

Hitachi Adaptable Modular Storage 2500 Dynamically Provisioned 22,880 User Exchange 2010 Mailbox Resiliency Storage Solution

Tested with: ESRP – Storage Version 3.0

Test Date: April 2010

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Table of Contents

Overview	1
Disclaimer	1
Features	1
Solution Description	2
Targeted Customer Profile	9
Tested Deployment	9
Replication Configuration	11
Best Practices	13
Storage – Mailbox Resiliency	13
Storage-based Replication	14
Backup Strategy	14
Test Result Summary	14
Reliability.....	14
Storage Performance Results	14
Database Backup and Recovery Performance	20
Conclusion	21
Appendix — Test Reports	22
Performance Test Result: SUN142	22
Performance Test Database Checksums Result: SUN142	25
Stress Test Database Performance Result: SUN142.....	27
Stress Test Database Checksums Result: SUN142	30
Database Backup Test Result: SUN142	32
Soft Recovery Test Result: SUN142	33
Soft Recovery Test Performance Result: SUN142.....	36

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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 22,880 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 22,880 users with a 0.18 IOPS per user profile and user mailbox size of 3GB. A 2500 with 480 450GB 15K RPM SAS disks, 32GB of cache and 16 4Gbit/s paths was used for these tests. Testing used 16 Sun Fire 4270 servers with 32GB of RAM, two quad-core Intel E5540 2.53GHz CPUs, 32 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 uses the Hitachi Adaptable Modular Storage 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 is deployed to avoid the routine issue of hot spots that occur on logical units (LUs) from individual RAID groups when the host workload exceeds the IOPS or throughput capacity of that RAID group. By using many RAID groups as members of a striped Dynamic Provisioning pool underneath the virtual or logical volumes seen by the hosts, a host workload will be distributed across many RAID groups which provides a smoothing effect that dramatically reduces hot spots and results in fewer mailbox moves for the Exchange administrator.

Hitachi Dynamic Provisioning 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 comprising 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.

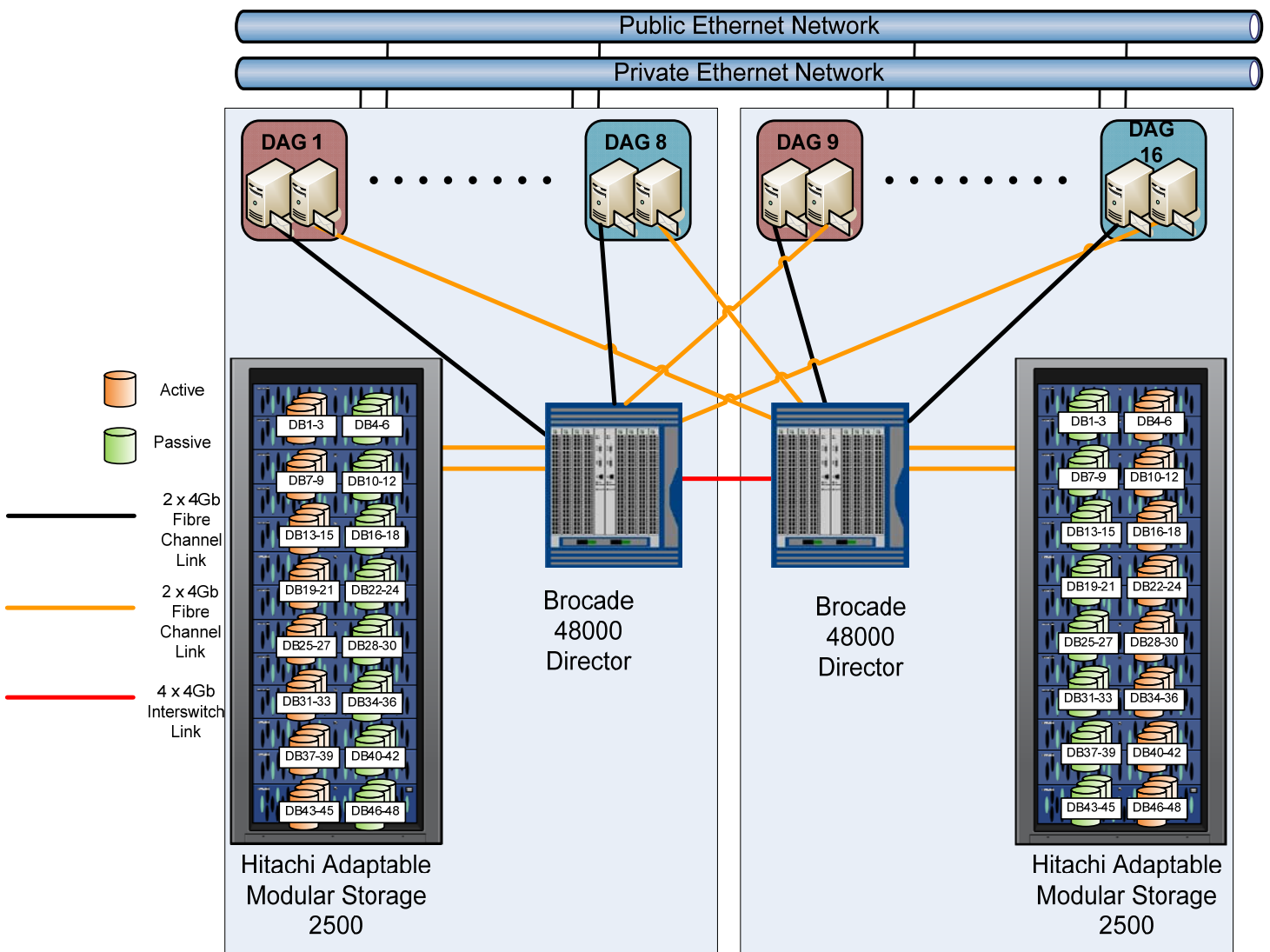
Any server in a DAG can host a copy of a mailbox database from any other server in the DAG. When a server is added to a DAG, it monitors and works with the other servers in the DAG to provide automatic recovery delivering a robust, highly-available Exchange solution without the administrative complexities 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 22,880 user resiliency solution, a Hitachi Adaptable Modular Storage 2500 configured with 480 disks (the maximum) and 16 host servers, each configured with 1,430 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



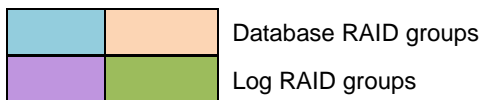
This solution enables organizations to consolidate Exchange Server 2010 DAG deployments on two 2500 storage systems. Using identical hardware and software configurations guarantees that an active database and its replicated copy do not share storage paths, disk spindles or storage controllers, making 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 storage system'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

Drive Slot	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
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 RAID groups and the log pool was created from six RAID-1+0 RAID 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

Server	Primary Path	Secondary Path
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 Database DP-VOL Layout

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

Table 4 outlines the port layout with the log DP-VOL assignments for primary storage and servers. An identical configuration was 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	48-50
0B	4-6	51-53
0C	7-9	54-56
0D	10-12	57-59
0E	13-15	60-62
0F	16-18	63-65
0G	19-21	66-68
0H	22-24	69-71
1A	25-27	72-74
1B	28-30	75-77
1C	31-33	78-80
1D	34-36	81-83
1E	37-39	84-86
1F	40-42	87-89
1G	43-45	90-92
1H	46-48	93-95

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 22,880 Exchange users with the following specifications:

- 32 Exchange servers (16 tested, simulating 32 for the database copies)
- 16 Database Availability Groups, each maintaining two servers and two copies per database
- Two Adaptable Modular Storage 2500 storage systems (one tested)
- 0.15 IOPS per user (0.18 tested for 20% growth)
- 3GB mailbox size
- Mailbox resiliency provides high-availability and used as primary data protection mechanism.
- Adaptable Modular Storage RAID protection against physical failure or loss.
- 24x7 background database maintenance enabled.

Tested Deployment

The following tables summarize the testing environment.

Table 6. Simulated Exchange Configuration

<i>Number of Exchange mailboxes simulated</i>	22,880
<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>	1,430
<i>Number of databases per host</i>	3
<i>Number of copies per database</i>	2
<i>Number of mailboxes per database</i>	476
<i>Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)</i>	0.18
<i>Database LU size</i>	1750GB
<i>Log LU size</i>	175GB
<i>Total database size for performance testing</i>	68,640GB
<i>% storage capacity used by Exchange database**</i>	79.6%

**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: 0890/B-Z WHQL listing: Hitachi 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 2.54GHz quad-core Intel Xeon CPUs, 32GB 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 7.2.30.16
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. Primary 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 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	7,661GB (Dynamic Provisioning log pool)

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: 0890/B-Z WHQL listing: Hitachi 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 2.54GHz quad-core Intel Xeon CPUs, 32GB 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 7.2.30.16
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 (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.”](#)

Storage – Mailbox Resiliency

1. When formatting a newly partitioned LUN, Hitachi 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>	443
<i>Database disk reads per second</i>	279
<i>Database disk writes per second</i>	164
<i>Average database disk read latency (ms)</i>	9.1
<i>Average database disk write latency (ms)</i>	4.2
Transaction Log I/O	
<i>Log disk writes per second</i>	136
<i>Average log disk write latency (ms)</i>	2.5

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

Database I/O	
<i>Database disk transfers per second</i>	572
<i>Database disk reads per second</i>	361
<i>Database disk writes per second</i>	211
<i>Average database disk read latency (ms)</i>	7.7
<i>Average database disk write latency (ms)</i>	2.5
Transaction Log I/O	
<i>Log disk writes per second</i>	179
<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>	424
<i>Database disk reads per second</i>	267
<i>Database disk writes per second</i>	157
<i>Average database disk read latency (ms)</i>	9.4
<i>Average database disk write latency (ms)</i>	4.7
Transaction Log I/O	
<i>Log disk writes per second</i>	130
<i>Average log disk write latency (ms)</i>	2.8

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

Database I/O	
<i>Database disk transfers per second</i>	603
<i>Database disk reads per second</i>	381
<i>Database disk writes per second</i>	222
<i>Average database disk read latency (ms)</i>	7.6
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	193
<i>Average log disk write latency (ms)</i>	1.0

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

Database I/O	
<i>Database disk transfers per second</i>	600
<i>Database disk reads per second</i>	379
<i>Database disk writes per second</i>	221
<i>Average database disk read latency (ms)</i>	7.6
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	189
<i>Average log disk write latency (ms)</i>	1.4

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

Database I/O	
<i>Database disk transfers per second</i>	643
<i>Database disk reads per second</i>	407
<i>Database disk writes per second</i>	236
<i>Average database disk read latency (ms)</i>	7.4
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	206
<i>Average log disk write latency (ms)</i>	1.0

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

Database I/O	
<i>Database disk transfers per second</i>	652
<i>Database disk reads per second</i>	413
<i>Database disk writes per second</i>	239
<i>Average database disk read latency (ms)</i>	7.3
<i>Average database disk write latency (ms)</i>	2.3
Transaction Log I/O	
<i>Log disk writes per second</i>	210
<i>Average log disk write latency (ms)</i>	0.9

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

Database I/O	
<i>Database disk transfers per second</i>	570
<i>Database disk reads per second</i>	360
<i>Database disk writes per second</i>	210
<i>Average database disk read latency (ms)</i>	7.7
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	180
<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>	620
<i>Database disk reads per second</i>	392
<i>Database disk writes per second</i>	228
<i>Average database disk read latency (ms)</i>	7.5
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	200
<i>Average log disk write latency (ms)</i>	1.0

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

Database I/O	
<i>Database disk transfers per second</i>	654
<i>Database disk reads per second</i>	414
<i>Database disk writes per second</i>	240
<i>Average database disk read latency (ms)</i>	7.3
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	210
<i>Average log disk write latency (ms)</i>	1.0

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

Database I/O	
<i>Database disk transfers per second</i>	595
<i>Database disk reads per second</i>	376
<i>Database disk writes per second</i>	219
<i>Average database disk read latency (ms)</i>	7.7
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	187
<i>Average log disk write latency (ms)</i>	1.4

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

Database I/O	
<i>Database disk transfers per second</i>	471
<i>Database disk reads per second</i>	297
<i>Database disk writes per second</i>	174
<i>Average database disk read latency (ms)</i>	9.1
<i>Average database disk write latency (ms)</i>	4.7
Transaction Log I/O	
<i>Log disk writes per second</i>	150
<i>Average log disk write latency (ms)</i>	1.7

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

Database I/O	
<i>Database disk transfers per second</i>	616
<i>Database disk reads per second</i>	389
<i>Database disk writes per second</i>	227
<i>Average database disk read latency (ms)</i>	7.5
<i>Average database disk write latency (ms)</i>	2.5
Transaction Log I/O	
<i>Log disk writes per second</i>	198
<i>Average log disk write latency (ms)</i>	1.0

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

Database I/O	
<i>Database disk transfers per second</i>	589
<i>Database disk reads per second</i>	372
<i>Database disk writes per second</i>	217
<i>Average database disk read latency (ms)</i>	7.6
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	185
<i>Average log disk write latency (ms)</i>	1.4

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

Database I/O	
<i>Database disk transfers per second</i>	594
<i>Database disk reads per second</i>	375
<i>Database disk writes per second</i>	219
<i>Average database disk read latency (ms)</i>	7.6
<i>Average database disk write latency (ms)</i>	2.4
Transaction Log I/O	
<i>Log disk writes per second</i>	187
<i>Average log disk write latency (ms)</i>	1.4

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

Database I/O	
<i>Database disk transfers per second</i>	442
<i>Database disk reads per second</i>	279
<i>Database disk writes per second</i>	163
<i>Average database disk read latency (ms)</i>	9.2
<i>Average database disk write latency (ms)</i>	4.4
Transaction Log I/O	
<i>Log disk writes per second</i>	135
<i>Average log disk write latency (ms)</i>	2.7

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>	9088
<i>Database disk reads per second</i>	5741
<i>Database disk writes per second</i>	3347
<i>Average database disk read latency (ms)</i>	8.0
<i>Average database disk write latency (ms)</i>	2.8
Transaction Log I/O	
<i>Log disk writes per second</i>	2875
<i>Average log disk write latency (ms)</i>	1.5

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).

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>	47.0
<i>MB read per second total per server</i>	141

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>	1.2
--	-----

Conclusion

This document details a tested a robust Exchange Server 2010 Resiliency solution capable of supporting 22,880 users with a 0.18 IOPS per user profile and user mailbox size of 3GB 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 (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 22,880 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 — 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: SUN142

Test Summary

Overall Test Result	Pass
Machine Name	SUN142
Test Description	
Test Start Time	4/29/2010 7:26:15 AM
Test End Time	4/29/2010 9:51:51 AM
Collection Start Time	4/29/2010 7:28:19 AM
Collection End Time	4/29/2010 9:28:04 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_3GB\Performance\Performance_2010_4_29_7_26_23.blg C:\ESRP3.0_3GB\Performance\DBChecksum_2010_4_29_9_51_51.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	571.773
Target Transactional I/O per Second	257.4
Initial Database Size (bytes)	4606362058752
Final Database Size (bytes)	4608492765184
Database Files (Count)	3

Jetstress System Parameters

Thread Count	4 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2

Database Configuration

Instance3404.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3404.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3404.3	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
Instance3404.1	7.872	2.683	120.293	70.202	33479.103	37361.152	0.000	1.461	0.000	59.653	0.000	4971.749
Instance3404.2	7.722	2.527	119.918	69.863	33514.442	37380.510	0.000	1.381	0.000	59.420	0.000	4955.232
Instance3404.3	7.622	2.317	120.923	70.574	33444.980	37350.262	0.000	1.355	0.000	60.347	0.000	4924.841

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3404.1	30.473	261881.795
Instance3404.2	30.564	261893.687
Instance3404.3	30.641	261891.451

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3404.1	1.212	232562.930
Instance3404.2	1.203	232561.778
Instance3404.3	1.212	232562.250

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
Instance3404.1	7.872	2.683	150.766	70.202	79643.575	37361.152	1.924	1.461	1.212	59.653	232562.930	4971.749
Instance3404.2	7.722	2.527	150.482	69.863	79899.650	37380.510	1.799	1.381	1.203	59.420	232561.778	4955.232
Instance3404.3	7.622	2.317	151.563	70.574	79628.896	37350.262	2.170	1.355	1.212	60.347	232562.250	4924.841

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.599	0.000	4.586
Available MBytes	29871.242	29860.000	29896.000
Free System Page Table Entries	33555643.259	33555641.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70896304.367	70873088.000	70983680.000
Pool Paged Bytes	105906526.597	105852928.000	106012672.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

4/29/2010 7: 26: 15 AM -- Jetstress testing begins ...
4/29/2010 7: 26: 15 AM -- Prepare testing begins ...
4/29/2010 7: 26: 19 AM -- Attaching databases ...
4/29/2010 7: 26: 19 AM -- Prepare testing ends.
4/29/2010 7: 26: 19 AM -- Dispatching transactions begins ...
4/29/2010 7: 26: 19 AM -- Database cache settings: (minimum: 96.0 MB, maximum:
768.0 MB)
4/29/2010 7: 26: 19 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/29/2010 7: 26: 23 AM -- Database read latency thresholds: (average: 20 msec/read,
maximum: 100 msec/read).
4/29/2010 7: 26: 23 AM -- Log write latency thresholds: (average: 10 msec/write,
maximum: 100 msec/write).
4/29/2010 7: 26: 28 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%,
Replaces 5%, Reads 35%, Lazy Commits 70%.
4/29/2010 7: 26: 28 AM -- Performance logging begins (interval: 15000 ms).
4/29/2010 7: 26: 28 AM -- Attaining prerequisites:
4/29/2010 7: 28: 19 AM -- \MSExchange Database(JetstressWin)\Database Cache Size,
Last: 728543200.0 (lower bound: 724775700.0, upper bound: none)
4/29/2010 9: 28: 19 AM -- Performance logging ends.
4/29/2010 9: 51: 50 AM -- JetInterop batch transaction stats: 50878, 50532 and
50828.
4/29/2010 9: 51: 51 AM -- Dispatching transactions ends.
4/29/2010 9: 51: 51 AM -- Shutting down databases ...
4/29/2010 9: 51: 51 AM -- Instance3404.1 (complete), Instance3404.2 (complete) and

```

Instance3404.3 (complete)
 4/29/2010 9:51:53 AM -- Performance logging begins (interval: 30000 ms).
 4/29/2010 9:51:53 AM -- Verifying database checksums ...
 4/29/2010 9:50:23 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 4/29/2010 9:50:23 PM -- Performance logging ends.
 4/29/2010 9:50:23 PM --
 C:\ESRP3.0_3GB\Performance\DBChecksum_2010_4_29_9_51_51.blg has 1436 samples.
 4/29/2010 9:50:28 PM --
 C:\ESRP3.0_3GB\Performance\DBChecksum_2010_4_29_9_51_51.html is saved.
 4/29/2010 9:50:28 PM -- Verifying log checksums ...
 4/29/2010 9:50:30 PM -- C:\alogluns\log1 (8 log(s) processed), C:\alogluns\log2 (8 log(s) processed) and C:\alogluns\log3 (7 log(s) processed)
 4/29/2010 9:50:30 PM --
 C:\ESRP3.0_3GB\Performance\Performance_2010_4_29_7_26_23.blg has 486 samples.
 4/29/2010 9:50:30 PM -- Creating test report ...
 4/29/2010 9:50:33 PM -- Instance3404.1 has 7.9 for I/O Database Reads Average Latency.
 4/29/2010 9:50:33 PM -- Instance3404.1 has 1.5 for I/O Log Writes Average Latency.
 4/29/2010 9:50:33 PM -- Instance3404.1 has 1.5 for I/O Log Reads Average Latency.
 4/29/2010 9:50:33 PM -- Instance3404.2 has 7.7 for I/O Database Reads Average Latency.
 4/29/2010 9:50:33 PM -- Instance3404.2 has 1.4 for I/O Log Writes Average Latency.
 4/29/2010 9:50:33 PM -- Instance3404.2 has 1.4 for I/O Log Reads Average Latency.
 4/29/2010 9:50:33 PM -- Instance3404.3 has 7.6 for I/O Database Reads Average Latency.
 4/29/2010 9:50:33 PM -- Instance3404.3 has 1.4 for I/O Log Writes Average Latency.
 4/29/2010 9:50:33 PM -- Instance3404.3 has 1.4 for I/O Log Reads Average Latency.
 4/29/2010 9:50:33 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 4/29/2010 9:50:33 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 4/29/2010 9:50:33 PM --
 C:\ESRP3.0_3GB\Performance\Performance_2010_4_29_7_26_23.xml has 478 samples queried.

Performance Test Database Checksums Result: SUN142

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\asgluns\sg1\Jetstress001001.edb	46880098	0	0	0	1465003 MBytes / 43110 sec
C:\asgluns\sg2\Jetstress002001.edb	46879842	0	0	0	1464995 MBytes / 29498 sec
C:\asgluns\sg3\Jetstress003001.edb	46880098	0	0	0	1465003 MBytes / 42943 sec
(Sum)	140640038	0	0	0	4395001 MBytes / 43110 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	0.100	0.000	542.804	0.000	65536.000
C:\asgluns\sg2	0.091	0.000	794.523	0.000	65536.000
C:\asgluns\sg3	0.100	0.000	544.173	0.000	65536.000

Memory System Performance of Checksum

Counter	Average	Minimum	Maximum
% Processor Time	1.190	0.000	4.395
Available MBytes	30687.545	30671.000	30704.000
Free System Page Table Entries	33555643.955	33555641.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71168887.086	71118848.000	71360512.000
Pool Paged Bytes	104889925.883	104108032.000	107544576.000

Test Log

4/29/2010 7: 26: 15 AM -- Jetstress testing begins ...
 4/29/2010 7: 26: 15 AM -- Prepare testing begins ...
 4/29/2010 7: 26: 19 AM -- Attaching databases ...
 4/29/2010 7: 26: 19 AM -- Prepare testing ends.
 4/29/2010 7: 26: 19 AM -- Dispatching transactions begins ...
 4/29/2010 7: 26: 19 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 4/29/2010 7: 26: 19 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 4/29/2010 7: 26: 23 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 4/29/2010 7: 26: 23 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 4/29/2010 7: 26: 28 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 4/29/2010 7: 26: 28 AM -- Performance logging begins (interval: 15000 ms).
 4/29/2010 7: 26: 28 AM -- Attaining prerequisites:
 4/29/2010 7: 28: 19 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 728543200.0 (lower bound: 724775700.0, upper bound: none)
 4/29/2010 9: 28: 19 AM -- Performance logging ends.
 4/29/2010 9: 51: 50 AM -- JetInterop batch transaction stats: 50878, 50532 and 50828.
 4/29/2010 9: 51: 51 AM -- Dispatching transactions ends.
 4/29/2010 9: 51: 51 AM -- Shutting down databases ...
 4/29/2010 9: 51: 51 AM -- Instance3404.1 (complete), Instance3404.2 (complete) and Instance3404.3 (complete)
 4/29/2010 9: 51: 53 AM -- Performance logging begins (interval: 30000 ms).
 4/29/2010 9: 51: 53 AM -- Verifying database checksums ...
 4/29/2010 9: 50: 23 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 4/29/2010 9: 50: 23 PM -- Performance logging ends.
 4/29/2010 9: 50: 23 PM --
 C:\ESRP3.0_3GB\Performance\DBChecksum_2010_4_29_9_51_51.blg has 1436 samples.

Stress Test Database Performance Result: SUN142

Test Summary

Overall Test Result	Pass
Machine Name	SUN142
Test Description	
Test Start Time	4/29/2010 10:27:48 PM
Test End Time	5/1/2010 1:13:41 AM
Collection Start Time	4/29/2010 10:29:51 PM
Collection End Time	4/30/2010 10:29:47 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_3GB\Stress\Stress_2010_4_29_22_27_56.blg C:\ESRP3.0_3GB\Stress\DBChecksum_2010_5_1_1_13_41.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	569.265
Target Transactional I/O per Second	257.4
Initial Database Size (bytes)	4608492765184
Final Database Size (bytes)	4630470918144
Database Files (Count)	3

Jetstress System Parameters

Thread Count	4 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2

Database Configuration

Instance3404.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3404.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3404.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb

Transactional I/O Performance

MSExchange Database => Instance	I/O Database Read Average Latency (msec)	I/O Database Write 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
Instance3404.1	8.104	2.692	118.734	70.864	33436.707	35397.901	0.000	1.388	0.000	56.103	0.000	4923.894
Instance3404.2	7.669	2.351	118.830	70.941	33513.475	35395.185	0.000	1.351	0.000	56.066	0.000	4929.181
Instance3404.3	7.775	2.254	118.945	70.950	33513.653	35397.553	0.000	1.295	0.000	56.253	0.000	4907.020

Background Database Maintenance I/O Performance

MSExchange Database => Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3404.1	30.380	261876.308
Instance3404.2	30.597	261882.056
Instance3404.3	30.547	261872.510

Log Replication I/O Performance

MSExchange Database => Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3404.1	1.127	232565.642
Instance3404.2	1.127	232560.424
Instance3404.3	1.126	232564.910

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
Instance3 404.1	8.104	2.692	149.114	70.864	79978.426	35397.901	2.249	1.388	1.127	56.103	232565.642	4923.894
Instance3 404.2	7.669	2.351	149.428	70.941	80275.043	35395.185	2.305	1.351	1.127	56.066	232560.424	4929.181
Instance3 404.3	7.775	2.254	149.492	70.950	80176.059	35397.553	2.205	1.295	1.126	56.253	232564.910	4907.020

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.641	0.000	8.359
Available MBytes	29844.101	29830.000	29875.000
Free System Page Table Entries	33555642.815	33555635.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71158740.221	71036928.000	71311360.000
Pool Paged Bytes	104530359.213	103534592.000	109400064.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

4/29/2010 10:27:48 PM -- Jetstress testing begins ...
4/29/2010 10:27:48 PM -- Prepare testing begins ...
4/29/2010 10:27:52 PM -- Attaching databases ...
4/29/2010 10:27:52 PM -- Prepare testing ends.
4/29/2010 10:27:52 PM -- Dispatching transactions begins ...
4/29/2010 10:27:52 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
4/29/2010 10:27:52 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/29/2010 10:27:56 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
4/29/2010 10:27:56 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
4/29/2010 10:28:01 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/29/2010 10:28:01 PM -- Performance logging begins (interval: 15000 ms).
4/29/2010 10:28:01 PM -- Attaining prerequisites:
4/29/2010 10:29:51 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 725778400.0 (lower bound: 724775700.0, upper bound: none)
4/30/2010 10:29:51 PM -- Performance logging ends.
5/1/2010 1:13:37 AM -- JetInterop batch transaction stats: 520350, 521235 and 520696.
5/1/2010 1:13:38 AM -- Dispatching transactions ends.
5/1/2010 1:13:38 AM -- Shutting down databases ...

```

5/1/2010 1:13:41 AM -- Instance3404.1 (complete), Instance3404.2 (complete) and Instance3404.3 (complete)
5/1/2010 1:13:43 AM -- Performance Logging begins (interval: 30000 ms).
5/1/2010 1:13:43 AM -- Verifying database checksums ...
5/1/2010 12:54:43 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
5/1/2010 12:54:43 PM -- Performance Logging ends.
5/1/2010 12:54:43 PM -- C:\ESRP3.0_3GB\Stress\DBChecksum_2010_5_1_1_13_41.blg has 1401 samples.
5/1/2010 12:54:47 PM -- C:\ESRP3.0_3GB\Stress\DBChecksum_2010_5_1_1_13_41.html is saved.
5/1/2010 12:54:47 PM -- Verifying log checksums ...
5/1/2010 12:54:51 PM -- C:\alogluns\log1 (8 log(s) processed), C:\alogluns\log2 (7 log(s) processed) and C:\alogluns\log3 (8 log(s) processed)
5/1/2010 12:54:51 PM -- C:\ESRP3.0_3GB\Stress\Stress_2010_4_29_22_27_56.blg has 5761 samples.
5/1/2010 12:54:51 PM -- Creating test report ...
5/1/2010 12:55:13 PM -- Instance3404.1 has 8.1 for I/O Database Reads Average Latency.
5/1/2010 12:55:13 PM -- Instance3404.1 has 1.4 for I/O Log Writes Average Latency.
5/1/2010 12:55:13 PM -- Instance3404.1 has 1.4 for I/O Log Reads Average Latency.
5/1/2010 12:55:13 PM -- Instance3404.2 has 7.7 for I/O Database Reads Average Latency.
5/1/2010 12:55:13 PM -- Instance3404.2 has 1.4 for I/O Log Writes Average Latency.
5/1/2010 12:55:13 PM -- Instance3404.2 has 1.4 for I/O Log Reads Average Latency.
5/1/2010 12:55:13 PM -- Instance3404.3 has 7.8 for I/O Database Reads Average Latency.
5/1/2010 12:55:13 PM -- Instance3404.3 has 1.3 for I/O Log Writes Average Latency.
5/1/2010 12:55:13 PM -- Instance3404.3 has 1.3 for I/O Log Reads Average Latency.
5/1/2010 12:55:13 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/1/2010 12:55:13 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/1/2010 12:55:13 PM -- C:\ESRP3.0_3GB\Stress\Stress_2010_4_29_22_27_56.xml has 5753 samples queried.

Stress Test Database Checksums Result: SUN142

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\asgluns\sg1\Jetstress001001.edb	47103842	0	0	0	1471995 MBytes / 41761 sec
C:\asgluns\sg2\Jetstress002001.edb	47103586	0	0	0	1471987 MBytes / 39970 sec
C:\asgluns\sg3\Jetstress003001.edb	47103330	0	0	0	1471979 MBytes / 42059 sec
(Sum)	141310758	0	0	0	4415961 MBytes / 42060 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	0.107	0.000	563.451	0.000	65536.000
C:\asgluns\sg2	0.101	0.000	588.922	0.000	65536.000
C:\asgluns\sg3	0.104	0.000	559.339	0.000	65536.000

Memory System Performance of Checksum

Counter	Average	Minimum	Maximum
% Processor Time	1.229	0.000	4.574
Available MBytes	30661.896	30646.000	30679.000
Free System Page Table Entries	33555643.081	33555641.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71281603.335	71204864.000	71610368.000
Pool Paged Bytes	104893905.587	103923712.000	107618304.000

Test Log

4/29/2010 10:27:48 PM -- Jetstress testing begins ...
 4/29/2010 10:27:48 PM -- Prepare testing begins ...
 4/29/2010 10:27:52 PM -- Attaching databases ...
 4/29/2010 10:27:52 PM -- Prepare testing ends.
 4/29/2010 10:27:52 PM -- Dispatching transactions begins ...
 4/29/2010 10:27:52 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 4/29/2010 10:27:52 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 4/29/2010 10:27:56 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 4/29/2010 10:27:56 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 4/29/2010 10:28:01 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 4/29/2010 10:28:01 PM -- Performance logging begins (interval: 15000 ms).
 4/29/2010 10:28:01 PM -- Attaining prerequisites:
 4/29/2010 10:29:51 PM -- \MSEXCHANGE Database(JetstressWin)\Database Cache Size, Last: 725778400.0 (lower bound: 724775700.0, upper bound: none)
 4/30/2010 10:29:51 PM -- Performance logging ends.
 5/1/2010 1:13:37 AM -- JetInterop batch transaction stats: 520350, 521235 and 520696.
 5/1/2010 1:13:38 AM -- Dispatching transactions ends.
 5/1/2010 1:13:38 AM -- Shutting down databases ...
 5/1/2010 1:13:41 AM -- Instance3404.1 (complete), Instance3404.2 (complete) and Instance3404.3 (complete)
 5/1/2010 1:13:43 AM -- Performance logging begins (interval: 30000 ms).
 5/1/2010 1:13:43 AM -- Verifying database checksums ...
 5/1/2010 12:54:43 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 5/1/2010 12:54:43 PM -- Performance logging ends.
 5/1/2010 12:54:43 PM -- C:\ESRP3.0_3GB\Stress\DBChecksum_2010_5_1_1_13_41.blg has 1401 samples.

Database Backup Test Result: SUN142

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance3404.1	1471987.09	08:57:06	45.68
Instance3404.2	1471979.09	09:37:51	42.45
Instance3404.3	1471971.09	09:29:48	43.05

Jetstress System Parameters

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

Database Configuration

Instance3404.1	Log Path: C:\alagluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3404.2	Log Path: C:\alagluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3404.3	Log Path: C:\alagluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb

Transactional I/O Performance

MSExc hange Databa se ==> Instan ces	I/O Datab ase Read s Avera ge Laten cy (msec)	I/O Datab ase Write s Avera ge Laten cy (msec)	I/O Datab ase Reads /sec	I/O Datab ase Writes /sec	I/O Datab ase Reads Avera ge Bytes	I/O Datab ase Writes Avera ge Bytes	I/O Log Rea ds Ave rage Laten cy (ms ec)	I/O Log Writes Avera ge Laten cy (msec)	I/O Log Reads/ sec	I/O Log Writes/ sec	I/O Log Reads Avera ge Bytes	I/O Log Writes Avera ge Bytes
Instance3404.1	8.646	0.000	182.647	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3404.2	10.635	0.000	169.858	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3404.3	10.563	0.000	172.246	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	0.958	0.000	3.992
Available MBytes	30670.074	30650.000	30679.000
Free System Page Table Entries	33555642.927	33555641.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71174397.562	71159808.000	71278592.000
Pool Paged Bytes	107398339.934	106389504.000	109748224.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

5/2/2010 2:07:14 AM -- Jetstress testing begins ...
5/2/2010 2:07:14 AM -- Prepare testing begins ...
5/2/2010 2:07:18 AM -- Attaching databases ...
5/2/2010 2:07:18 AM -- Prepare testing ends.
5/2/2010 2:07:24 AM -- Performance logging begins (interval: 30000 ms).
5/2/2010 2:07:24 AM -- Backing up databases ...
5/2/2010 11:45:16 AM -- Performance logging ends.
5/2/2010 11:45:16 AM -- Instance3404.1 (100% processed), Instance3404.2 (100% processed) and Instance3404.3 (100% processed)
5/2/2010 11:45:16 AM --
C:\ESRP3.0_3GB\BackupTest\DatabaseBackup_2010_5_2_2_7_18.blg has 1155 samples.
5/2/2010 11:45:16 AM -- Creating test report ...

Soft Recovery Test Result: SUN142

Soft Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance3404.1	503	650.5367426
Instance3404.2	500	598.8226517
Instance3404.3	503	653.1887472

Database Configuration

Instance3404.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3404.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3404.3	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
Instance3404.1	15.318	9.021	789.158	4.609	36726.438	30011.813	9.065	0.000	6.914	0.000	20615	0.000
Instance3404.2	15.699	8.792	827.581	5.024	36611.310	30443.243	7.757	0.002	7.544	0.020	21196	1.730
Instance3404.3	14.580	7.989	788.289	4.631	36757.465	29318.737	6.923	0.001	6.954	0.018	20525	1.585

Background Database Maintenance I/O Performance

MSExchange Database => Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3404.1	25.170	262014.125
Instance3404.2	25.985	261874.151
Instance3404.3	26.561	261767.784

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
Instance3404.1	15.318	9.021	814.328	4.609	43689.871	30011.813	9.065	0.000	6.914	0.000	20615	0.000
Instance3404.2	15.699	8.792	853.566	5.024	43468.990	30443.243	7.757	0.002	7.544	0.020	21196	1.730
Instance3404.3	14.580	7.989	814.850	4.631	44091.899	29318.737	6.923	0.001	6.954	0.018	20525	1.585

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	4.049	0.000	22.480
Available MBytes	29844.148	29821.000	30600.000
Free System Page Table Entries	33555644.719	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	75299764.148	71319552.000	76013568.000
Pool Paged Bytes	110145093.531	110129152.000	110292992.000
Database Page Fault Stalls/sec	0.008	0.000	0.994

Test Log

5/2/2010 8:51:37 PM -- Jetstress testing begins ...
5/2/2010 8:51:37 PM -- Prepare testing begins ...
5/2/2010 8:51:40 PM -- Attaching databases ...
5/2/2010 8:51:40 PM -- Prepare testing ends.
5/2/2010 8:51:40 PM -- Dispatching transactions begins ...
5/2/2010 8:51:40 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
5/2/2010 8:51:40 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
5/2/2010 8:51:44 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
5/2/2010 8:51:44 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
5/2/2010 8:51:47 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
5/2/2010 8:51:47 PM -- Performance logging begins (interval: 15000 ms).
5/2/2010 8:51:47 PM -- Generating log files ...
5/2/2010 9:55:38 PM -- C:\al\ogl\uns\log1 (100.6% generated), C:\al\ogl\uns\log2 (100.2% generated) and C:\al\ogl\uns\log3 (100.8% generated)
5/2/2010 9:55:38 PM -- Performance logging ends.
5/2/2010 9:55:38 PM -- JetInterop batch transaction stats: 21788, 21830 and 21919.
5/2/2010 9:55:38 PM -- Dispatching transactions ends.
5/2/2010 9:55:38 PM -- Shutting down databases ...
5/2/2010 9:55:39 PM -- Instance3404.1 (complete), Instance3404.2 (complete) and Instance3404.3 (complete)
5/2/2010 9:55:39 PM --
C:\ESRP3.0_3GB\SoftRecovery\Performance_2010_5_2_20_51_44.blg has 255 samples.
5/2/2010 9:55:39 PM -- Creating test report ...
5/2/2010 9:55:39 PM -- Instance3404.1 has 8.3 for I/O Database Reads Average Latency.
5/2/2010 9:55:39 PM -- Instance3404.1 has 1.3 for I/O Log Writes Average Latency.
5/2/2010 9:55:39 PM -- Instance3404.1 has 1.3 for I/O Log Reads Average Latency.
5/2/2010 9:55:39 PM -- Instance3404.2 has 8.0 for I/O Database Reads Average Latency.
5/2/2010 9:55:39 PM -- Instance3404.2 has 1.2 for I/O Log Writes Average Latency.
5/2/2010 9:55:39 PM -- Instance3404.2 has 1.2 for I/O Log Reads Average Latency.
5/2/2010 9:55:39 PM -- Instance3404.3 has 8.1 for I/O Database Reads Average Latency.
5/2/2010 9:55:39 PM -- Instance3404.3 has 1.3 for I/O Log Writes Average Latency.
5/2/2010 9:55:39 PM -- Instance3404.3 has 1.3 for I/O Log Reads Average Latency.
5/2/2010 9:55:39 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
5/2/2010 9:55:39 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
5/2/2010 9:55:39 PM --
C:\ESRP3.0_3GB\SoftRecovery\Performance_2010_5_2_20_51_44.xml has 254 samples queried.
5/2/2010 9:55:39 PM --
C:\ESRP3.0_3GB\SoftRecovery\Performance_2010_5_2_20_51_44.html is saved.

5/2/2010 10:13:22 PM -- Performance logging begins (interval: 2000 ms).
 5/2/2010 10:13:22 PM -- Recovering databases ...
 5/2/2010 10:24:15 PM -- Performance logging ends.
 5/2/2010 10:24:15 PM -- Instance3404.1 (650.5367426), Instance3404.2
 (598.8226517) and Instance3404.3 (653.1887472)
 5/2/2010 10:24:15 PM --
 C:\ESRP3.0_3GB\SoftRecovery\SoftRecovery_2010_5_2_22_13_18.blg has 324 samples.
 5/2/2010 10:24:15 PM -- Creating test report ...

Soft Recovery Test Performance Result: SUN142

Test Summary

Overall Test Result	Pass
Machine Name	SUN142
Test Description	
Test Start Time	5/2/2010 8:51:37 PM
Test End Time	5/2/2010 9:55:39 PM
Collection Start Time	5/2/2010 8:52:02 PM
Collection End Time	5/2/2010 9:55:35 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_3GB\SoftRecovery\Performance_2010_5_2_20_51_44.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	600.801
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	4630470918144
Final Database Size (bytes)	4631393665024
Database Files (Count)	3

Jetstress System Parameters

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

Database Configuration

Instance3404.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance3404.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance3404.3	Log Path: C:\alogluns\log3 Database: C:\asgluns\sg3\Jetstress003001.edb

Transactional I/O Performance

MSExchange Database => Instance	I/O Database Read s Average Latency (msec)	I/O Database Write s 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
Instance3404.1	8.264	3.092	125.845	75.304	32768.000	35042.721	0.000	1.294	0.000	58.755	0.000	4914.726
Instance3404.2	7.999	2.708	124.302	74.286	32768.202	35119.798	0.000	1.231	0.000	58.347	0.000	4925.658
Instance3404.3	8.054	2.638	125.780	75.284	32768.507	35055.116	0.000	1.267	0.000	58.965	0.000	4916.652

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.660	0.000	4.309
Available MBytes	29854.290	29828.000	30474.000
Free System Page Table Entries	33555643.384	33555641.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71259397.020	71147520.000	71405568.000
Pool Paged Bytes	109999862.965	109928448.000	110215168.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

5/2/2010 8:51:37 PM -- Jetstress testing begins ...
5/2/2010 8:51:37 PM -- Prepare testing begins ...
5/2/2010 8:51:40 PM -- Attaching databases ...
5/2/2010 8:51:40 PM -- Prepare testing ends.
5/2/2010 8:51:40 PM -- Dispatching transactions begins ...
5/2/2010 8:51:40 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
5/2/2010 8:51:40 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
5/2/2010 8:51:44 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
  
```

5/2/2010 8:51:44 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 5/2/2010 8:51:47 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 5/2/2010 8:51:47 PM -- Performance logging begins (interval: 15000 ms).
 5/2/2010 8:51:47 PM -- Generating log files ...
 5/2/2010 9:55:38 PM -- C:\alogs\log1 (100.6% generated), C:\alogs\log2 (100.2% generated) and C:\alogs\log3 (100.8% generated)
 5/2/2010 9:55:38 PM -- Performance logging ends.
 5/2/2010 9:55:38 PM -- JetInterop batch transaction stats: 21788, 21830 and 21919.
 5/2/2010 9:55:38 PM -- Dispatching transactions ends.
 5/2/2010 9:55:38 PM -- Shutting down databases ...
 5/2/2010 9:55:39 PM -- Instance3404.1 (complete), Instance3404.2 (complete) and Instance3404.3 (complete)
 5/2/2010 9:55:39 PM --
 C:\ESRP3.0_3GB\SoftRecovery\Performance_2010_5_2_20_51_44.blg has 255 samples.
 5/2/2010 9:55:39 PM -- Creating test report ...
 5/2/2010 9:55:39 PM -- Instance3404.1 has 8.3 for I/O Database Reads Average Latency.
 5/2/2010 9:55:39 PM -- Instance3404.1 has 1.3 for I/O Log Writes Average Latency.
 5/2/2010 9:55:39 PM -- Instance3404.1 has 1.3 for I/O Log Reads Average Latency.
 5/2/2010 9:55:39 PM -- Instance3404.2 has 8.0 for I/O Database Reads Average Latency.
 5/2/2010 9:55:39 PM -- Instance3404.2 has 1.2 for I/O Log Writes Average Latency.
 5/2/2010 9:55:39 PM -- Instance3404.2 has 1.2 for I/O Log Reads Average Latency.
 5/2/2010 9:55:39 PM -- Instance3404.3 has 8.1 for I/O Database Reads Average Latency.
 5/2/2010 9:55:39 PM -- Instance3404.3 has 1.3 for I/O Log Writes Average Latency.
 5/2/2010 9:55:39 PM -- Instance3404.3 has 1.3 for I/O Log Reads Average Latency.
 5/2/2010 9:55:39 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 5/2/2010 9:55:39 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 5/2/2010 9:55:39 PM --
 C:\ESRP3.0_3GB\SoftRecovery\Performance_2010_5_2_20_51_44.xml has 254 samples queried.



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