381.827	0.000
Instance 640.2	19.544	11.982	632.204	3.358	35769.122	32768.000	13.444	0.000	5.037	0.000	232578.135	0.000
Instance 640.3	18.137	11.696	667.338	3.386	36162.334	32618.374	17.282	0.000	5.080	0.000	230384.485	0.000
Instance 640.4	18.822	11.969	623.325	3.335	35997.142	32478.018	14.207	0.000	5.003	0.000	230386.110	0.000
Instance 640.5	19.239	11.493	650.993	3.445	35911.298	32616.995	15.032	0.020	5.168	0.003	231276.340	2.359

## Background Database Maintenance I/O Performance

<b>MSExchange Database =&gt; Instances</b>	<b>Database Maintenance IO Reads/sec</b>	<b>Database Maintenance IO Reads Average Bytes</b>
Instance640.1	21.647	261916.481
Instance640.2	21.512	261881.884
Instance640.3	21.492	261830.101
Instance640.4	22.009	261974.453
Instance640.5	20.620	261910.669

### 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 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
Instance 640.1	19.916	11.913	668.500	3.401	43332.904	32478.018	16.009	0.000	5.101	0.000	229381.827	0.000
Instance 640.2	19.544	11.982	653.716	3.358	43209.929	32768.000	13.444	0.000	5.037	0.000	232578.135	0.000
Instance 640.3	18.137	11.696	688.831	3.386	43203.456	32618.374	17.282	0.000	5.080	0.000	230384.485	0.000
Instance 640.4	18.822	11.969	645.334	3.335	43704.061	32478.018	14.207	0.000	5.003	0.000	230386.110	0.000
Instance 640.5	19.239	11.493	671.613	3.445	42849.975	32616.995	15.002	0.020	5.168	0.003	231276.340	2.359

### Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.949	0.000	11.940
Available MBytes	29371.907	29335.000	30568.000
Free System Page Table Entries	33555644.965	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	78880497.339	73302016.000	79429632.000
Pool Paged Bytes	103733545.727	103718912.000	103780352.000
Database Page Fault Stalls/sec	0.003	0.000	0.497

### Test Log

4/19/2010 9: 07: 34 PM -- Jetstress testing begins ...  
 4/19/2010 9: 07: 34 PM -- Prepare testing begins ...  
 4/19/2010 9: 07: 40 PM -- Attaching databases ...  
 4/19/2010 9: 07: 40 PM -- Prepare testing ends.  
 4/19/2010 9: 07: 40 PM -- Dispatching transactions begins ...  
 4/19/2010 9: 07: 40 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)  
 4/19/2010 9: 07: 40 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)  
 4/19/2010 9: 07: 46 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).  
 4/19/2010 9: 07: 46 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).  
 4/19/2010 9: 07: 50 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.  
 4/19/2010 9: 07: 50 PM -- Performance logging begins (interval: 15000 ms).  
 4/19/2010 9: 07: 50 PM -- Generating log files ...  
 4/19/2010 10: 18: 01 PM -- C: \al ogl uns\log1 (103.6% generated), C: \al ogl uns\log2

(102.0% generated), C:\al ogl uns\l og3 (100.2% generated), C:\al ogl uns\l og4 (101.6% generated) and C:\al ogl uns\l og5 (100.6% generated)  
4/19/2010 10:18:01 PM -- Performance logging ends.  
4/19/2010 10:18:01 PM -- JetInterop batch transaction stats: 22396, 22108, 21981, 21891 and 22135.  
4/19/2010 10:18:01 PM -- Dispatching transactions ends.  
4/19/2010 10:18:01 PM -- Shutting down databases ...  
4/19/2010 10:18:04 PM -- Instance640.1 (complete), Instance640.2 (complete), Instance640.3 (complete), Instance640.4 (complete) and Instance640.5 (complete)  
4/19/2010 10:18:04 PM --  
C:\ESRP3.0\_Raid5\SoftRecovery\Performance\_2010\_4\_19\_21\_7\_46.blg has 280 samples.  
4/19/2010 10:18:04 PM -- Creating test report ...  
4/19/2010 10:18:05 PM -- Instance640.1 has 14.7 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.1 has 3.8 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.1 has 3.8 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.2 has 14.4 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.2 has 8.2 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.2 has 8.2 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.3 has 13.6 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.3 has 3.5 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.3 has 3.5 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.4 has 13.7 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.4 has 3.8 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.4 has 3.8 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.5 has 13.7 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.5 has 3.7 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.5 has 3.7 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.  
4/19/2010 10:18:05 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.  
4/19/2010 10:18:05 PM --  
C:\ESRP3.0\_Raid5\SoftRecovery\Performance\_2010\_4\_19\_21\_7\_46.xml has 279 samples queried.  
4/19/2010 10:18:05 PM --  
C:\ESRP3.0\_Raid5\SoftRecovery\Performance\_2010\_4\_19\_21\_7\_46.html is saved.  
4/19/2010 10:23:00 PM -- Performance logging begins (interval: 4000 ms).  
4/19/2010 10:23:00 PM -- Recovering databases ...  
4/19/2010 10:38:15 PM -- Performance logging ends.  
4/19/2010 10:38:15 PM -- Instance640.1 (914.4112061), Instance640.2 (907.2507935), Instance640.3 (886.2999567), Instance640.4 (913.8808051) and Instance640.5 (878.3439427)  
4/19/2010 10:38:15 PM --  
C:\ESRP3.0\_Raid5\SoftRecovery\SoftRecovery\_2010\_4\_19\_22\_22\_56.blg has 227 samples.  
4/19/2010 10:38:15 PM -- Creating test report ...

## Soft Recovery Test Performance Result: SUN141

### Test Summary

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<b>Overall Test Result</b>	Pass
<b>Machine Name</b>	SUN141
<b>Test Description</b>	
<b>Test Start Time</b>	4/19/2010 9:07:34 PM
<b>Test End Time</b>	4/19/2010 10:18:04 PM
<b>Collection Start Time</b>	4/19/2010 9:08:05 PM
<b>Collection End Time</b>	4/19/2010 10:17:56 PM
<b>Jetstress Version</b>	14.01.0043.000
<b>Ese Version</b>	14.00.0639.019
<b>Operating System</b>	Windows Server 2008 R2 Enterprise (6.1.7600.0)
<b>Performance Log</b>	C:\ESRP3.0_Raid5\SoftRecovery\Performance_2010_4_19_21_7_46.blg

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### Database Sizing and Throughput

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<b>Achieved Transactional I/O per Second</b>	925.799
<b>Capacity Percentage</b>	100%
<b>Throughput Percentage</b>	100%
<b>Initial Database Size (bytes)</b>	8138475765760
<b>Final Database Size (bytes)</b>	8140052824064
<b>Database Files (Count)</b>	5

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### Jetstress System Parameters

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<b>Thread Count</b>	6 (per database)
<b>Minimum Database Cache</b>	160.0 MB
<b>Maximum Database Cache</b>	1280.0 MB
<b>Insert Operations</b>	40%
<b>Delete Operations</b>	20%
<b>Replace Operations</b>	5%
<b>Read Operations</b>	35%
<b>Lazy Commits</b>	70%

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## Database Configuration

<b>Instance640.1</b>	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
<b>Instance640.2</b>	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
<b>Instance640.3</b>	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb
<b>Instance640.4</b>	Log Path: C:\alogluns\log4 Database: C:\asgluns\sg4\Jetstress004001.edb
<b>Instance640.5</b>	Log Path: C:\alogluns\log5 Database: C:\asgluns\sg5\Jetstress005001.edb

## Transactional I/O Performance

<b>MSExchange =&gt; Instance</b>	<b>I/O Database Reads Average Latency (msec)</b>	<b>I/O Database Writes Average Latency (msec)</b>	<b>I/O Database Reads/sec</b>	<b>I/O Database Writes/sec</b>	<b>I/O Database Average Reads Bytes</b>	<b>I/O Database Average Writes Bytes</b>	<b>I/O Log Reads Average Latency (msec)</b>	<b>I/O Log Writes Average Latency (msec)</b>	<b>I/O Log Reads/sec</b>	<b>I/O Log Writes/sec</b>	<b>I/O Log Reads Average Bytes</b>	<b>I/O Log Writes Average Bytes</b>
Instance 640.1	14.699	9.305	119.136	71.138	32768.039	35006.238	0.000	3.768	0.000	47.753	0.000	5583.994
Instance 640.2	14.411	8.679	115.204	68.706	32768.672	35018.015	0.000	8.186	0.000	43.829	0.000	5985.782
Instance 640.3	13.603	7.677	116.031	69.257	32768.000	34923.164	0.000	3.480	0.000	46.901	0.000	5489.118
Instance 640.4	13.725	7.750	114.602	68.439	32768.295	34988.109	0.000	3.829	0.000	45.983	0.000	5690.828
Instance 640.5	13.733	7.153	114.694	68.591	32768.446	34998.548	0.000	3.718	0.000	46.469	0.000	5578.270

## Host System Performance

<b>Counter</b>	<b>Average</b>	<b>Minimum</b>	<b>Maximum</b>
% Processor Time	1.000	0.000	2.800
Available MBytes	29372.732	29348.000	30299.000
Free System Page Table Entries	33555644.968	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72849115.429	72663040.000	73031680.000
Pool Paged Bytes	103883819.886	103854080.000	104001536.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

## Test Log

4/19/2010 9:07:34 PM -- Jetstress testing begins ...  
4/19/2010 9:07:34 PM -- Prepare testing begins ...  
4/19/2010 9:07:40 PM -- Attaching databases ...  
4/19/2010 9:07:40 PM -- Prepare testing ends.  
4/19/2010 9:07:40 PM -- Dispatching transactions begins ...  
4/19/2010 9:07:40 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)  
4/19/2010 9:07:40 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)  
4/19/2010 9:07:46 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).  
4/19/2010 9:07:46 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).  
4/19/2010 9:07:50 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.  
4/19/2010 9:07:50 PM -- Performance logging begins (interval: 15000 ms).  
4/19/2010 9:07:50 PM -- Generating log files ...  
4/19/2010 10:18:01 PM -- C:\al ogl uns\log1 (103.6% generated), C:\al ogl uns\log2 (102.0% generated), C:\al ogl uns\log3 (100.2% generated), C:\al ogl uns\log4 (101.6% generated) and C:\al ogl uns\log5 (100.6% generated)  
4/19/2010 10:18:01 PM -- Performance logging ends.  
4/19/2010 10:18:01 PM -- JetInterop batch transaction stats: 22396, 22108, 21981, 21891 and 22135.  
4/19/2010 10:18:01 PM -- Dispatching transactions ends.  
4/19/2010 10:18:01 PM -- Shutting down databases ...  
4/19/2010 10:18:04 PM -- Instance640.1 (complete), Instance640.2 (complete), Instance640.3 (complete), Instance640.4 (complete) and Instance640.5 (complete)  
4/19/2010 10:18:04 PM -- C:\ESRP3.0\_Raid5\SoftRecovery\Performance\_2010\_4\_19\_21\_7\_46.blg has 280 samples.  
4/19/2010 10:18:04 PM -- Creating test report ...  
4/19/2010 10:18:05 PM -- Instance640.1 has 14.7 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.1 has 3.8 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.1 has 3.8 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.2 has 14.4 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.2 has 8.2 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.2 has 8.2 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.3 has 13.6 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.3 has 3.5 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.3 has 3.5 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.4 has 13.7 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.4 has 3.8 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.4 has 3.8 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.5 has 13.7 for I/O Database Reads Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.5 has 3.7 for I/O Log Writes Average Latency.  
4/19/2010 10:18:05 PM -- Instance640.5 has 3.7 for I/O Log Reads Average Latency.  
4/19/2010 10:18:05 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.  
4/19/2010 10:18:05 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.  
4/19/2010 10:18:05 PM -- C:\ESRP3.0\_Raid5\SoftRecovery\Performance\_2010\_4\_19\_21\_7\_46.xml has 279 samples queried.



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