

Hitachi Adaptable Modular Storage 2100 Dynamically Provisioned 7,040 Mailbox Exchange 2010 Mailbox Resiliency Storage Solution

Tested with: ESRP – Storage Version 3.0

Test Date: December 2010

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Overview

This document provides information on a Hitachi Adaptable Modular Storage 2100 Mailbox Resiliency storage solution using Hitachi Dynamic Provisioning for Microsoft Exchange Server 2010. This solution is based on the Microsoft Exchange Solution Reviewed Program (ESRP) – Storage program. For more information about the contents of this document or Hitachi Data Systems best practice recommendations for Microsoft Exchange Server 2010 storage design, see Hitachi Data Systems [Microsoft Exchange Solutions Web page](#).

The ESRP – Storage program was developed by Microsoft Corporation to provide a common storage testing framework for vendors to provide information on its storage solutions for Microsoft Exchange Server software. For more information about the Microsoft ESRP – Storage program, see [TechNet's overview of the program](#).

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Features

The purpose of this testing was to measure the ESRP 3.0 results on a Microsoft Exchange 2010 environment with 7,040 users and four servers. This testing used a Hitachi Adaptable Modular Storage 2100 (AMS 2100) storage system using Hitachi Dynamic Provisioning in a two-pool RAID-10 (2D+2D) configuration (one for databases and one for logs) in a resiliency configuration. These results help answer questions about the kind of performance capabilities to expect with a large-scale Exchange deployment on the 2100.

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

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

This solution includes Exchange 2010 Mailbox Resiliency by using the Database Availability Group (DAG) feature. This tested configuration uses four DAGs, each containing two database copies and two servers (one simulated). The test configuration was capable of supporting 7,040 users with a 0.18 IOPS per user profile and user mailbox size of 3GB.

An AMS 2100 with the following was used for these tests:

- 112 600GB 15k RPM SAS disks
- 8GB of cache
- Eight 4Gb/sec paths (four used)

Hitachi Adaptable Modular Storage 2100 is a 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, AMS 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 uses an AMS 2100 to meet the needs of a large Exchange Server deployment.

This solution uses Hitachi Dynamic Provisioning, which is enabled on AMS 2100 via a license key. In the most basic sense, Hitachi Dynamic Provisioning is similar to the use of a host-based logical volume manager (LVM), but with several additional features available within AMS 2100 and without the need to install software on the host or incur host processing overhead. Hitachi Dynamic Provisioning is a superior solution by providing for one or more pools of wide striping across many RAID groups within an AMS 2100. One or more dynamic provisioning virtual volumes (DP-VOLs) of a user-specified logical size (with no initial physical space allocated) are created and associated with a single pool.

Primarily, Hitachi Dynamic Provisioning is deployed to avoid the routine issue of hot spots that occur on logical units (LUs) from individual RAID groups when the host workload exceeds the IOPS or throughput capacity of that RAID group. By using many RAID groups as members of a striped dynamic provisioning pool underneath the virtual or logical volumes seen by the hosts, a host workload 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 also carries the side benefit of thin provisioning, where physical space is only assigned from the pool to the DP-VOL as needed using 1GB chunks, up to the logical size specified for each DP-VOL. A pool can also be dynamically expanded by adding more RAID groups without disruption or requiring downtime. Upon expansion, a pool can easily be rebalanced so that the data and workload is wide striped evenly across the current and newly added RAID groups that make up the pool.

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

Any server in a DAG can host a copy of a mailbox database from any other server in the DAG. When a server is added to a DAG, it monitors and works with the other servers in the DAG to provide automatic recovery delivering a robust, highly available Exchange solution without the administrative complexities of traditional failover clustering. For 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 four DAGs, with each DAG configured with two servers (one simulated) that host active mailboxes in four databases.

To target the 7,040-user resiliency solution, a Hitachi Adaptable Modular Storage 2100 (AMS 2100) was configured with 112 disks (of a maximum of 120). Four servers (one per DAG) were used, with each server configured with 1,760 mailboxes. There were 16 active databases and the simulated database copies for the tests.

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

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

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

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

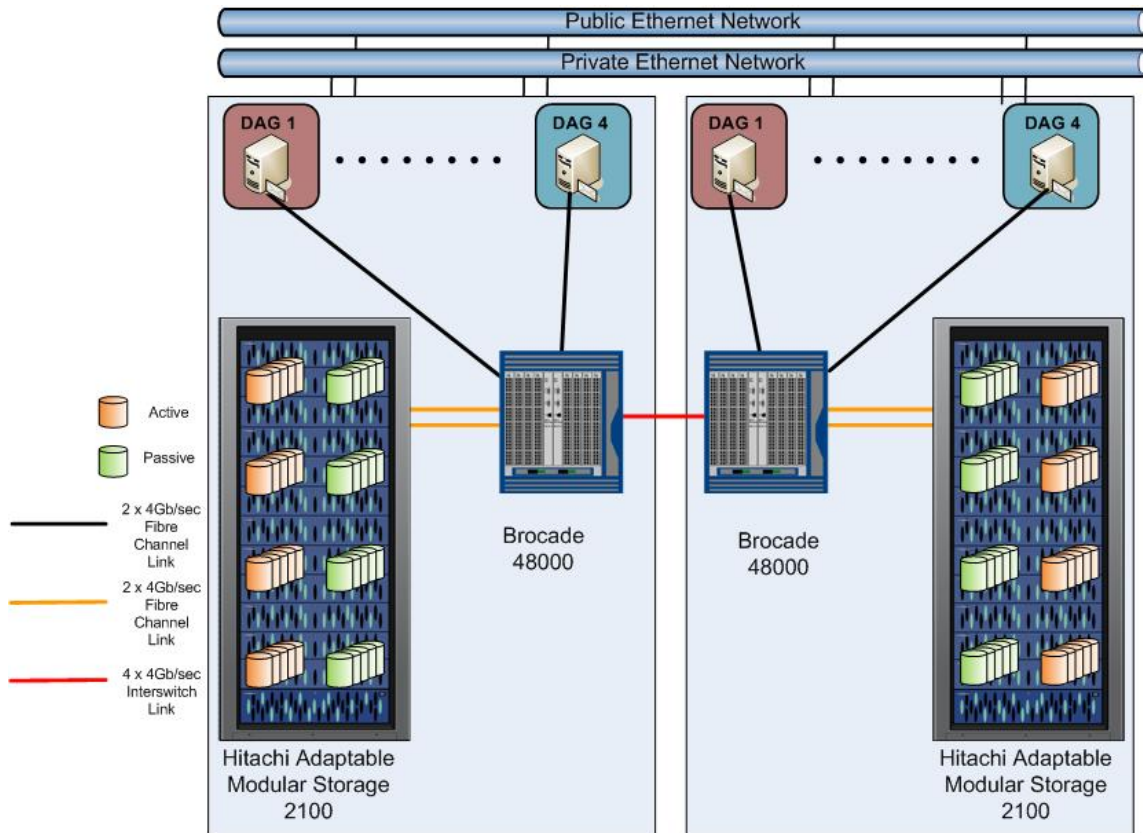


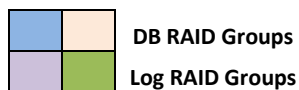
Figure 1

This solution enables organizations to consolidate Exchange Server 2010 DAG deployments on two AMS 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 disks in an AMS 2100 were organized into RAID groups for use by the databases or logs. Each set of colored disks represents a RAID-10 (2D+2D) RAID group. There were 112 disks used in these tests configured as 28 RAID groups for the Exchange databases and logs.

Table1. Adaptable Modular Storage 2100 RAID Groups by RKA Tray Layout

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



Disk tray RKA-0 was the internal 15-disk tray that wasn't used during these tests. Trays RKA-1 through tray RKA-6 each held 19 600GB 15K SAS disks. Tray RKA-6 had 2 disks used as spares. There were actually three dense trays, but each is accessed as two separate trays, so trays RKA-1 and RKA-2 are dense enclosure 1, and so forth.

Two dynamic provisioning pools were created, one for the databases and the other for the logs. The database pool was created from 25 RAID-10 (2D+2D) RAID groups and the log pool was created from three RAID-10 (2D+2D) RAID groups. From the database pool, 16 DP-VOLs (each specified to have a 1,600GB size limit) were created for 16 databases (four per server). From the log pool, 16 DP-VOLs (each specified to have a size limit of 160GB) were created for 16 logs (four per server).

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

Table2. Adaptable Modular Storage 2100 Port to Server Layout

Server	Primary path	Secondary path
SUN158	0A	1A
SUN159	0B	1B
SUN160	1A	0A
SUN161	1B	0B

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

Table3. Adaptable Modular Storage 2100 Port to Database DP-VOL Layout

<i>Port</i>	<i>Database</i>	<i>DB DP-VOL</i>
0A	Database 1-4	0-3
0B	Database 5-8	4-7
1A	Database 9-12	8-11
1B	Database 13-16	12-15

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

Table4. Adaptable Modular Storage 2100 Port to Log DP-VOL Layout

<i>Port</i>	<i>Log</i>	<i>Log DP-VOL</i>
0A	Log 1-4	16-19
0B	Log 5-8	20-23
1A	Log 9-12	24-27
1B	Log 13-16	28-31

Table 5 provides the detailed specifications for the storage configuration which uses RAID-10 (2D+2D) groups and 600GB 15K disks. Dynamic provisioning pool 0 is dedicated for the databases and dynamic provisioning pool 1 is dedicated for the logs.

Table5. Adaptable Modular Storage 2100 Configuration Details

<i>Host</i>	<i>Pool</i>	<i>Port</i>	<i>DP-VOLs</i>	<i>Size (GB)</i>	<i>Description</i>
Sun158	0	0A/1A	0-3	1600	Database 1-4
Sun159	0	0B/1B	4-7	1600	Database 5-8
Sun160	0	1A/0A	8-11	1600	Database 9-12
Sun161	0	1B/0B	12-15	1600	Database 13-16
Sun158	1	0A/1A	16-19	160	Log 1-4
Sun159	1	0B/1B	20-23	160	Log 5-8
Sun160	1	1A/0A	24-27	160	Log 9-12
Sun161	1	1B/0B	28-31	160	Log 13-16

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 7,040 Exchange users with the following specifications:

- 8 Exchange servers (four servers tested, four servers simulated for the database copies)
- 4 Database Availability Groups each with two servers (one simulated) and two copies per database
- 2 Adaptable Modular Storage 2100s (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.

Test Deployment

The following tables summarize the testing environment.

Table 6. Simulated Exchange Configuration

<i>Number of Exchange mailboxes simulated</i>	7,040
<i>Number of database availability groups (DAGs)</i>	4
<i>Number of servers per DAG</i>	2 (1 simulated)
<i>Number of active mailboxes per server</i>	1,760
<i>Number of databases per host</i>	4
<i>Number of copies per database</i>	2
<i>Number of mailboxes per database</i>	440
<i>Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)</i>	0.18
<i>Database LU size</i>	1600GB
<i>Log LU siz</i>	160GB
<i>Total database size for performance testing</i>	21,120GB
<i>% storage capacity used by Exchange database**</i>	79.7%

**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. Storage Hardware

<i>Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)</i>	Fibre Channel
<i>Storage model and OS/firmware revision</i>	1 Hitachi Adaptable Modular Storage 2100 Firmware: 0897/A-X WHQL listing: Hitachi Adaptable Modular Storage 2100
<i>Storage cache</i>	8GB
<i>Number of storage controllers</i>	2
<i>Number of storage ports</i>	4
<i>Maximum bandwidth of storage connectivity to host</i>	16Gb/sec (4 x 4Gb/sec ports)
<i>Switch type/model/firmware revision</i>	Brocade 5320, Fabric OS v6.4.0b
<i>HBA model and firmware</i>	Emulex LightPulse LPe 11002-S FW : 2.82A3
<i>Number of HBAs per host</i>	2 dual-ported HBA per host, 1 4Gb/sec port used per HBA
<i>Host server type</i>	Sun Fire 4270 2 2.54GHz quad-core Intel Xeon CPUs, 32GB memory
<i>Total number of disks tested in solution</i>	112
<i>Maximum number of spindles that can be hosted in the storage</i>	120

Table 8. Storage Software

<i>HBA driver</i>	Storport Miniport 7.2.30.016
<i>HBA QueueTarget setting</i>	0
<i>HBA QueueDepth setting</i>	32
<i>Multipathing</i>	Hitachi Dynamic Link Manager v6.4.0-00
<i>Host OS</i>	Microsoft Windows Server 2008 R2 Enterprise
<i>ESE.dll file version</i>	14.00.0639.019
<i>Replication solution name/version</i>	N/A

Table 9. Storage Disk Configuration (Mailbox Store Disks)

<i>Disk type, speed and firmware revision</i>	SAS 600GB 15K 5C53
<i>Raw capacity per disk (GB)</i>	600GB
<i>Number of physical disks in test</i>	100 (dynamic provisioning pool)
<i>Total raw storage capacity (GB)</i>	60,000
<i>Disk slice size (GB)</i>	N/A
<i>Number of slices per LU or number of disks per LU</i>	N/A
<i>RAID level</i>	RAID-10 (2D+2D) at storage level
<i>Total formatted capacity</i>	26,500GB
<i>Storage capacity utilization</i>	44.2%
<i>Database capacity utilization</i>	42.7%

Table 10. Storage Disk Configuration (Transaction Log Disks)

<i>Disk type, speed and firmware revision</i>	SAS 600GB 15K 5C53
<i>Raw capacity per disk (GB)</i>	600GB
<i>Number of spindles in test</i>	12 (dynamic provisioning pool)
<i>Total raw storage capacity (GB)</i>	12,000
<i>Disk slice size (GB)</i>	N/A
<i>Number of slices per LU or number of disks per LU</i>	N/A
<i>RAID level</i>	RAID-10 (2D+2D) at storage level
<i>Total formatted capacity</i>	3,180GB

Replication Configuration

Table 11. Replication Configuration

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

Table 12. Replicated Storage Hardware

<i>Storage connectivity (Fiber Channel, SAS, SATA, iSCSI)</i>	Fibre Channel
<i>Storage model and OS/firmware revision</i>	1 Hitachi Adaptable Modular Storage 2100 Firmware: 0897/A-X WHQL listing: Hitachi Adaptable Modular Storage 2100
<i>Storage cache</i>	8GB
<i>Number of storage controllers</i>	2
<i>Number of storage ports</i>	4
<i>Maximum bandwidth of storage connectivity to host</i>	16Gb/sec (4 x 4Gb/sec ports)
<i>Switch type/model/firmware revision</i>	Brocade 5320, Fabric OS v6.4.0b
<i>HBA model and firmware</i>	Emulex LightPulse LPe 11002-S FW : 2.82A3
<i>Number of HBAs per host</i>	2 dual-ported HBA per host, 1 4Gb/sec port used per HBA
<i>Host server type</i>	Sun Fire 4270 2 2.54GHz quad-core Intel Xeon CPUs, 32GB memory
<i>Total number of disks tested in solution</i>	112
<i>Maximum number of spindles that can be hosted in the storage</i>	120

Table 13. Replicated Storage Software

<i>HBA driver</i>	Storport Miniport 7.2.30.016
<i>HBA QueueTarget setting</i>	0
<i>HBA QueueDepth setting</i>	32
<i>Multipathing</i>	Hitachi Dynamic Link Manager v6.4.0-00
<i>Host OS</i>	Microsoft Windows Server 2008 R2 Enterprise
<i>ESE.dll file version</i>	14.00.0639.019
<i>Replication solution name/version</i>	N/A

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

<i>Disk type, speed and firmware revision</i>	SAS 600GB 15K 5C53
<i>Raw capacity per disk (GB)</i>	600GB
<i>Number of physical disks in test</i>	100 (dynamic provisioning pool)
<i>total raw storage capacity (GB)</i>	60,000
<i>Disk slice size (GB)</i>	N /A
<i>Number of slices per LU or number of disks per LU</i>	N/A
<i>Raid level</i>	RAID-10 (2D+2D) at storage level
<i>Total formatted capacity</i>	26,500GB
<i>Storage capacity utilization</i>	44.2%
<i>Database capacity utilization</i>	42.7%

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

<i>Disk type, speed and firmware revision</i>	SAS 600GB 15K 5C53
<i>Raw capacity per disk (GB)</i>	600GB
<i>Number of spindles in test</i>	12 (dynamic provisioning pool)
<i>Total raw storage capacity (GB)</i>	7,200
<i>Disk slice size (GB)</i>	N/A
<i>Number of slices per LU or number of disks per LU</i>	N/A
<i>Raid level</i>	RAID-10 (2D+2D) at storage level
<i>Total formatted capacity</i>	3,180GB

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](#)."

Core Storage

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

Storage-based Replication

N/A

Backup Strategy

N/A

Test Results 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.
- If done, no errors were reported during the backup to disk test [process](#).
- No errors were reported for the database checksum on the remote storage database.

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 Input/outputs 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 the input/outputs across the storage groups and the average latency across all storage groups on a per-server basis.

Table 16. Individual Server Metrics for Exchange Server (SUN158)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	729
<i>Database Disk Reads Per Second</i>	455
<i>Database Disk Writes Per Second</i>	274
<i>Average Database Disk Read Latency (ms)</i>	8.1
<i>Average Database Disk Write Latency (ms)</i>	2.1
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	226
<i>Average Log Disk Write Latency (ms)</i>	0.7

Table 17. Individual Server Metrics for Exchange Server (SUN159)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	770
<i>Database Disk Reads Per Second</i>	480
<i>Database Disk Writes Per Second</i>	289
<i>Average Database Disk Read Latency (ms)</i>	7.7
<i>Average Database Disk Write Latency (ms)</i>	2.1
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	238
<i>Average Log Disk Write Latency (ms)</i>	0.7

Table 18. Individual Server Metrics for Exchange Server (SUN160)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	751
<i>Database Disk Reads Per Second</i>	469
<i>Database Disk Writes Per Second</i>	282
<i>Average Database Disk Read Latency (ms)</i>	7.8
<i>Average Database Disk Write Latency (ms)</i>	2.2
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	231
<i>Average Log Disk Write Latency (ms)</i>	0.7

Table 19. Individual Server Metrics for Exchange Server (SUN161)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	761
<i>Database Disk Reads Per Second</i>	475
<i>Database Disk Writes Per Second</i>	286
<i>Average Database Disk Read Latency (ms)</i>	7.7
<i>Average Database Disk Write Latency (ms)</i>	2.2
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	235
<i>Average Log Disk Write Latency (ms)</i>	0.7

Aggregate Performance Across All Servers Metric

The aggregate performance across all server metrics shows the sum of Input/outputs 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	
Database Disk Transfers Per Second	3010.188
Database Disk Reads Per Second	1878.185
Database Disk Writes Per Second	1132.003
Average Database Disk Read Latency (ms)	7.834
Average Database Disk Write Latency (ms)	2.130
Transaction Log I/O	
Log Disk Writes Per Second	930.279
Average Log Disk Write Latency (ms)	0.676

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 26. Database Read-only Performance

MB Read Per Second Per Database	72.83
MB Read Per Second Total Per Server	291.32

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 storage group. Each log file is 1MB in size.

Table 27. Transaction Log Recovery/Replay Performance

Average Time to Play One Log File (sec)	1.06539
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Conclusion

This document details a tested and robust Exchange Server 2010 Resiliency solution capable of supporting 7,040 users with a 0.18 IOPS per user profile and user mailbox size of 3GB using four DAG's each configured with 2 server nodes (one simulated).

A Hitachi Adaptable Modular Storage 2100 (AMS 2100), with 8GB of cache and four 4Gb/sec Fibre Channel host paths, using Hitachi Dynamic Provisioning (with two pools) and 112 600GB 15K RPM SAS disks in a RAID-10 (2D+2D) configuration was used for these tests.

Testing confirmed that an AMS 2100 is more than capable of delivering the IOPS and capacity requirements needed to support the active and replicated databases for 7,040 Exchange mailboxes configured with the specified user profile, while maintaining additional head room to support peak throughput.

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

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

This document is developed by Hitachi Data Systems and reviewed by the 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 Report : Sun158

Test Summary

<i>Overall Test Result</i>	Pass
<i>Machine Name</i>	SUN158
<i>Test Description</i>	
<i>Test Start Time</i>	12/8/2010 2:17:45 AM
<i>Test End Time</i>	12/8/2010 7:44:05 PM
<i>Collection Start Time</i>	12/8/2010 2:19:47 AM
<i>Collection End Time</i>	12/8/2010 4:19:40 AM
<i>Jetstress Version</i>	14.01.0043.000
<i>Ese Version</i>	14.00.0639.019
<i>Operating System</i>	Windows Server 2008 R2 Enterprise (6.1.7600.0)
<i>Performance Log</i>	C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Performance Test\Performance_2010_12_8_2_17_54.blg C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Performance Test\DBChecksum_2010_12_8_19_44_5.blg

Database Sizing and Throughput

<i>Achieved Transactional I/O per Second</i>	729.132
<i>Target Transactional I/O per Second</i>	316.8
<i>Initial Database Size (bytes)</i>	5758177771520
<i>Final Database Size (bytes)</i>	5776464936960
<i>Database Files (Count)</i>	4

Jetstress System Parameters

<i>Thread Count</i>	4 (per database)
<i>Minimum Database Cache</i>	128.0 MB
<i>Maximum Database Cache</i>	1024.0 MB
<i>Insert Operations</i>	40%
<i>Delete Operations</i>	20%
<i>Replace Operations</i>	5%
<i>Read Operations</i>	35%
<i>Lazy Commits</i>	70%
<i>Run Background Database Maintenance</i>	True
<i>Number of Copies per Database</i>	2

Database Configuration

<i>Instance2612.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance2612.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance2612.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance2612.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2612.1	7.688	2.473	113.963	68.771	33627.035	34980.853	0.000	0.687	0.000	56.867	0.000	4634.713
Instance2612.2	8.195	2.364	113.223	68.341	33580.952	34966.313	0.000	0.674	0.000	56.638	0.000	4625.066
Instance2612.3	8.184	1.869	113.492	68.400	33543.665	34931.240	0.000	0.690	0.000	55.726	0.000	4610.533
Instance2612.4	8.210	1.685	114.102	68.841	33555.612	34930.755	0.000	0.671	0.000	56.663	0.000	4600.735

Background Database Maintenance I/O Performance

<i>MSEExchange Database ==> Instances</i>	<i>Database Maintenance IO Reads/sec</i>	<i>Database Maintenance IO Reads Average Bytes</i>
Instance2612.1	31.295	261865.212
Instance2612.2	30.556	261828.253
Instance2612.3	30.472	261843.686
Instance2612.4	30.503	261856.975

Log Replication I/O Performance

<i>MSEExchange Database ==> Instances</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Reads Average Bytes</i>
Instance2612.1	1.068	232561.778
Instance2612.2	1.062	232561.778
Instance2612.3	1.042	232555.570
Instance2612.4	1.055	232563.973

Total I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2612.1	7.688	2.473	145.257	68.771	82799.310	34980.853	1.361	0.687	1.068	56.867	232561.778	4634.713
Instance2612.2	8.195	2.364	143.779	68.341	82088.205	34966.313	1.392	0.674	1.062	56.638	232561.778	4625.066
Instance2612.3	8.184	1.869	143.964	68.400	81866.668	34931.240	1.402	0.690	1.042	55.726	232555.570	4610.533
Instance2612.4	8.210	1.685	144.605	68.841	81714.001	34930.755	1.523	0.671	1.055	56.663	232563.973	4600.735

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.778	0.000	2.583
Available MBytes	29812.257	29805.000	29824.000
Free System Page Table Entries	33555642.990	33555641.000	33555643.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	64080517.612	63897600.000	64131072.000
Pool Paged Bytes	92176546.472	92114944.000	92233728.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log12/8/2010 2:17:45 AM -- Jetstress testing begins ...
 12/8/2010 2:17:45 AM -- Prepare testing begins ...
 12/8/2010 2:17:50 AM -- Attaching databases ...
 12/8/2010 2:17:50 AM -- Prepare testing ends.
 12/8/2010 2:17:50 AM -- Dispatching transactions begins ...
 12/8/2010 2:17:50 AM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 12/8/2010 2:17:50 AM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 12/8/2010 2:17:54 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 12/8/2010 2:17:54 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 12/8/2010 2:17:59 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 12/8/2010 2:17:59 AM -- Performance logging begins (interval: 15000 ms).
 12/8/2010 2:17:59 AM -- Attaining prerequisites:
 12/8/2010 2:19:47 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 970448900.0 (lower bound: 966367600.0, upper bound: none)
 12/8/2010 4:19:47 AM -- Performance logging ends.
 12/8/2010 7:44:05 PM -- JetInterop batch transaction stats: 323604, 323715, 322226 and 323251.
 12/8/2010 7:44:05 PM -- Dispatching transactions ends.
 12/8/2010 7:44:05 PM -- Shutting down databases ...
 12/8/2010 7:44:05 PM -- Instance2612.1 (complete), Instance2612.2 (complete), Instance2612.3 (complete) and Instance2612.4 (complete)
 12/8/2010 7:44:07 PM -- Performance logging begins (interval: 30000 ms).
 12/8/2010 7:44:07 PM -- Verifying database checksums ...
 12/9/2010 1:32:24 AM -- C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed) and C:\dbluns\db4 (100% processed)
 12/9/2010 1:32:24 AM -- Performance logging ends.
 12/9/2010 1:32:24 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Performance Test\DBChecksum_2010_12_8_19_44_5.blg has 696 samples.
 12/9/2010 1:32:27 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Performance Test\DBChecksum_2010_12_8_19_44_5.html is saved.
 12/9/2010 1:32:27 AM -- Verifying log checksums ...
 12/9/2010 1:32:28 AM -- C:\logluns\log1 (11 log(s) processed), C:\logluns\log2 (9 log(s) processed), C:\logluns\log3 (10 log(s) processed) and C:\logluns\log4 (12 log(s) processed)
 12/9/2010 1:32:28 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Performance Test\Performance_2010_12_8_2_17_54.blg has 486 samples.

12/9/2010 1:32:28 AM -- Creating test report ...
 12/9/2010 1:32:30 AM -- Instance2612.1 has 7.7 for I/O Database Reads Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.1 has 0.7 for I/O Log Writes Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.1 has 0.7 for I/O Log Reads Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.2 has 8.2 for I/O Database Reads Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.2 has 0.7 for I/O Log Writes Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.2 has 0.7 for I/O Log Reads Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.3 has 8.2 for I/O Database Reads Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.3 has 0.7 for I/O Log Writes Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.3 has 0.7 for I/O Log Reads Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.4 has 8.2 for I/O Database Reads Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.4 has 0.7 for I/O Log Writes Average Latency.
 12/9/2010 1:32:30 AM -- Instance2612.4 has 0.7 for I/O Log Reads Average Latency.
 12/9/2010 1:32:30 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 12/9/2010 1:32:30 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 12/9/2010 1:32:30 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_12_8_2_17_54.xml has 478 samples
 queried.

Performance Test Database Checksums Result: SUN158

Checksum Statistics - All

<i>Database</i>	<i>Seen pages</i>	<i>Bad pages</i>	<i>Correctable pages</i>	<i>Wrong page-number pages</i>	<i>File length / seconds taken</i>
C:\dbluns\db1\Jetstress001001.edb	44070482	0	0	0	1377202 MBytes / 20839 sec
C:\dbluns\db2\Jetstress002001.edb	44070738	0	0	0	1377210 MBytes / 20897 sec
C:\dbluns\db3\Jetstress003001.edb	44070738	0	0	0	1377210 MBytes / 20876 sec
C:\dbluns\db4\Jetstress004001.edb	44071762	0	0	0	1377242 MBytes / 20789 sec
(Sum)	176283720	0	0	0	5508866 MBytes / 20897 sec

Disk Subsystem Performance (of checksum)

<i>LogicalDisk</i>	<i>Avg. Disk sec/Read</i>	<i>Avg. Disk sec/Write</i>	<i>Disk Reads/sec</i>	<i>Disk Writes/sec</i>	<i>Avg. Disk Bytes/Read</i>
C:\dbluns\db1	0.059	0.000	1056.676	0.000	65536.000
C:\dbluns\db2	0.060	0.000	1054.217	0.000	65536.000
C:\dbluns\db3	0.059	0.000	1054.259	0.000	65536.000
C:\dbluns\db4	0.059	0.000	1059.045	0.000	65536.000

Memory System Performance (of checksum)

<i>Counter</i>	<i>Average</i>	<i>Minimum</i>	<i>Maximum</i>
% Processor Time	1.539	0.000	4.531
Available MBytes	30884.260	30838.000	30895.000
Free System Page Table Entries	33555644.046	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	64707283.862	64602112.000	65097728.000
Pool Paged Bytes	97251781.149	95440896.000	124190720.000

Test Log12/8/2010 2:17:45 AM -- Jetstress testing begins ...
12/8/2010 2:17:45 AM -- Prepare testing begins ...
12/8/2010 2:17:50 AM -- Attaching databases ...
12/8/2010 2:17:50 AM -- Prepare testing ends.
12/8/2010 2:17:50 AM -- Dispatching transactions begins ...
12/8/2010 2:17:50 AM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
12/8/2010 2:17:50 AM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
12/8/2010 2:17:54 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
12/8/2010 2:17:54 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
12/8/2010 2:17:59 AM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
12/8/2010 2:17:59 AM -- Performance logging begins (interval: 15000 ms).
12/8/2010 2:17:59 AM -- Attaining prerequisites:
12/8/2010 2:19:47 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 970448900.0 (lower bound: 966367600.0, upper bound: none)
12/8/2010 4:19:47 AM -- Performance logging ends.
12/8/2010 7:44:05 PM -- JetInterop batch transaction stats: 323604, 323715, 322226 and 323251.
12/8/2010 7:44:05 PM -- Dispatching transactions ends.
12/8/2010 7:44:05 PM -- Shutting down databases ...
12/8/2010 7:44:05 PM -- Instance2612.1 (complete), Instance2612.2 (complete), Instance2612.3 (complete) and Instance2612.4 (complete)
12/8/2010 7:44:07 PM -- Performance logging begins (interval: 30000 ms).
12/8/2010 7:44:07 PM -- Verifying database checksums ...
12/9/2010 1:32:24 AM -- C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed) and C:\dbluns\db4 (100% processed)
12/9/2010 1:32:24 AM -- Performance logging ends.
12/9/2010 1:32:24 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox

Raid1+0\Sun158\Performance Test\DBChecksum_2010_12_8_19_44_5.blg has 696 samples.

Stress Test Result Report: SUN158

Test Summary

<i>Overall Test Result</i>	Pass
<i>Machine Name</i>	SUN158
<i>Test Description</i>	
<i>Test Start Time</i>	12/9/2010 8:14:50 PM
<i>Test End Time</i>	12/12/2010 5:36:32 AM
<i>Collection Start Time</i>	12/9/2010 8:16:54 PM
<i>Collection End Time</i>	12/10/2010 8:16:44 PM
<i>Jetstress Version</i>	14.01.0043.000
<i>Ese Version</i>	14.00.0639.019
<i>Operating System</i>	Windows Server 2008 R2 Enterprise (6.1.7600.0)
<i>Performance Log</i>	C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_12_9_20_14_59.blg C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Stress Test\DBChecksum_2010_12_12_5_36_32.blg

Database Sizing and Throughput

<i>Achieved Transactional I/O per Second</i>	731.85
<i>Target Transactional I/O per Second</i>	316.8
<i>Initial Database Size (bytes)</i>	5776464936960
<i>Final Database Size (bytes)</i>	5836930023424
<i>Database Files (Count)</i>	4

Jetstress System Parameters

<i>Thread Count</i>	4 (per database)
<i>Minimum Database Cache</i>	128.0 MB
<i>Maximum Database Cache</i>	1024.0 MB
<i>Insert Operations</i>	40%
<i>Delete Operations</i>	20%
<i>Replace Operations</i>	5%
<i>Read Operations</i>	35%
<i>Lazy Commits</i>	70%
<i>Run Background Database Maintenance</i>	True
<i>Number of Copies per Database</i>	2

Database Configuration

<i>Instance2612.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance2612.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance2612.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance2612.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2612.1	7.702	2.513	114.081	68.693	33620.800	34929.637	0.000	0.683	0.000	56.362	0.000	4628.617
Instance2612.2	8.096	2.380	114.405	68.887	33584.772	34938.194	0.000	0.676	0.000	56.506	0.000	4614.875
Instance2612.3	8.093	1.859	114.129	68.707	33585.344	34938.182	0.000	0.684	0.000	56.462	0.000	4624.995
Instance2612.4	8.089	1.701	114.185	68.764	33596.797	34940.628	0.000	0.674	0.000	56.463	0.000	4625.484

Background Database Maintenance I/O Performance

<i>MSExchange Database ==> Instances</i>	<i>Database Maintenance IO Reads/sec</i>	<i>Database Maintenance IO Reads Average Bytes</i>
Instance2612.1	31.246	261862.464
Instance2612.2	30.666	261861.743
Instance2612.3	30.605	261849.441
Instance2612.4	30.691	261866.396

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>
Instance2612.1	1.058	232435.981
Instance2612.2	1.057	232523.937
Instance2612.3	1.059	232480.157
Instance2612.4	1.059	232479.319

Total I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2612.1	7.702	2.513	145.328	68.693	82694.311	34929.637	1.401	0.683	1.058	56.362	232435.981	4628.617
Instance2612.2	8.096	2.380	145.071	68.887	81840.108	34938.194	1.423	0.676	1.057	56.506	232523.937	4614.875
Instance2612.3	8.093	1.859	144.734	68.707	81854.044	34938.182	1.436	0.684	1.059	56.462	232480.157	4624.995
Instance2612.4	8.089	1.701	144.876	68.764	81954.090	34940.628	1.416	0.674	1.059	56.463	232479.319	4625.484

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.850	0.000	4.290
Available MBytes	29796.245	29789.000	29816.000
Free System Page Table Entries	33555643.089	33555635.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	64843526.722	64806912.000	64892928.000
Pool Paged Bytes	97879918.350	96055296.000	100929536.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log12/9/2010 8:14:50 PM -- Jetstress testing begins ...
 12/9/2010 8:14:50 PM -- Prepare testing begins ...
 12/9/2010 8:14:54 PM -- Attaching databases ...
 12/9/2010 8:14:54 PM -- Prepare testing ends.
 12/9/2010 8:14:54 PM -- Dispatching transactions begins ...
 12/9/2010 8:14:54 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 12/9/2010 8:14:54 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 12/9/2010 8:14:59 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 12/9/2010 8:14:59 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 12/9/2010 8:15:04 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 12/9/2010 8:15:04 PM -- Performance logging begins (interval: 15000 ms).
 12/9/2010 8:15:04 PM -- Attaining prerequisites:
 12/9/2010 8:16:54 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 973549600.0 (lower bound: 966367600.0, upper bound: none)
 12/10/2010 8:16:54 PM -- Performance logging ends.
 12/12/2010 5:36:30 AM -- JetInterop batch transaction stats: 1062487, 1062535, 1061734 and 1062121.
 12/12/2010 5:36:31 AM -- Dispatching transactions ends.
 12/12/2010 5:36:31 AM -- Shutting down databases ...
 12/12/2010 5:36:32 AM -- Instance2612.1 (complete), Instance2612.2 (complete), Instance2612.3 (complete) and Instance2612.4 (complete)
 12/12/2010 5:36:33 AM -- Performance logging begins (interval: 30000 ms).
 12/12/2010 5:36:33 AM -- Verifying database checksums ...
 12/12/2010 11:30:43 AM -- C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed) and C:\dbluns\db4 (100% processed)
 12/12/2010 11:30:43 AM -- Performance logging ends.
 12/12/2010 11:30:43 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Stress Test\DBChecksum_2010_12_12_5_36_32.blg has 708 samples.
 12/12/2010 11:30:46 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Stress Test\DBChecksum_2010_12_12_5_36_32.html is saved.
 12/12/2010 11:30:46 AM -- Verifying log checksums ...
 12/12/2010 11:30:47 AM -- C:\logluns\log1 (12 log(s) processed), C:\logluns\log2 (12 log(s) processed), C:\logluns\log3 (11 log(s) processed) and C:\logluns\log4 (12 log(s) processed)
 12/12/2010 11:30:47 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox

Raid1+0\Sun158\Stress Test\Stress_2010_12_9_20_14_59.blg has 5758 samples.
 12/12/2010 11:30:47 AM -- Creating test report ...
 12/12/2010 11:31:14 AM -- Instance2612.1 has 7.7 for I/O Database Reads Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.1 has 0.7 for I/O Log Writes Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.1 has 0.7 for I/O Log Reads Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.2 has 8.1 for I/O Database Reads Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.2 has 0.7 for I/O Log Writes Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.2 has 0.7 for I/O Log Reads Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.3 has 8.1 for I/O Database Reads Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.3 has 0.7 for I/O Log Writes Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.3 has 0.7 for I/O Log Reads Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.4 has 8.1 for I/O Database Reads Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.4 has 0.7 for I/O Log Writes Average Latency.
 12/12/2010 11:31:14 AM -- Instance2612.4 has 0.7 for I/O Log Reads Average Latency.
 12/12/2010 11:31:14 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 12/12/2010 11:31:14 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than

Stress Test Database Checksums Result: SUN158

Checksum Statistics - All

<i>Database</i>	<i>Seen pages</i>	<i>Bad pages</i>	<i>Correctable pages</i>	<i>Wrong page-number pages</i>	<i>File length / seconds taken</i>
C:\dbluns\db1\Jetstress001001.edb	44531282	0	0	0	1391602 MBytes / 21086 sec
C:\dbluns\db2\Jetstress002001.edb	44532050	0	0	0	1391626 MBytes / 21249 sec
C:\dbluns\db3\Jetstress003001.edb	44532050	0	0	0	1391626 MBytes / 21115 sec
C:\dbluns\db4\Jetstress004001.edb	44533586	0	0	0	1391674 MBytes / 21108 sec
(Sum)	178128968	0	0	0	5566530 MBytes / 21250 sec

Disk Subsystem Performance (of checksum)

<i>LogicalDisk</i>	<i>Avg. Disk sec/Read</i>	<i>Avg. Disk sec/Write</i>	<i>Disk Reads/sec</i>	<i>Disk Writes/sec</i>	<i>Avg. Disk Bytes/Read</i>
C:\dbluns\db1	0.060	0.000	1055.407	0.000	65536.000
C:\dbluns\db2	0.061	0.000	1047.682	0.000	65536.000
C:\dbluns\db3	0.059	0.000	1054.192	0.000	65536.000
C:\dbluns\db4	0.059	0.000	1054.684	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	1.523	0.000	4.174
Available MBytes	30871.411	30856.000	30889.000
Free System Page Table Entries	33555643.395	33555643.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	65245722.034	65101824.000	65413120.000
Pool Paged Bytes	97679764.972	97656832.000	97849344.000

Test Log12/9/2010 8:14:50 PM -- Jetstress testing begins ...
12/9/2010 8:14:50 PM -- Prepare testing begins ...
12/9/2010 8:14:54 PM -- Attaching databases ...
12/9/2010 8:14:54 PM -- Prepare testing ends.
12/9/2010 8:14:54 PM -- Dispatching transactions begins ...
12/9/2010 8:14:54 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
12/9/2010 8:14:54 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
12/9/2010 8:14:59 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
12/9/2010 8:14:59 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
12/9/2010 8:15:04 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
12/9/2010 8:15:04 PM -- Performance logging begins (interval: 15000 ms).
12/9/2010 8:15:04 PM -- Attaining prerequisites:
12/9/2010 8:16:54 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 973549600.0 (lower bound: 966367600.0, upper bound: none)
12/10/2010 8:16:54 PM -- Performance logging ends.
12/12/2010 5:36:30 AM -- JetInterop batch transaction stats: 1062487, 1062535, 1061734 and 1062121.
12/12/2010 5:36:31 AM -- Dispatching transactions ends.
12/12/2010 5:36:31 AM -- Shutting down databases ...
12/12/2010 5:36:32 AM -- Instance2612.1 (complete), Instance2612.2 (complete), Instance2612.3 (complete) and Instance2612.4 (complete)
12/12/2010 5:36:33 AM -- Performance logging begins (interval: 30000 ms).
12/12/2010 5:36:33 AM -- Verifying database checksums ...
12/12/2010 11:30:43 AM -- C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed) and C:\dbluns\db4 (100% processed)
12/12/2010 11:30:43 AM -- Performance logging ends.
12/12/2010 11:30:43 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Stress Test\DBChecksum_2010_12_12_5_36_32.blg has 708 samples

Backup Test Result Report: SUN 158

Database Backup Statistics - All

<i>Database Instance</i>	<i>Database Size (MBytes)</i>	<i>Elapsed Backup Time</i>	<i>MBytes Transferred/sec</i>
Instance464.1	1391594.59	05:30:51	70.10
Instance464.2	1391618.59	05:22:12	71.98
Instance464.3	1391618.59	05:04:49	76.09
Instance464.4	1391666.59	05:22:44	71.87

Jetstress System Parameters

<i>Thread Count</i>	4 (per database)
<i>Minimum Database Cache</i>	128.0 MB
<i>Maximum Database Cache</i>	1024.0 MB
<i>Insert Operations</i>	40%
<i>Delete Operations</i>	20%
<i>Replace Operations</i>	5%
<i>Read Operations</i>	35%
<i>Lazy Commits</i>	70%

Database Configuration

<i>Instance464.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance464.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance464.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance464.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance464.1	5.511	0.000	280.175	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance464.2	5.280	0.000	287.850	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance464.3	4.980	0.000	304.262	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance464.4	5.274	0.000	287.328	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	1.025	0.000	2.465
Available MBytes	30933.469	30919.000	30935.000
Free System Page Table Entries	33555131.109	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	60846253.507	60841984.000	60895232.000
Pool Paged Bytes	89564257.598	89534464.000	89718784.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log12/13/2010 6:06:13 AM -- Jetstress testing begins ...
 12/13/2010 6:06:13 AM -- Prepare testing begins ...
 12/13/2010 6:06:18 AM -- Attaching databases ...
 12/13/2010 6:06:18 AM -- Prepare testing ends.
 12/13/2010 6:06:25 AM -- Performance logging begins (interval: 30000 ms).
 12/13/2010 6:06:25 AM -- Backing up databases ...
 12/13/2010 11:37:17 AM -- Performance logging ends.
 12/13/2010 11:37:17 AM -- Instance464.1 (100% processed), Instance464.2 (100% processed),
 Instance464.3 (100% processed) and Instance464.4 (100% processed)
 12/13/2010 11:37:17 AM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox
 Raid1+0\Sun158\Backup Test\DatabaseBackup_2010_12_13_6_6_18.blg has 661 samples.
 12/13/2010 11:37:17 AM -- Creating test report ...

Soft Recovery Test Result Report: SUN158

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance464.1	507	534.9249395
Instance464.2	506	544.4721563
Instance464.3	500	534.9249395
Instance464.4	505	576.0310117

Database Configuration

Instance464.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance464.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance464.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance464.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance464.1	17.443	11.524	1142.050	5.692	35393.559	32768.000	3.714	0.000	8.537	0.000	231669.954	0.000
Instance464.2	18.579	11.601	1128.129	5.597	35514.820	32646.186	3.644	0.001	8.395	0.006	231583.364	1.903
Instance464.3	18.866	12.436	1144.906	5.613	35576.216	32395.636	3.799	0.000	8.419	0.000	229859.914	0.000
Instance464.4	18.358	11.734	1051.912	5.262	35650.337	32423.074	4.068	0.000	7.893	0.000	228462.130	0.000

Background Database Maintenance I/O Performance

<i>MSExchange Database ==> Instances</i>	<i>Database Maintenance IO Reads/sec</i>	<i>Database Maintenance IO Reads Average Bytes</i>
Instance464.1	28.763	261966.612
Instance464.2	27.268	262012.550
Instance464.3	27.227	261920.343
Instance464.4	27.465	261803.902

Total I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance464.1	17.443	11.524	1170.813	5.692	40959.660	32768.000	3.714	0.000	8.537	0.000	231669.954	0.000
Instance464.2	18.579	11.601	1155.397	5.597	40860.210	32646.186	3.644	0.001	8.395	0.006	231583.364	1.903
Instance464.3	18.866	12.436	1172.132	5.613	40833.869	32395.636	3.799	0.000	8.419	0.000	229859.914	0.000
Instance464.4	18.358	11.734	1079.377	5.262	41404.821	32423.074	4.068	0.000	7.893	0.000	228462.130	0.000

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	3.573	0.000	22.190
Available MBytes	29827.724	29804.000	30790.000
Free System Page Table Entries	33555100.972	33555093.000	33555101.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	69278927.664	63635456.000	70037504.000
Pool Paged Bytes	92624752.783	92590080.000	92782592.000
Database Page Fault Stalls/sec	0.005	0.000	0.994

Test Log12/13/2010 7:35:30 PM -- Jetstress testing begins ...

12/13/2010 7:35:30 PM -- Prepare testing begins ...

12/13/2010 7:35:34 PM -- Attaching databases ...

12/13/2010 7:35:34 PM -- Prepare testing ends.

12/13/2010 7:35:34 PM -- Dispatching transactions begins ...

12/13/2010 7:35:34 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)

12/13/2010 7:35:34 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

12/13/2010 7:35:39 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

12/13/2010 7:35:39 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

12/13/2010 7:35:43 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

12/13/2010 7:35:43 PM -- Performance logging begins (interval: 15000 ms).

12/13/2010 7:35:43 PM -- Generating log files ...

12/13/2010 8:47:59 PM -- C:\logluns\log1 (101.6% generated), C:\logluns\log2 (101.4% generated), C:\logluns\log3 (100.2% generated) and C:\logluns\log4 (101.2% generated)

12/13/2010 8:47:59 PM -- Performance logging ends.

12/13/2010 8:47:59 PM -- JetInterop batch transaction stats: 22282, 22264, 22350 and 21992.

12/13/2010 8:47:59 PM -- Dispatching transactions ends.

12/13/2010 8:47:59 PM -- Shutting down databases ...

12/13/2010 8:48:00 PM -- Instance464.1 (complete), Instance464.2 (complete), Instance464.3 (complete) and Instance464.4 (complete)

12/13/2010 8:48:00 PM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_12_13_19_35_39.blg has 288 samples.

12/13/2010 8:48:00 PM -- Creating test report ...

12/13/2010 8:48:01 PM -- Instance464.1 has 8.5 for I/O Database Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.1 has 1.0 for I/O Log Writes Average Latency.

12/13/2010 8:48:01 PM -- Instance464.1 has 1.0 for I/O Log Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.2 has 8.7 for I/O Database Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.2 has 1.0 for I/O Log Writes Average Latency.

12/13/2010 8:48:01 PM -- Instance464.2 has 1.0 for I/O Log Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.3 has 8.6 for I/O Database Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.3 has 1.0 for I/O Log Writes Average Latency.

12/13/2010 8:48:01 PM -- Instance464.3 has 1.0 for I/O Log Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.4 has 8.6 for I/O Database Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.4 has 1.0 for I/O Log Writes Average Latency.

12/13/2010 8:48:01 PM -- Instance464.4 has 1.0 for I/O Log Reads Average Latency.
 12/13/2010 8:48:01 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 12/13/2010 8:48:01 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 12/13/2010 8:48:01 PM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_12_13_19_35_39.xml has 287 samples queried.
 12/13/2010 8:48:01 PM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_12_13_19_35_39.html is saved.
 12/13/2010 8:53:24 PM -- Performance logging begins (interval: 2000 ms).
 12/13/2010 8:53:24 PM -- Recovering databases ...
 12/13/2010 9:03:00 PM -- Performance logging ends.
 12/13/2010 9:03:00 PM -- Instance464.1 (534.9249395), Instance464.2 (544.4721563), Instance464.3 (534.9249395) and Instance464.4 (576.0310117)
 12/13/2010 9:03:00 PM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Soft Recovery\SoftRecovery_2010_12_13_20_53_20.blg has 286 samples.
 12/13/2010 9:03:00 PM -- Creating test report ...

Soft Recovery Test Performance Result: SUN158

Test Summary

Overall Test Result	Pass
Machine Name	SUN158
Test Description	
Test Start Time	12/13/2010 7:35:30 PM
Test End Time	12/13/2010 8:48:00 PM
Collection Start Time	12/13/2010 7:35:58 PM
Collection End Time	12/13/2010 8:47:45 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:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_12_13_19_35_39.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	722.615
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	5836930023424
Final Database Size (bytes)	5838188314624
Database Files (Count)	4

Jetstress System Parameters

<i>Thread Count</i>	4 (per database)
<i>Minimum Database Cache</i>	128.0 MB
<i>Maximum Database Cache</i>	1024.0 MB
<i>Insert Operations</i>	40%
<i>Delete Operations</i>	20%
<i>Replace Operations</i>	5%
<i>Read Operations</i>	35%
<i>Lazy Commits</i>	70%

Database Configuration

<i>Instance464.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance464.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance464.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance464.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance464.1	8.522	3.755	113.181	67.871	32768.000	34954.128	0.000	0.986	0.000	54.484	0.000	4740.475
Instance464.2	8.683	3.509	112.963	67.502	32768.000	34933.686	0.000	0.977	0.000	54.707	0.000	4713.899
Instance464.3	8.613	2.499	112.705	67.353	32768.000	34876.319	0.000	0.991	0.000	54.102	0.000	4690.531
Instance464.4	8.647	2.391	113.358	67.681	32768.287	34929.531	0.000	0.972	0.000	54.714	0.000	4702.414

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.858	0.000	3.144
Available MBytes	29841.924	29825.000	30664.000
Free System Page Table Entries	33555132.993	33555132.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	62434147.556	61190144.000	62574592.000
Pool Paged Bytes	92383914.667	92348416.000	92479488.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log12/13/2010 7:35:30 PM -- Jetstress testing begins ...

12/13/2010 7:35:30 PM -- Prepare testing begins ...

12/13/2010 7:35:34 PM -- Attaching databases ...

12/13/2010 7:35:34 PM -- Prepare testing ends.

12/13/2010 7:35:34 PM -- Dispatching transactions begins ...

12/13/2010 7:35:34 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)

12/13/2010 7:35:34 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

12/13/2010 7:35:39 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

12/13/2010 7:35:39 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

12/13/2010 7:35:43 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

12/13/2010 7:35:43 PM -- Performance logging begins (interval: 15000 ms).

12/13/2010 7:35:43 PM -- Generating log files ...

12/13/2010 8:47:59 PM -- C:\logluns\log1 (101.6% generated), C:\logluns\log2 (101.4% generated), C:\logluns\log3 (100.2% generated) and C:\logluns\log4 (101.2% generated)

12/13/2010 8:47:59 PM -- Performance logging ends.

12/13/2010 8:47:59 PM -- JetInterop batch transaction stats: 22282, 22264, 22350 and 21992.

12/13/2010 8:47:59 PM -- Dispatching transactions ends.

12/13/2010 8:47:59 PM -- Shutting down databases ...

12/13/2010 8:48:00 PM -- Instance464.1 (complete), Instance464.2 (complete), Instance464.3 (complete) and Instance464.4 (complete)

12/13/2010 8:48:00 PM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_12_13_19_35_39.blg has 288 samples.

12/13/2010 8:48:00 PM -- Creating test report ...

12/13/2010 8:48:01 PM -- Instance464.1 has 8.5 for I/O Database Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.1 has 1.0 for I/O Log Writes Average Latency.

12/13/2010 8:48:01 PM -- Instance464.1 has 1.0 for I/O Log Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.2 has 8.7 for I/O Database Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.2 has 1.0 for I/O Log Writes Average Latency.

12/13/2010 8:48:01 PM -- Instance464.2 has 1.0 for I/O Log Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.3 has 8.6 for I/O Database Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.3 has 1.0 for I/O Log Writes Average Latency.

12/13/2010 8:48:01 PM -- Instance464.3 has 1.0 for I/O Log Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.4 has 8.6 for I/O Database Reads Average Latency.

12/13/2010 8:48:01 PM -- Instance464.4 has 1.0 for I/O Log Writes Average Latency.

12/13/2010 8:48:01 PM -- Instance464.4 has 1.0 for I/O Log Reads Average Latency.
12/13/2010 8:48:01 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
12/13/2010 8:48:01 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
12/13/2010 8:48:01 PM -- C:\ESRP v 3.0 AMS2100 600GB SAS 3GB MailBox Raid1+0\Sun158\Soft
Recovery\Performance_2010_12_13_19_35_39.xml has 287 samples queried.

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