

Hitachi Adaptable Modular Storage 2100 Dynamically Provisioned 5,800 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 2100 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 5,800 users and 4 servers. This testing used the Hitachi Adaptable Modular Storage 2100 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 2100.

This solution includes Exchange 2010 Mailbox Resiliency by using the new Database Availability Group (DAG) feature. This tested configuration utilizes four DAGs, each containing two database copies and two servers. The test configuration was capable of supporting 5,800 users with a 0.18 IOPS per user profile and user mailbox size of 3GB. A 2100 with 120 450GB 15K RPM SAS disks, 8GB of cache and 4Gbit/s paths was used for these tests. Testing used four Sun Fire 4270 servers with 32GB of RAM, two quad-core Intel E5540 2.53GHz CPUs, eight Emulex 4Gbit/s Fibre Channel adapters, and Windows Server 2008 R2 Enterprise.

The Hitachi Adaptable Modular Storage 2100 is a medium-sized, high-performance, highly reliable midrange storage system that can scale to 120 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 2100 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 2100 to meet the needs of a large Exchange Server deployment.

This solution uses Hitachi Dynamic Provisioning software, which is enabled on the 2100 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 2100 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 2100. 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 is 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 make up the pool.

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

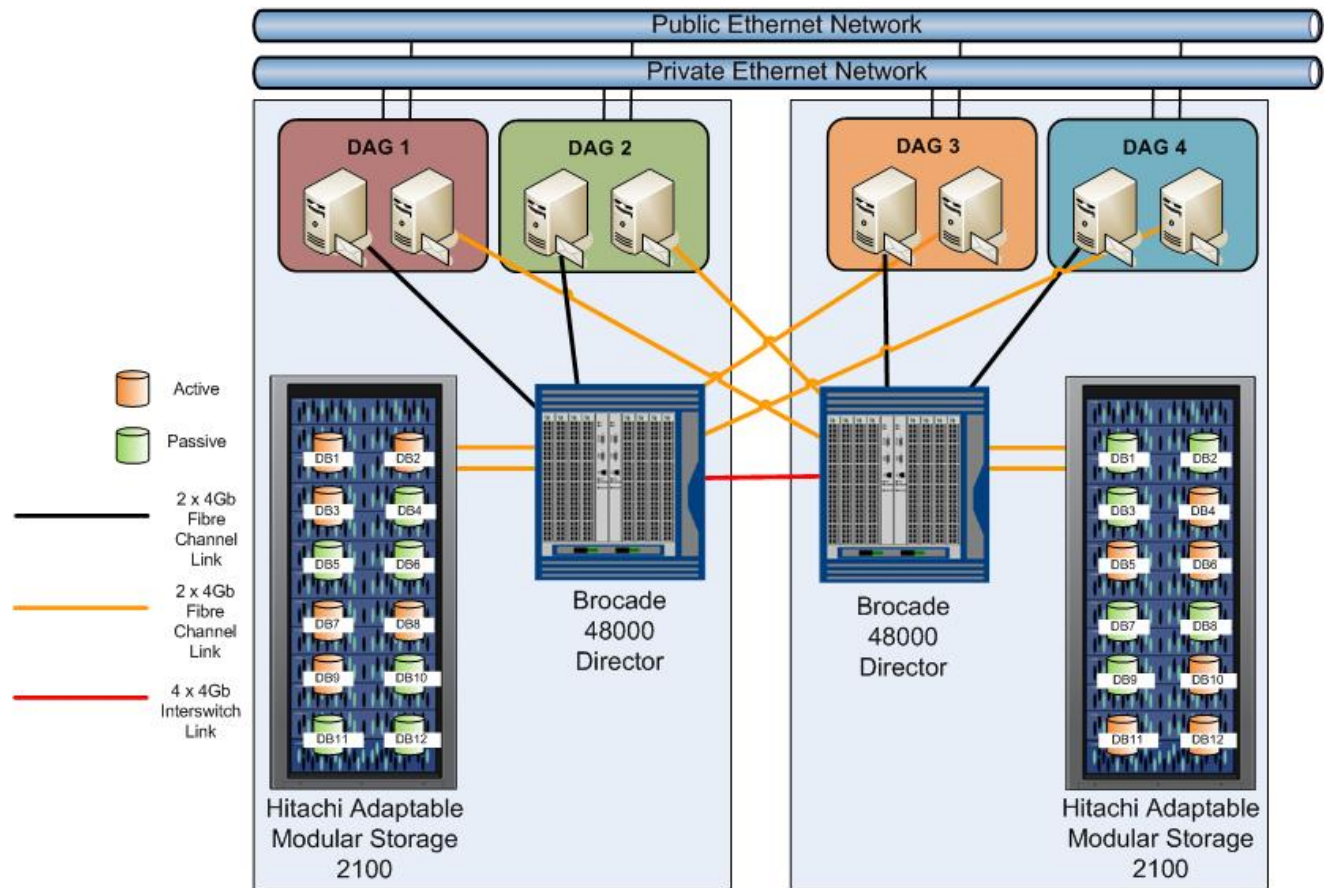
Any server in a DAG can host a copy of a mailbox database from any other server in the DAG. When a server is added to a DAG, it monitors and works with the other servers in the DAG to provide automatic recovery delivering a robust, highly available Exchange solution without the administrative complexities of traditional failover clustering. For more 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 4 DAG's, each configured with four servers that host active mailboxes in three databases. To target the 5,800-user resiliency solution, a Hitachi Adaptable Modular Storage 2100 configured with 120 disks (the maximum) and four servers, each configured with 1,450 mailboxes, were used to host the 12 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 2100 and the passive copy on another server connected to a second 2100. 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 2100's. Each simulated DAG server node in this solution would maintain a mirrored configuration and possess 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

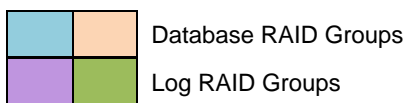


This solution enables organizations to consolidate Exchange Server 2010 DAG deployments on two 2100 storage systems. Using identical hardware and software configurations guarantees that an active database and its replicated copy do not share storage paths, disk spindles or storage controllers, making 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 2100's disks were organized into RAID groups for use by either databases or logs. Each set of colored disks represents a RAID-1+0 (2D+2D) 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 2100 RAID Groups by RKA Tray Layout

<i>Drive Slot</i>	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>13</i>	<i>14</i>
RKA 7	26	26	26	27	27	27	27	28	28	28	28	29	29	29	29
RKA 6	22	22	23	23	23	23	24	24	24	24	25	25	25	25	26
RKA 5	18	19	19	19	19	20	20	20	20	21	21	21	21	22	22
RKA 4	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18
RKA 3	11	11	11	12	12	12	12	13	13	13	13	14	14	14	14
RKA 2	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11
RKA 1	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7
RKA 0	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3



Two Dynamic Provisioning pools were created, one for the databases and the other for the logs. The database pool was created from 27 RAID-10 groups and the log pool was created from three RAID-1+0 groups. From the database pool, 12 DP-VOLs (each specified to have a 1,750GB size limit) were created for 12 databases (three per server). From the log pool, 12 DP-VOLs (each specified to have a size limit of 175GB) were created for 12 logs (three per server).

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

Table 2. Adaptable Modular Storage 2100 Port to Server Layout

<i>Server</i>	<i>Primary Path</i>	<i>Secondary Path</i>
SUN149	0A	1A
SUN150	0B	1B
SUN151	1A	0A
SUN152	1B	0B

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 2100 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
1A	7-9	6-8
1B	10-12	9-11

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

Table 4. Adaptable Modular Storage 2100 Port to Log DP-VOL Layout

<i>Port</i>	<i>Log</i>	<i>DP-VOL</i>
0A	1-3	12-14
0B	4-6	15-17
1A	7-9	18-20
1B	10-12	21-23

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

Table 5. Adaptable Modular Storage 2100 Configuration Details

<i>Host</i>	<i>Pool</i>	<i>Port</i>	<i>DP-VOL</i>	<i>Size (GB)</i>	<i>Description</i>
Sun149	0	0A/1A	0-2	1750	Databases 1-3
Sun150	0	0B/1B	3-5	1750	Databases 4-6
Sun151	0	1A/0A	6-8	1750	Databases 7-9
Sun152	0	1B/0B	9-11	1750	Databases 10-12
Sun149	1	0A/1A	12-14	175	Logs 1-3
Sun150	1	0B/1B	15-17	175	Logs 4-6
Sun151	1	1A/0A	18-20	175	Logs 7-9
Sun152	1	1B/0B	21-23	175	Logs 10-12

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 5,800 Exchange users with the following specifications:

- Eight Exchange servers (four tested, simulating eight for the database copies)
- Two Adaptable Modular Storage 2100 storage systems (one tested)
- 0.15 IOPS per user (0.18 tested for 20 percent growth)
- 3GB mailbox size
- Mailbox resiliency provides high-availability and used as primary data protection mechanism.
- Adaptable Modular Storage RAID protection against physical failure or loss.
- 24x7 background database maintenance enabled

Tested Deployment

The following tables summarize the testing environment.

Table 6. Simulated Exchange Configuration

<i>Number of Exchange mailboxes simulated</i>	5,800
<i>Number of database availability groups (DAGs)</i>	4
<i>Number of servers per DAG</i>	2
<i>Number of active mailboxes per server</i>	1,450
<i>Number of databases per host</i>	3
<i>Number of copies per database</i>	2
<i>Number of mailboxes per database</i>	483
<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>	17,400GB
<i>% storage capacity used by Exchange database**</i>	80.8%

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

Table 7. Primary Storage Hardware

Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	Fibre Channel
Storage model and OS/firmware revision	1 Hitachi Adaptable Modular Storage 2100 Firmware: 0872/B-S WHQL listing: Hitachi Adaptable Modular Storage 2100
Storage cache	8GB
Number of storage controllers	2
Number of storage ports	4
Maximum bandwidth of storage connectivity to host	16Gb/s (4 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	120
Maximum number of spindles can be hosted in the storage	120

Table 8. Primary Storage Software

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

Table 9. 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	108 (Dynamic Provisioning pool)
Total raw storage capacity (GB)	48,600GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID 1+0 (2+2) at storage level
Total formatted capacity	21,546GB (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	12 (Dynamic Provisioning pool)
Total raw storage capacity (GB)	5,400GB
Disk slice size (GB)	N/A
Number of slices per LU or number of disks per LU	N/A
RAID level	RAID 1+0 (2+2) at storage level
Total formatted capacity	2,394GB (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 2100 Firmware: 0872/B-S WHQL listing: Hitachi Adaptable Modular Storage 2100
Storage cache	8GB
Number of storage controllers	2
Number of storage ports	4
Maximum bandwidth of storage connectivity to host	16Gb/s (4 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	120
Maximum number of spindles can be hosted in the storage	120

Table 13. Replicated Storage Software

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

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

Disk type, speed and firmware revision	SAS Disk 450GB 15K 4C57
Raw capacity per disk (GB)	450GB
Number of physical disks in test	108 (Dynamic Provisioning pool)
Total raw storage capacity (GB)	48,600GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID 1+0 (2+2) at storage level
Total formatted capacity	21,546GB (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	12 (Dynamic Provisioning pool)
Total raw storage capacity (GB)	5,400GB
Disk slice size (GB)	N/A
Number of slices per LU or number of disks per LU	N/A
RAID level	RAID 1+0 (2+2) at storage level
Total formatted capacity	2,394GB (Dynamic Provisioning log pool)

Best Practices

Microsoft Exchange Server 2010 is a disk-intensive application. It presents two distinct workload patterns to the storage, with 32KB random read/write operations to the databases, and sequential write operations of varying size (between 512 bytes up to the log buffer size) to the transaction logs. For this reason, designing an optimal storage configuration can prove challenging in practice. Based on the testing run using the ESRP framework, Hitachi Data Systems recommends these best practices to improve the performance of the Hitachi Adaptable Modular Storage 2100 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 LU, Hitachi Data Systems recommends setting the ALU to 64K and 4K respectively for the database and log files.
2. Disk alignment is no longer required when using Microsoft Windows Server 2008.
3. Keep the Exchange workload isolated from other applications. Mixing another I/O intensive application whose workload differs from Exchange can cause the performance for both applications to degrade.
4. Use Hitachi Dynamic Link Manager multipathing software to provide fault tolerance and high availability for host connectivity.
5. Use Hitachi Dynamic Provisioning 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. LU concatenation is not recommended.
10. Hitachi Data Systems recommends implementing Mailbox Resiliency using the Exchange Server 2010 Database Availability Group feature.
11. Ensure that each Database Availability Groups 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 2100.
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 (SUN149)

Database I/O	
<i>Database disk transfers per second</i>	1457
<i>Database disk reads per second</i>	913
<i>Database disk writes per second</i>	544
<i>Average database disk read latency (ms)</i>	6.2
<i>Average database disk write latency (ms)</i>	4.2
Transaction Log I/O	
<i>Log disk writes per second</i>	321
<i>Average log disk write latency (ms)</i>	1.0

Table 17. Individual Server Metrics for Exchange Server (SUN150)

Database I/O	
<i>Database disk transfers per second</i>	1443
<i>Database disk reads per second</i>	904
<i>Database disk writes per second</i>	539
<i>Average database disk read latency (ms)</i>	6.4
<i>Average database disk write latency (ms)</i>	4.2
Transaction Log I/O	
<i>Log disk writes per second</i>	321
<i>Average log disk write latency (ms)</i>	0.9

Table 18. Individual Server Metrics for Exchange Server (SUN151)

Database I/O	
<i>Database disk transfers per second</i>	1469
<i>Database disk reads per second</i>	921
<i>Database disk writes per second</i>	548
<i>Average database disk read latency (ms)</i>	6.2
<i>Average database disk write latency (ms)</i>	4.2
Transaction Log I/O	
<i>Log disk writes per second</i>	324
<i>Average log disk write latency (ms)</i>	1.0

Table 19. Individual Server Metrics for Exchange Server (SUN152)

Database I/O	
<i>Database disk transfers per second</i>	1456
<i>Database disk reads per second</i>	912
<i>Database disk writes per second</i>	544
<i>Average database disk read latency (ms)</i>	6.3
<i>Average database disk write latency (ms)</i>	4.2
Transaction Log I/O	
<i>Log disk writes per second</i>	323
<i>Average log disk write latency (ms)</i>	0.9

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 20. Aggregate Performance for Exchange Server 2010

Database I/O	
<i>Database disk transfers per second</i>	5825
<i>Database disk reads per second</i>	3650
<i>Database disk writes per second</i>	2175
<i>Average database disk read latency (ms)</i>	6.3
<i>Average database disk write latency (ms)</i>	4.2
Transaction Log I/O	
<i>Log disk writes per second</i>	1289
<i>Average log disk write latency (ms)</i>	0.9

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 21. Database Read-only Performance

<i>MB read per second per database</i>	75
<i>MB read per second total per server</i>	226

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 was 1MB in size.

Table 22. Transaction Log Recovery/Replay Performance

<i>Average time to play one log file (sec)</i>	0.76
------------------------------------------------	------

Conclusion

This document details a tested and robust Exchange Server 2010 Resiliency solution capable of supporting 5,800 users with a 0.18 IOPS per user profile and user mailbox size of 3GB using four DAGs each configured with two server nodes. A Hitachi Adaptable Modular Storage 2100, with 8GB of cache and four 4Gbit/s Fibre Channel host paths, using Hitachi Dynamic Provisioning (with two pools) and 120 450GB 15K RPM SAS disks in a RAID-1+0 configuration was used for these tests. Testing confirmed that the 2100 is more than capable of delivering the IOPS and capacity requirements needed to support the active and replicated databases for 5,800 Exchange mailboxes configured with the specified user profile, while maintaining additional headroom to support peak throughput.

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

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

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

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

Appendix — 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: SUN149

Test Summary

Overall Test Result	Pass
Machine Name	SUN149
Test Description	
Test Start Time	4/9/2010 9:59:39 PM
Test End Time	4/10/2010 12:02:55 AM
Collection Start Time	4/9/2010 10:00:43 PM
Collection End Time	4/10/2010 12:00:40 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:\ESRP RAID 10 3GB\Performance Test\Performance_2010_4_9_21_59_45.blg C:\ESRP RAID 10 3GB\Performance Test\DBChecksum_2010_4_10_0_2_55.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1457.813
Target Transactional I/O per Second	261
Initial Database Size (bytes)	4670786568192
Final Database Size (bytes)	4673789689856
Database Files (Count)	3

Jetstress System Parameters

Thread Count	6 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2

Database Configuration

Instance2436.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance2436.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance2436.3	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
Instance2436.1	6.263	5.012	302.323	180.299	33096.162	35456.462	0.000	1.019	0.000	106.501	0.000	4649.909
Instance2436.2	6.269	4.149	305.597	182.150	33071.141	35470.560	0.000	0.929	0.000	108.050	0.000	4597.972
Instance2436.3	6.135	3.327	305.541	181.903	33092.103	35456.232	0.000	1.017	0.000	106.419	0.000	4643.784

Background Database Maintenance I/O Performance

MSExchange Database => Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2436.1	31.457	261860.608
Instance2436.2	31.417	261853.653
Instance2436.3	31.534	261910.723

Log Replication I/O Performance

MSExchange Database => Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2436.1	2.020	232565.051
Instance2436.2	2.024	232561.484
Instance2436.3	2.015	232562.019

Total I/O Performance

MSExchange Databases => Instance	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads /sec	I/O Database Writes /sec	I/O Database Average Bytes	I/O Database Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2 436.1	6.263	5.012	333.780	180.299	54655.683	35456.462	1.723	1.019	2.020	106.501	232565.051	4649.909
Instance2 436.2	6.269	4.149	337.014	182.150	54398.562	35470.560	1.509	0.929	2.024	108.050	232561.484	4597.972
Instance2 436.3	6.135	3.327	337.074	181.903	54498.366	35456.232	1.655	1.017	2.015	106.419	232562.019	4643.784

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.300	0.000	4.093
Available MBytes	29752.781	29739.000	29779.000
Free System Page Table Entries	33555130.992	33555128.000	33555131.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	70950417.067	70119424.000	71196672.000
Pool Paged Bytes	116589414.400	114274304.000	118329344.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

4/9/2010 9:59:39 PM -- Jetstress testing begins ...
4/9/2010 9:59:39 PM -- Prepare testing begins ...
4/9/2010 9:59:42 PM -- Attaching databases ...
4/9/2010 9:59:42 PM -- Prepare testing ends.
4/9/2010 9:59:42 PM -- Dispatching transactions begins ...
4/9/2010 9:59:42 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
4/9/2010 9:59:42 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/9/2010 9:59:45 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/9/2010 9:59:45 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/9/2010 9:59:50 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/9/2010 9:59:50 PM -- Performance logging begins (interval: 15000 ms).
4/9/2010 9:59:50 PM -- Attaining prerequisites:
4/9/2010 10:00:43 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 725983200.0 (lower bound: 724775700.0, upper bound: none)
4/10/2010 12:00:43 AM -- Performance logging ends.
4/10/2010 12:02:52 AM -- JetInterop batch transaction stats: 71735, 71897 and 72047.
4/10/2010 12:02:52 AM -- Dispatching transactions ends.
4/10/2010 12:02:52 AM -- Shutting down databases ...
4/10/2010 12:02:55 AM -- Instance2436.1 (complete), Instance2436.2 (complete) and

```

Instance2436.3 (complete)
4/10/2010 12:02:56 AM -- Performance Logging begins (interval: 30000 ms).
4/10/2010 12:02:56 AM -- Verifying database checksums ...
4/10/2010 7:54:07 AM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
4/10/2010 7:54:07 AM -- Performance Logging ends.
4/10/2010 7:54:07 AM -- C:\ESRP RAID 10 3GB\Performance
Test\DBChecksum_2010_4_10_0_2_55.blg has 941 samples.
4/10/2010 7:54:10 AM -- C:\ESRP RAID 10 3GB\Performance
Test\DBChecksum_2010_4_10_0_2_55.html is saved.
4/10/2010 7:54:10 AM -- Verifying Log checksums ...
4/10/2010 7:54:11 AM -- C:\alogluns\log1 (14 Log(s) processed), C:\alogluns\log2 (13 Log(s) processed) and C:\alogluns\log3 (13 Log(s) processed)
4/10/2010 7:54:11 AM -- C:\ESRP RAID 10 3GB\Performance
Test\Performance_2010_4_9_21_59_45.blg has 483 samples.
4/10/2010 7:54:11 AM -- Creating test report ...
4/10/2010 7:54:13 AM -- Instance2436.1 has 6.3 for I/O Database Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.1 has 1.0 for I/O Log Writes Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.1 has 1.0 for I/O Log Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.2 has 6.3 for I/O Database Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.2 has 0.9 for I/O Log Writes Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.2 has 0.9 for I/O Log Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.3 has 6.1 for I/O Database Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.3 has 1.0 for I/O Log Writes Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.3 has 1.0 for I/O Log Reads Average Latency.
4/10/2010 7:54:13 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/10/2010 7:54:13 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/10/2010 7:54:13 AM -- C:\ESRP RAID 10 3GB\Performance
Test\Performance_2010_4_9_21_59_45.xml has 479 samples queried.

Performance Test Database Checksums Result: SUN149

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\asgluns\sg1\Jetstress001001.edb	47544418	0	0	0	1485763 MBytes / 28271 sec
C:\asgluns\sg2\Jetstress002001.edb	47544162	0	0	0	1485755 MBytes / 15886 sec
C:\asgluns\sg3\Jetstress003001.edb	47544162	0	0	0	1485755 MBytes / 18669 sec
(Sum)	142632742	0	0	0	4457273 MBytes / 28271 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	0.079	0.000	840.490	0.000	65535.997
C:\asgluns\sg2	0.056	0.000	1496.130	0.000	65536.000
C:\asgluns\sg3	0.059	0.000	1273.933	0.000	65536.000

Memory System Performance of Checksum

Counter	Average	Minimum	Maximum
% Processor Time	0.916	0.000	4.242
Available MBytes	30549.351	30539.000	30559.000
Free System Page Table Entries	33555131.006	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71400288.034	71225344.000	71659520.000
Pool Paged Bytes	117339278.555	116613120.000	117891072.000

Test Log

4/9/2010 9:59:39 PM -- Jetstress testing begins ...
4/9/2010 9:59:39 PM -- Prepare testing begins ...
4/9/2010 9:59:42 PM -- Attaching databases ...
4/9/2010 9:59:42 PM -- Prepare testing ends.
4/9/2010 9:59:42 PM -- Dispatching transactions begins ...
4/9/2010 9:59:42 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
4/9/2010 9:59:42 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/9/2010 9:59:45 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/9/2010 9:59:45 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/9/2010 9:59:50 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/9/2010 9:59:50 PM -- Performance logging begins (interval: 15000 ms).
4/9/2010 9:59:50 PM -- Attaining prerequisites:
4/9/2010 10:00:43 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 725983200.0 (lower bound: 724775700.0, upper bound: none)
4/10/2010 12:00:43 AM -- Performance logging ends.
4/10/2010 12:02:52 AM -- JetInterop batch transaction stats: 71735, 71897 and 72047.
4/10/2010 12:02:52 AM -- Dispatching transactions ends.
4/10/2010 12:02:52 AM -- Shutting down databases ...
4/10/2010 12:02:55 AM -- Instance2436.1 (complete), Instance2436.2 (complete) and Instance2436.3 (complete)
4/10/2010 12:02:56 AM -- Performance logging begins (interval: 30000 ms).
4/10/2010 12:02:56 AM -- Verifying database checksums ...
4/10/2010 7:54:07 AM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
4/10/2010 7:54:07 AM -- Performance logging ends.
4/10/2010 7:54:07 AM -- C:\ESRP RAID 10 3GB\Performance Test\DBChecksum_2010_4_10_0_2_55.blg has 941 samples.

Stress Test Database Performance Result: SUN149

Test Summary

Overall Test Result	Pass
Machine Name	SUN149
Test Description	
Test Start Time	4/10/2010 9:12:41 AM
Test End Time	4/11/2010 9:45:36 AM
Collection Start Time	4/10/2010 9:13:46 AM
Collection End Time	4/11/2010 9:13:33 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:\ESRP RAID 10 3GB\Stress Test\Stress_2010_4_10_9_12_48.blg C:\ESRP RAID 10 3GB\Stress Test\DBChecksum_2010_4_11_9_45_36.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1442.38
Target Transactional I/O per Second	261
Initial Database Size (bytes)	4673789689856
Final Database Size (bytes)	4707939713024
Database Files (Count)	3

Jetstress System Parameters

Thread Count	6 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2

Database Configuration

Instance2436.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance2436.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance2436.3	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
Instance2436.1	6.462	4.912	299.077	182.110	33062.521	34405.025	0.000	0.994	0.000	102.027	0.000	4572.734
Instance2436.2	6.384	4.095	298.834	182.129	33089.593	34396.233	0.000	0.901	0.000	102.882	0.000	4530.109
Instance2436.3	6.224	3.262	298.336	181.893	33109.331	34394.190	0.000	0.996	0.000	101.444	0.000	4585.530

Background Database Maintenance I/O Performance

MSExchange Database => Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2436.1	31.504	261873.966
Instance2436.2	31.440	261869.724
Instance2436.3	31.563	261891.900

Log Replication I/O Performance

<i>MSExchange Database ==> Instances</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Reads Average Bytes</i>
Instance2436.1	1.901	232560.984
Instance2436.2	1.897	232561.088
Instance2436.3	1.895	232560.107

Total I/O Performance

<i>MSExchange Database ==> Instance s</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>
Instance2436.1	6.462	4.912	330.581	182.110	54868.158	34405.025	1.772	0.994	1.901	102.027	232560.984	4572.734
Instance2436.2	6.384	4.095	330.274	182.129	54868.013	34396.233	1.438	0.901	1.897	102.882	232561.088	4530.109
Instance2436.3	6.224	3.262	329.899	181.893	54997.890	34394.190	1.721	0.996	1.895	101.444	232560.107	4585.530

Host System Performance

<i>Counter</i>	<i>Average</i>	<i>Minimum</i>	<i>Maximum</i>
% Processor Time	1.287	0.000	4.573
Available MBytes	29650.839	29631.000	29712.000
Free System Page Table Entries	33555130.994	33555126.000	33555131.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71427941.199	71102464.000	71614464.000
Pool Paged Bytes	117825634.219	115871744.000	119795712.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

4/9/2010 9:59:39 PM -- Jetstress testing begins ...
4/9/2010 9:59:39 PM -- Prepare testing begins ...
4/9/2010 9:59:42 PM -- Attaching databases ...
4/9/2010 9:59:42 PM -- Prepare testing ends.
4/9/2010 9:59:42 PM -- Dispatching transactions begins ...
4/9/2010 9:59:42 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
4/9/2010 9:59:42 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/9/2010 9:59:45 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/9/2010 9:59:45 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/9/2010 9:59:50 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/9/2010 9:59:50 PM -- Performance logging begins (interval: 15000 ms).
4/9/2010 9:59:50 PM -- Attaining prerequisites:
4/9/2010 10:00:43 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 725983200.0 (lower bound: 724775700.0, upper bound: none)
4/10/2010 12:00:43 AM -- Performance logging ends.
4/10/2010 12:02:52 AM -- JetInterop batch transaction stats: 71735, 71897 and 72047.
4/10/2010 12:02:52 AM -- Dispatching transactions ends.
4/10/2010 12:02:52 AM -- Shutting down databases ...
4/10/2010 12:02:55 AM -- Instance2436.1 (complete), Instance2436.2 (complete) and Instance2436.3 (complete)
4/10/2010 12:02:56 AM -- Performance logging begins (interval: 30000 ms).
4/10/2010 12:02:56 AM -- Verifying database checksums ...
4/10/2010 7:54:07 AM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
4/10/2010 7:54:07 AM -- Performance logging ends.
4/10/2010 7:54:07 AM -- C:\ESRP RAID 10 3GB\Performance Test\DBChecksum_2010_4_10_0_2_55.blg has 941 samples.
4/10/2010 7:54:10 AM -- C:\ESRP RAID 10 3GB\Performance Test\DBChecksum_2010_4_10_0_2_55.html is saved.
4/10/2010 7:54:10 AM -- Verifying log checksums ...
4/10/2010 7:54:11 AM -- C:\alogluns\log1 (14 log(s) processed), C:\alogluns\log2 (13 log(s) processed) and C:\alogluns\log3 (13 log(s) processed)
4/10/2010 7:54:11 AM -- C:\ESRP RAID 10 3GB\Performance Test\Performance_2010_4_9_21_59_45.blg has 483 samples.
4/10/2010 7:54:11 AM -- Creating test report ...
4/10/2010 7:54:13 AM -- Instance2436.1 has 6.3 for I/O Database Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.1 has 1.0 for I/O Log Writes Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.1 has 1.0 for I/O Log Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.2 has 6.3 for I/O Database Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.2 has 0.9 for I/O Log Writes Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.2 has 0.9 for I/O Log Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.3 has 6.1 for I/O Database Reads Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.3 has 1.0 for I/O Log Writes Average Latency.
4/10/2010 7:54:13 AM -- Instance2436.3 has 1.0 for I/O Log Reads Average Latency.
4/10/2010 7:54:13 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/10/2010 7:54:13 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/10/2010 7:54:13 AM -- C:\ESRP RAID 10 3GB\Performance Test\Performance_2010_4_9_21_59_45.xml has 479 samples queried.
4/10/2010 7:54:14 AM -- C:\ESRP RAID 10 3GB\Performance Test\Performance_2010_4_9_21_59_45.html is saved.
4/10/2010 7:54:14 AM -- C:\ESRP RAID 10 3GB\Performance Test\Application_2010_4_10_7_54_14.evt is saved.
4/10/2010 7:54:14 AM -- C:\ESRP RAID 10 3GB\Performance Test\System_2010_4_10_7_54_14.evt is saved.

4/10/2010 7:54:14 AM -- Jetstress testing ends.
 4/10/2010 9:12:41 AM -- Jetstress testing begins ...
 4/10/2010 9:12:41 AM -- Prepare testing begins ...
 4/10/2010 9:12:44 AM -- Attaching databases ...
 4/10/2010 9:12:44 AM -- Prepare testing ends.
 4/10/2010 9:12:44 AM -- Dispatching transactions begins ...
 4/10/2010 9:12:44 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 4/10/2010 9:12:44 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 4/10/2010 9:12:48 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 4/10/2010 9:12:48 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 4/10/2010 9:12:52 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 4/10/2010 9:12:52 AM -- Performance logging begins (interval: 15000 ms).
 4/10/2010 9:12:52 AM -- Attaining prerequisites:
 4/10/2010 9:13:46 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 734556200.0 (Lower bound: 724775700.0, upper bound: none)
 4/11/2010 9:13:46 AM -- Performance logging ends.
 4/11/2010 9:45:33 AM -- JetInterop batch transaction stats: 809895, 808654 and 808074.
 4/11/2010 9:45:34 AM -- Dispatching transactions ends.
 4/11/2010 9:45:34 AM -- Shutting down databases ...
 4/11/2010 9:45:36 AM -- Instance2436.1 (complete), Instance2436.2 (complete) and Instance2436.3 (complete)
 4/11/2010 9:45:37 AM -- Performance logging begins (interval: 30000 ms).
 4/11/2010 9:45:37 AM -- Verifying database checksums ...
 4/11/2010 5:16:32 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 4/11/2010 5:16:32 PM -- Performance logging ends.
 4/11/2010 5:16:32 PM -- C:\ESRP RAID 10 3GB\Stress Test\DBChecksum_2010_4_11_9_45_36.blg has 901 samples.
 4/11/2010 5:16:35 PM -- C:\ESRP RAID 10 3GB\Stress Test\DBChecksum_2010_4_11_9_45_36.html is saved.
 4/11/2010 5:16:35 PM -- Verifying log checksums ...
 4/11/2010 5:16:36 PM -- C:\alogluns\log1 (13 log(s) processed), C:\alogluns\log2 (13 log(s) processed) and C:\alogluns\log3 (15 log(s) processed)
 4/11/2010 5:16:36 PM -- C:\ESRP RAID 10 3GB\Stress Test\Stress_2010_4_10_9_12_48.blg has 5758 samples.
 4/11/2010 5:16:36 PM -- Creating test report ...
 4/11/2010 5:16:56 PM -- Instance2436.1 has 6.5 for I/O Database Reads Average Latency.
 4/11/2010 5:16:56 PM -- Instance2436.1 has 1.0 for I/O Log Writes Average Latency.
 4/11/2010 5:16:56 PM -- Instance2436.1 has 1.0 for I/O Log Reads Average Latency.
 4/11/2010 5:16:56 PM -- Instance2436.2 has 6.4 for I/O Database Reads Average Latency.
 4/11/2010 5:16:56 PM -- Instance2436.2 has 0.9 for I/O Log Writes Average Latency.
 4/11/2010 5:16:56 PM -- Instance2436.2 has 0.9 for I/O Log Reads Average Latency.
 4/11/2010 5:16:56 PM -- Instance2436.3 has 6.2 for I/O Database Reads Average Latency.
 4/11/2010 5:16:56 PM -- Instance2436.3 has 1.0 for I/O Log Writes Average Latency.
 4/11/2010 5:16:56 PM -- Instance2436.3 has 1.0 for I/O Log Reads Average Latency.
 4/11/2010 5:16:56 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 4/11/2010 5:16:56 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 4/11/2010 5:16:56 PM -- C:\ESRP RAID 10 3GB\Stress Test\Stress_2010_4_10_9_12_48.xml has 5754 samples queried.

Stress Test Database Checksums Result: SUN149

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\asgluns\sg1\Jetstress001001.edb	47892322	0	0	0	1496635 MBytes / 27055 sec
C:\asgluns\sg2\Jetstress002001.edb	47891298	0	0	0	1496603 MBytes / 15949 sec
C:\asgluns\sg3\Jetstress003001.edb	47891298	0	0	0	1496603 MBytes / 19191 sec
(Sum)	143674918	0	0	0	4489841 MBytes / 27055 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	0.078	0.000	884.619	0.000	65535.997
C:\asgluns\sg2	0.056	0.000	1501.132	0.000	65536.000
C:\asgluns\sg3	0.059	0.000	1247.841	0.000	65536.000

Memory System Performance of Checksum

Counter	Average	Minimum	Maximum
% Processor Time	0.949	0.000	3.881
Available MBytes	30453.476	30438.000	30462.000
Free System Page Table Entries	33555130.999	33555130.000	33555131.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71897456.231	71774208.000	72114176.000
Pool Paged Bytes	117412858.317	116842496.000	119660544.000

Test Log

4/9/2010 9:59:39 PM -- Jetstress testing begins ...
 4/9/2010 9:59:39 PM -- Prepare testing begins ...
 4/9/2010 9:59:42 PM -- Attaching databases ...
 4/9/2010 9:59:42 PM -- Prepare testing ends.
 4/9/2010 9:59:42 PM -- Dispatching transactions begins ...
 4/9/2010 9:59:42 PM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 4/9/2010 9:59:42 PM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 4/9/2010 9:59:45 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 4/9/2010 9:59:45 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 4/9/2010 9:59:50 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 4/9/2010 9:59:50 PM -- Performance logging begins (interval: 15000 ms).
 4/9/2010 9:59:50 PM -- Attaining prerequisites:
 4/9/2010 10:00:43 PM -- \MSEXchange Database(JetstressWin)\Database Cache Size, Last: 725983200.0 (lower bound: 724775700.0, upper bound: none)

4/10/2010 12:00:43 AM -- Performance logging ends.
 4/10/2010 12:02:52 AM -- JetInterop batch transaction stats: 71735, 71897 and 72047.
 4/10/2010 12:02:52 AM -- Dispatching transactions ends.
 4/10/2010 12:02:52 AM -- Shutting down databases ...
 4/10/2010 12:02:55 AM -- Instance2436.1 (complete), Instance2436.2 (complete) and Instance2436.3 (complete)
 4/10/2010 12:02:56 AM -- Performance logging begins (interval: 30000 ms).
 4/10/2010 12:02:56 AM -- Verifying database checksums ...
 4/10/2010 7:54:07 AM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 4/10/2010 7:54:07 AM -- Performance logging ends.
 4/10/2010 7:54:07 AM -- C:\ESRP RAID 10 3GB\Performance Test\DBChecksum_2010_4_10_0_2_55.blg has 941 samples.
 4/10/2010 7:54:10 AM -- C:\ESRP RAID 10 3GB\Performance Test\DBChecksum_2010_4_10_0_2_55.html is saved.
 4/10/2010 7:54:10 AM -- Verifying log checksums ...
 4/10/2010 7:54:11 AM -- C:\alogluns\log1 (14 log(s) processed), C:\alogluns\log2 (13 log(s) processed) and C:\alogluns\log3 (13 log(s) processed)
 4/10/2010 7:54:11 AM -- C:\ESRP RAID 10 3GB\Performance Test\Performance_2010_4_9_21_59_45.blg has 483 samples.
 4/10/2010 7:54:11 AM -- Creating test report ...
 4/10/2010 7:54:13 AM -- Instance2436.1 has 6.3 for I/O Database Reads Average Latency.
 4/10/2010 7:54:13 AM -- Instance2436.1 has 1.0 for I/O Log Writes Average Latency.
 4/10/2010 7:54:13 AM -- Instance2436.1 has 1.0 for I/O Log Reads Average Latency.
 4/10/2010 7:54:13 AM -- Instance2436.2 has 6.3 for I/O Database Reads Average Latency.
 4/10/2010 7:54:13 AM -- Instance2436.2 has 0.9 for I/O Log Writes Average Latency.
 4/10/2010 7:54:13 AM -- Instance2436.2 has 0.9 for I/O Log Reads Average Latency.
 4/10/2010 7:54:13 AM -- Instance2436.3 has 6.1 for I/O Database Reads Average Latency.
 4/10/2010 7:54:13 AM -- Instance2436.3 has 1.0 for I/O Log Writes Average Latency.
 4/10/2010 7:54:13 AM -- Instance2436.3 has 1.0 for I/O Log Reads Average Latency.
 4/10/2010 7:54:13 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 4/10/2010 7:54:13 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 4/10/2010 7:54:13 AM -- C:\ESRP RAID 10 3GB\Performance Test\Performance_2010_4_9_21_59_45.xml has 479 samples queried.
 4/10/2010 7:54:14 AM -- C:\ESRP RAID 10 3GB\Performance Test\Performance_2010_4_9_21_59_45.html is saved.
 4/10/2010 7:54:14 AM -- C:\ESRP RAID 10 3GB\Performance Test\Application_2010_4_10_7_54_14.evt is saved.
 4/10/2010 7:54:14 AM -- C:\ESRP RAID 10 3GB\Performance Test\System_2010_4_10_7_54_14.evt is saved.
 4/10/2010 7:54:14 AM -- Jetstress testing ends.
 4/10/2010 9:12:41 AM -- Jetstress testing begins ...
 4/10/2010 9:12:41 AM -- Prepare testing begins ...
 4/10/2010 9:12:44 AM -- Attaching databases ...
 4/10/2010 9:12:44 AM -- Prepare testing ends.
 4/10/2010 9:12:44 AM -- Dispatching transactions begins ...
 4/10/2010 9:12:44 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
 4/10/2010 9:12:44 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
 4/10/2010 9:12:48 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 4/10/2010 9:12:48 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 4/10/2010 9:12:52 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 4/10/2010 9:12:52 AM -- Performance logging begins (interval: 15000 ms).
 4/10/2010 9:12:52 AM -- Attaining prerequisites:
 4/10/2010 9:13:46 AM -- \MSEXchange Database(JetstressWin)\Database Cache Size, Last: 734556200.0 (lower bound: 724775700.0, upper bound: none)
 4/11/2010 9:13:46 AM -- Performance logging ends.

4/11/2010 9:45:33 AM -- JetInterop batch transaction stats: 809895, 808654 and 808074.
 4/11/2010 9:45:34 AM -- Dispatching transactions ends.
 4/11/2010 9:45:34 AM -- Shutting down databases ...
 4/11/2010 9:45:36 AM -- Instance2436.1 (complete), Instance2436.2 (complete) and Instance2436.3 (complete)
 4/11/2010 9:45:37 AM -- Performance logging begins (interval: 30000 ms).
 4/11/2010 9:45:37 AM -- Verifying database checksums ...
 4/11/2010 5:16:32 PM -- C:\asgluns\sg1 (100% processed), C:\asgluns\sg2 (100% processed) and C:\asgluns\sg3 (100% processed)
 4/11/2010 5:16:32 PM -- Performance logging ends.
 4/11/2010 5:16:32 PM -- C:\ESRP RAID 10 3GB\Stress Test\DBChecksum_2010_4_11_9_45_36.blg has 901 samples.

Database Backup Test Result: SUN149

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance2436.1	1496627.09	06:25:33	64.70
Instance2436.2	1496595.09	04:20:01	95.93
Instance2436.3	1496595.09	06:25:26	64.71

Jetstress System Parameters

Thread Count	6 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance2436.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance2436.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance2436.3	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 Average Bytes	I/O Database Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2436.1	7.760	0.000	258.640	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2436.2	4.327	0.000	383.775	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2436.3	7.747	0.000	258.832	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	0.858	0.000	2.891
Available MBytes	30455.281	30445.000	30457.000
Free System Page Table Entries	33555131.665	33555131.000	33555643.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71598510.878	71577600.000	71680000.000
Pool Paged Bytes	119064368.540	118890496.000	119451648.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

4/11/2010 6:35:43 PM -- Jetstress testing begins ...
4/11/2010 6:35:43 PM -- Prepare testing begins ...
4/11/2010 6:35:46 PM -- Attaching databases ...
4/11/2010 6:35:46 PM -- Prepare testing ends.
4/11/2010 6:35:53 PM -- Performance logging begins (interval: 30000 ms).
4/11/2010 6:35:53 PM -- Backing up databases ...
4/12/2010 1:01:26 AM -- Performance logging ends.
4/12/2010 1:01:26 AM -- Instance2436.1 (100% processed), Instance2436.2 (100%
processed) and Instance2436.3 (100% processed)
4/12/2010 1:01:26 AM -- C:\ESRP RAID 10 3GB\Database Backup
Test\DatabaseBackup_2010_4_11_18_35_46.blg has 770 samples.
4/12/2010 1:01:26 AM -- Creating test report ...

```

Soft Recovery Test Result: SUN149

Soft Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance2436.1	500	392.7618899
Instance2436.2	500	363.8550391
Instance2436.3	504	394.0878922

Database Configuration

Instance2436.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance2436.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance2436.3	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
Instance2436.1	31.420	21.362	1549.574	7.666	35394.648	32768.000	4.467	0.006	11.522	0.031	232519.347	2.639
Instance2436.2	27.805	20.135	1733.336	8.285	35538.329	32584.939	3.853	0.000	12.439	0.000	231204.997	0.000
Instance2436.3	29.396	20.673	1556.032	7.641	35409.553	32599.093	4.844	0.000	11.477	0.000	231313.557	0.000

Background Database Maintenance I/O Performance

MSExchange Database Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2436.1	25.992	261881.301
Instance2436.2	26.062	261874.467
Instance2436.3	26.282	261916.316

Total I/O Performance

MSExchange => Instance	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads /sec	I/O Database Writes /sec	I/O Database Average Bytes	I/O Database Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2436.1	31.420	21.362	1575.567	7.666	39131.046	32768.000	4.467	0.006	11.522	0.031	232519.347	2.639
Instance2436.2	27.805	20.135	1759.398	8.285	38891.021	32584.939	3.853	0.000	12.439	0.000	231204.997	0.000
Instance2436.3	29.396	20.673	1582.314	7.641	39171.748	32599.093	4.844	0.000	11.477	0.000	231313.557	0.000

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	4.478	0.000	32.122
Available MBytes	29637.118	29620.000	30371.000
Free System Page Table Entries	33555131.082	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	76435308.964	72310784.000	76918784.000
Pool Paged Bytes	119095569.067	119054336.000	119214080.000
Database Page Fault Stalls/sec	0.008	0.000	1.491

Test Log

```

4/12/2010 1:11:03 AM -- Jetstress testing begins ...
4/12/2010 1:11:03 AM -- Prepare testing begins ...
4/12/2010 1:11:07 AM -- Attaching databases ...
4/12/2010 1:11:07 AM -- Prepare testing ends.
4/12/2010 1:11:07 AM -- Dispatching transactions begins ...
4/12/2010 1:11:07 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
4/12/2010 1:11:07 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/12/2010 1:11:10 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/12/2010 1:11:10 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/12/2010 1:11:13 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/12/2010 1:11:13 AM -- Performance logging begins (interval: 15000 ms).
4/12/2010 1:11:13 AM -- Generating log files ...
4/12/2010 1:47:47 AM -- C:\alogs\log1 (100.2% generated), C:\alogs\log2 (100.2% generated) and C:\alogs\log3 (101.0% generated)
4/12/2010 1:47:47 AM -- Performance logging ends.
4/12/2010 1:47:47 AM -- JetInterop batch transaction stats: 21771, 21763 and 21679.
4/12/2010 1:47:47 AM -- Dispatching transactions ends.
4/12/2010 1:47:47 AM -- Shutting down databases ...
4/12/2010 1:47:48 AM -- Instance2436.1 (complete), Instance2436.2 (complete) and

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Instance2436.3 (complete)
4/12/2010 1:47:48 AM -- C:\ESRP RAID 10 3GB\Soft Recovery Test\Performance_2010_4_12_1_11_10.blg has 146 samples.
4/12/2010 1:47:48 AM -- Creating test report ...
4/12/2010 1:47:49 AM -- Instance2436.1 has 6.6 for I/O Database Reads Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.1 has 0.7 for I/O Log Writes Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.1 has 0.7 for I/O Log Reads Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.2 has 6.4 for I/O Database Reads Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.2 has 0.6 for I/O Log Writes Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.2 has 0.6 for I/O Log Reads Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.3 has 6.3 for I/O Database Reads Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.3 has 0.7 for I/O Log Writes Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.3 has 0.7 for I/O Log Reads Average Latency.
4/12/2010 1:47:49 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/12/2010 1:47:49 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/12/2010 1:47:49 AM -- C:\ESRP RAID 10 3GB\Soft Recovery Test\Performance_2010_4_12_1_11_10.xml has 145 samples queried.
4/12/2010 1:47:49 AM -- C:\ESRP RAID 10 3GB\Soft Recovery Test\Performance_2010_4_12_1_11_10.html is saved.
4/12/2010 1:48:46 AM -- Performance Logging begins (interval: 2000 ms).
4/12/2010 1:48:46 AM -- Recovering databases ...
4/12/2010 1:55:20 AM -- Performance Logging ends.
4/12/2010 1:55:20 AM -- Instance2436.1 (392.7618899), Instance2436.2 (363.8550391) and Instance2436.3 (394.0878922)
4/12/2010 1:55:21 AM -- C:\ESRP RAID 10 3GB\Soft Recovery Test\SoftRecovery_2010_4_12_1_48_43.blg has 195 samples.
4/12/2010 1:55:21 AM -- Creating test report ...

Soft Recovery Test Performance Result: SUN149

Test Summary

Overall Test Result	Pass
Machine Name	SUN149
Test Description	
Test Start Time	4/12/2010 1:11:03 AM
Test End Time	4/12/2010 1:47:48 AM
Collection Start Time	4/12/2010 1:11:28 AM
Collection End Time	4/12/2010 1:47:44 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:\ESRP RAID 10 3GB\Soft Recovery Test\Performance_2010_4_12_1_11_10.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1483.428
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	4707939713024
Final Database Size (bytes)	4708854071296
Database Files (Count)	3

Jetstress System Parameters

Thread Count	6 (per database)
Minimum Database Cache	96.0 MB
Maximum Database Cache	768.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance2436.1	Log Path: C:\alogluns\log1 Database: C:\asgluns\sg1\Jetstress001001.edb
Instance2436.2	Log Path: C:\alogluns\log2 Database: C:\asgluns\sg2\Jetstress002001.edb
Instance2436.3	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 Average Bytes	I/O Database Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads /sec	I/O Log Writes /sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2 436.1	6.588	5.153	302.279	192.903	32791.376	34276.185	0.000	0.735	0.000	108.646	0.000	4613.054
Instance2 436.2	6.440	4.368	302.665	193.632	32796.667	34305.680	0.000	0.630	0.000	110.497	0.000	4548.436
Instance2 436.3	6.298	3.159	300.405	191.544	32794.906	34330.425	0.000	0.739	0.000	108.966	0.000	4642.709

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.394	0.000	4.047
Available MBytes	29636.397	29624.000	30161.000
Free System Page Table Entries	33555131.014	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71808855.671	71565312.000	71946240.000
Pool Paged Bytes	119032649.644	118956032.000	119250944.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

4/12/2010 1:11:03 AM -- Jetstress testing begins ...
4/12/2010 1:11:03 AM -- Prepare testing begins ...
4/12/2010 1:11:07 AM -- Attaching databases ...
4/12/2010 1:11:07 AM -- Prepare testing ends.
4/12/2010 1:11:07 AM -- Dispatching transactions begins ...
4/12/2010 1:11:07 AM -- Database cache settings: (minimum: 96.0 MB, maximum: 768.0 MB)
4/12/2010 1:11:07 AM -- Database flush thresholds: (start: 7.7 MB, stop: 15.3 MB)
4/12/2010 1:11:10 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/12/2010 1:11:10 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/12/2010 1:11:13 AM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/12/2010 1:11:13 AM -- Performance logging begins (interval: 15000 ms).
4/12/2010 1:11:13 AM -- Generating log files ...
4/12/2010 1:47:47 AM -- C:\alogs\log1 (100.2% generated), C:\alogs\log2 (100.2% generated) and C:\alogs\log3 (101.0% generated)
4/12/2010 1:47:47 AM -- Performance logging ends.
4/12/2010 1:47:47 AM -- JetInterop batch transaction stats: 21771, 21763 and 21679.
4/12/2010 1:47:47 AM -- Dispatching transactions ends.
4/12/2010 1:47:47 AM -- Shutting down databases ...
4/12/2010 1:47:48 AM -- Instance2436.1 (complete), Instance2436.2 (complete) and

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Instance2436.3 (complete)
4/12/2010 1:47:48 AM -- C:\ESRP RAID 10 3GB\Soft Recovery
Test\Performance_2010_4_12_1_11_10.blg has 146 samples.
4/12/2010 1:47:48 AM -- Creating test report ...
4/12/2010 1:47:49 AM -- Instance2436.1 has 6.6 for I/O Database Reads Average
Latency.
4/12/2010 1:47:49 AM -- Instance2436.1 has 0.7 for I/O Log Writes Average
Latency.
4/12/2010 1:47:49 AM -- Instance2436.1 has 0.7 for I/O Log Reads Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.2 has 6.4 for I/O Database Reads Average
Latency.
4/12/2010 1:47:49 AM -- Instance2436.2 has 0.6 for I/O Log Writes Average
Latency.
4/12/2010 1:47:49 AM -- Instance2436.2 has 0.6 for I/O Log Reads Average Latency.
4/12/2010 1:47:49 AM -- Instance2436.3 has 6.3 for I/O Database Reads Average
Latency.
4/12/2010 1:47:49 AM -- Instance2436.3 has 0.7 for I/O Log Writes Average
Latency.
4/12/2010 1:47:49 AM -- Instance2436.3 has 0.7 for I/O Log Reads Average Latency.
4/12/2010 1:47:49 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/12/2010 1:47:49 AM -- Test has 0 Database Page Fault Stalls/sec samples higher
than 0.
4/12/2010 1:47:49 AM -- C:\ESRP RAID 10 3GB\Soft Recovery
Test\Performance_2010_4_12_1_11_10.xml has 145 samples queried.



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