

Hitachi Adaptable Modular Storage 2100 Dynamically Provisioned 21,200 Mailbox Exchange 2010 Mailbox Resiliency Storage Solution

Tested with: ESRP – Storage Version 3.0

Test Date: October-November 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 System [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 21,200 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 an AMS 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 21,200 users with a 0.12 IOPS per user profile and user mailbox size of 1GB.

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

- 112 600GB 15k RPM SAS disks
- 8GB of cache
- Eight 8Gb/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 21,200-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 5,300 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](#).

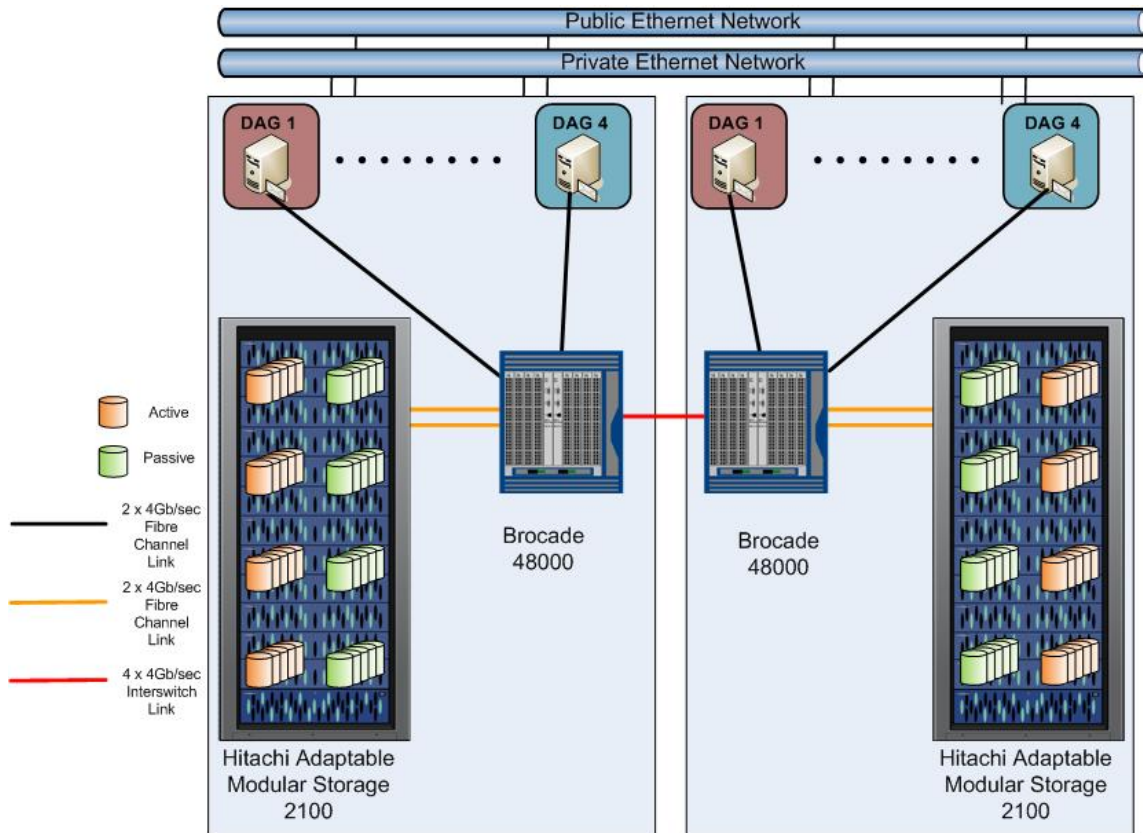


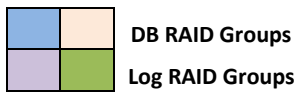
Figure 1

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

Port	Database	DB DP-VOL
0A	Databases 1-4	0-3
0B	Databases 5-8	4-7
1A	Databases 9-12	8-11
1B	Databases 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.

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

Port	Log	DB DP-VOL
0A	Log 1-4	0-3
0B	Log 5-8	4-7
1A	Log 9-12	8-11
1B	Log 13-16	12-15

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

Host	Pool	Port	DP-VOLs	Size (GB)	Description
Sun158	0	0A/1A	0-3	1600	Databases 1-4
Sun159	0	0B/1B	4-7	1600	Databases 5-8
Sun160	0	1A/0A	8-11	1600	Databases 9-12
Sun161	0	1B/0B	12-15	1600	Databases 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 21,200 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)
- 0.1 IOPS per user (0.12 tested for 20 percent growth)
- 1GB mailbox size
- Mailbox resiliency provides high-availability and used as primary data protection mechanism
- Adaptable Modular Storage RAID protection against physical failure or loss
- 24x7 background database maintenance enabled

Test Deployment

The following tables summarize the testing environment.

Table 6. Simulated Exchange Configuration

Number of Exchange mailboxes simulated	21,200
Number of database availability groups (DAGs)	4
Number of servers per DAG	2 (1 simulated)
Number of active mailboxes per server	5,300
Number of databases per host	4
Number of copies per database	2
Number of mailboxes per database	1,325
Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)	0.12
Database LU size	1600GB
Log LU siz	160GB
Total database size for performance testing	26,500GB
% storage capacity used by Exchange database**	80%

**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

Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	Fibre Channel
Storage model and OS/firmware revision	1 Hitachi Adaptable Modular Storage 2100 Firmware: 0897/A-X 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/sec (4 x 4Gb/sec ports)
Switch type/model/firmware revision	Brocade 5320, Fabric OS v6.4.0b
HBA model and firmware	Emulex LightPulse LPe 11002-S FW : 2.82A3
Number of HBAs per host	2 dual-ported HBA per host, 1 4Gb/sec 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	112
Maximum number of spindles that can be hosted in the storage	120

Table 8. Storage Software

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

Table 9. Storage Disk Configuration (Mailbox Store Disks)

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

Table 10. Storage Disk Configuration (Transaction Log Disks)

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

Replication Configuration

Table 11. Replication 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 (1Gb/sec)

Table 12. Replicated Storage Hardware

Storage connectivity (Fiber Channel, SAS, SATA, iSCSI)	Fibre Channel
Storage model and OS/firmware revision	1 Hitachi Adaptable Modular Storage 2100 Firmware: 0897/A-X 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/sec (4 x 4Gb/sec ports)
Switch type/model/firmware revision	Brocade 5320, Fabric OS v6.4.0b
HBA model and firmware	Emulex LightPulse LPe 11002-S FW : 2.82A3
Number of HBAs per host	2 dual-ported HBA per host, 1 4Gb/sec 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	112
Maximum number of spindles that can be hosted in the storage	120

Table 13. Replicated Storage Software

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

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

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

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

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

Database I/O	
Database Disk Transfers Per Second	857
Database Disk Reads Per Second	539
Database Disk Writes Per Second	318
Average Database Disk Read Latency (ms)	8.7
Average Database Disk Write Latency (ms)	2.4
Transaction Log I/O	
Log Disk Writes Per Second	259
Average Log Disk Write Latency (ms)	1.1

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

Database I/O	
Database Disk Transfers Per Second	960
Database Disk Reads Per Second	604
Database Disk Writes Per Second	356
Average Database Disk Read Latency (ms)	8.2
Average Database Disk Write Latency (ms)	2.5
Transaction Log I/O	
Log Disk Writes Per Second	297
Average Log Disk Write Latency (ms)	0.7

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

Database I/O	
Database Disk Transfers Per Second	886
Database Disk Reads Per Second	558
Database Disk Writes Per Second	329
Average Database Disk Read Latency (ms)	8.6
Average Database Disk Write Latency (ms)	2.5
Transaction Log I/O	
Log Disk Writes Per Second	269
Average Log Disk Write Latency (ms)	1.0

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

Database I/O	
Database Disk Transfers Per Second	857
Database Disk Reads Per Second	538
Database Disk Writes Per Second	319
Average Database Disk Read Latency (ms)	9.4
Average Database Disk Write Latency (ms)	4.3
Transaction Log I/O	
Log Disk Writes Per Second	262
Average Log Disk Write Latency (ms)	1.1

Aggregate Performance Across All Servers Metric

The aggregate performance across all server metrics shows the sum of inputs/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	3560.472
Database Disk Reads Per Second	2238.629
Database Disk Writes Per Second	1321.843
Average Database Disk Read Latency (ms)	8.741
Average Database Disk Write Latency (ms)	2.920
Transaction Log I/O	
Log Disk Writes Per Second	1086.053
Average Log Disk Write Latency (ms)	0.991

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

MB Read Per Second Per Database	77.53
MB Read Per Second Total Per Server	310.10>

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 22. Transaction Log Recovery/Replay Performance

Average Time to Play One Log File (sec)	1.159142
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Conclusion

This document details a tested and robust Exchange Server 2010 Resiliency solution capable of supporting 21,200 users with a 0.12 IOPS per user profile and user mailbox size of 1GB 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 8Gb/sec Fibre Channel host paths (limited to 4Gbps by the host ports), 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 21,200 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 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

Overall Test Result	Pass
Machine Name	SUN158
Test Description	
Test Start Time	11/1/2010 2:35:34 AM
Test End Time	11/1/2010 4:47:38 AM
Collection Start Time	11/1/2010 2:37:23 AM
Collection End Time	11/1/2010 4:37:15 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 v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Performance Test\Performance_2010_11_1_2_35_43.blg C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Performance Test\DBChecksum_2010_11_1_4_47_38.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	857.124
Target Transactional I/O per Second	636
Initial Database Size (bytes)	5694793449472
Final Database Size (bytes)	5697519747072
Database Files (Count)	4

Jetstress System Parameters

Thread Count	5 (per database)
Minimum Database Cache	128.0 MB
Maximum Database Cache	1024.0 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

Instance496.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance496.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance496.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance496.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.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
Instance496.1	8.108	2.622	134.297	79.157	33440.894	36063.894	0.000	1.132	0.000	64.902	0.000	4873.741
Instance496.2	9.183	2.822	134.926	79.565	33326.659	36068.393	0.000	1.089	0.000	64.911	0.000	4860.507
Instance496.3	8.543	1.894	134.579	79.368	33508.496	36044.057	0.000	1.140	0.000	64.515	0.000	4860.819
Instance496.4	9.151	2.123	135.416	79.815	33376.985	35984.778	0.000	1.090	0.000	64.787	0.000	4817.125

Background Database Maintenance I/O Performance

MSEExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance496.1	31.101	261896.643
Instance496.2	29.578	261911.910
Instance496.3	30.172	261835.304
Instance496.4	29.605	261803.471

Log Replication I/O Performance

MSEExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance496.1	1.290	232567.643
Instance496.2	1.285	232569.157
Instance496.3	1.280	232540.596
Instance496.4	1.272	232562.930

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance496.1	8.108	2.622	165.399	79.157	76399.418	36063.894	1.797	1.132	1.290	64.902	232567.643	4873.741
Instance496.2	9.183	2.822	164.505	79.565	74426.847	36068.393	1.782	1.089	1.285	64.911	232569.157	4860.507
Instance496.3	8.543	1.894	164.751	79.368	75324.023	36044.057	1.672	1.140	1.280	64.515	232540.596	4860.819
Instance496.4	9.151	2.123	165.021	79.815	74357.496	35984.778	1.779	1.090	1.272	64.787	232562.930	4817.125

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.941	0.000	3.374
Available MBytes	29807.697	29801.000	29819.000
Free System Page Table Entries	33555131.242	33555123.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	63344417.670	63311872.000	63557632.000
Pool Paged Bytes	90382857.620	90337280.000	90443776.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log10/31/2010 11:59:57 PM—Jetstress testing begins ...
 10/31/2010 11:59:57 PM—Prepare testing begins ...
 11/1/2010 12:00:01 AM—Attaching databases ...
 11/1/2010 12:00:01 AM—Prepare testing ends.
 11/1/2010 12:00:01 AM—Dispatching transactions begins ...
 11/1/2010 12:00:01 AM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 11/1/2010 12:00:01 AM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 11/1/2010 12:00:06 AM—Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 11/1/2010 12:00:06 AM—Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 11/1/2010 12:00:11 AM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 11/1/2010 12:00:11 AM—Performance logging begins (interval: 15000 ms).
 11/1/2010 12:00:11 AM—Attaining prerequisites:
 11/1/2010 12:01:44 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 971223000.0 (lower bound: 966367600.0, upper bound: none)
 11/1/2010 2:01:44 AM—Performance logging ends.
 11/1/2010 2:24:07 AM—JetInterop batch transaction stats: 54645, 54128, 54537 and 54714.
 11/1/2010 2:24:07 AM—Dispatching transactions ends.
 11/1/2010 2:24:07 AM—Shutting down databases ...
 11/1/2010 2:24:08 AM—Instance496.1 (complete), Instance496.2 (complete), Instance496.3 (complete) and Instance496.4 (complete)
 11/1/2010 2:24:09 AM—Performance logging begins (interval: 30000 ms).
 11/1/2010 2:24:09 AM—Verifying database checksums ...
 11/1/2010 2:27:57 AM—C:\dbluns\db1 (2% processed), C:\dbluns\db2 (1% processed), C:\dbluns\db3 (2% processed) and C:\dbluns\db4 (1% processed)
 11/1/2010 2:27:57 AM—Verifying log checksums ...
 11/1/2010 2:27:57 AM—C:\logluns\log1 (0 log(s) processed), C:\logluns\log2 (0 log(s) processed), C:\logluns\log3 (0 log(s) processed) and C:\logluns\log4 (0 log(s) processed)
 11/1/2010 2:27:57 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_11_1_0_0_6.blg has 485 samples.
 11/1/2010 2:27:57 AM—Creating test report ...
 11/1/2010 2:27:58 AM—Instance496.1 has 8.0 for I/O Database Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.1 has 1.2 for I/O Log Writes Average Latency.
 11/1/2010 2:27:58 AM—Instance496.1 has 1.2 for I/O Log Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.2 has 9.3 for I/O Database Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.2 has 1.1 for I/O Log Writes Average Latency.

11/1/2010 2:27:58 AM—Instance496.2 has 1.1 for I/O Log Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.3 has 8.5 for I/O Database Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.3 has 1.2 for I/O Log Writes Average Latency.
 11/1/2010 2:27:58 AM—Instance496.3 has 1.2 for I/O Log Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.4 has 9.3 for I/O Database Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.4 has 1.1 for I/O Log Writes Average Latency.
 11/1/2010 2:27:58 AM—Instance496.4 has 1.1 for I/O Log Reads Average Latency.
 11/1/2010 2:27:58 AM—Test has 0 Maximum Database Page Fault Stalls/sec.
 11/1/2010 2:27:58 AM—Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 11/1/2010 2:27:58 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_11_1_0_0_6.xml has 478 samples queried.
 11/1/2010 2:27:59 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_11_1_0_0_6.html is saved.
 11/1/2010 2:27:59 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Application_2010_11_1_2_27_59.evt is saved.
 11/1/2010 2:27:59 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\System_2010_11_1_2_27_59.evt is saved.
 11/1/2010 2:27:59 AM—Jetstress testing ends.
 11/1/2010 2:35:34 AM—Jetstress testing begins ...
 11/1/2010 2:35:34 AM—Prepare testing begins ...
 11/1/2010 2:35:38 AM—Attaching databases ...
 11/1/2010 2:35:38 AM—Prepare testing ends.
 11/1/2010 2:35:38 AM—Dispatching transactions begins ...
 11/1/2010 2:35:38 AM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 11/1/2010 2:35:38 AM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 11/1/2010 2:35:43 AM—Database read latency thresholds: (average: 20 msec/read, maximum:
 100 msec/read).
 11/1/2010 2:35:43 AM—Log write latency thresholds: (average: 10 msec/write, maximum: 100
 msec/write).
 11/1/2010 2:35:49 AM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%,
 Reads 35%, Lazy Commits 70%.
 11/1/2010 2:35:49 AM—Performance logging begins (interval: 15000 ms).
 11/1/2010 2:35:49 AM—Attaining prerequisites:
 11/1/2010 2:37:23 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last:
 973885400.0 (lower bound: 966367600.0, upper bound: none)
 11/1/2010 4:37:24 AM—Performance logging ends.
 11/1/2010 4:47:37 AM—JetInterop batch transaction stats: 48778, 49012, 49055 and 48727.
 11/1/2010 4:47:37 AM—Dispatching transactions ends.
 11/1/2010 4:47:37 AM—Shutting down databases ...
 11/1/2010 4:47:38 AM—Instance496.1 (complete), Instance496.2 (complete), Instance496.3
 (complete) and Instance496.4 (complete)
 11/1/2010 4:47:39 AM—Performance logging begins (interval: 30000 ms).
 11/1/2010 4:47:39 AM—Verifying database checksums ...
 11/1/2010 10:16:56 AM—C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed),
 C:\dbluns\db3 (100% processed) and C:\dbluns\db4 (100% processed)
 11/1/2010 10:16:56 AM—Performance logging ends.
 11/1/2010 10:16:56 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\DBChecksum_2010_11_1_4_47_38.blg has 658 samples.
 11/1/2010 10:16:58 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\DBChecksum_2010_11_1_4_47_38.html is saved.
 11/1/2010 10:16:58 AM—Verifying log checksums ...
 11/1/2010 10:17:00 AM—C:\logluns\log1 (11 log(s) processed), C:\logluns\log2 (12 log(s)
 processed), C:\logluns\log3 (12 log(s) processed) and C:\logluns\log4 (12 log(s) processed)

11/1/2010 10:17:00 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_11_1_2_35_43.blg has 485 samples.
 11/1/2010 10:17:00 AM—Creating test report ...
 11/1/2010 10:17:03 AM—Instance496.1 has 8.1 for I/O Database Reads Average Latency.
 11/1/2010 10:17:03 AM—Instance496.1 has 1.1 for I/O Log Writes Average Latency.
 11/1/2010 10:17:03 AM—Instance496.1 has 1.1 for I/O Log Reads Average Latency.
 11/1/2010 10:17:03 AM—Instance496.2 has 9.2 for I/O Database Reads Average Latency.
 11/1/2010 10:17:03 AM—Instance496.2 has 1.1 for I/O Log Writes Average Latency.
 11/1/2010 10:17:03 AM—Instance496.2 has 1.1 for I/O Log Reads Average Latency.
 11/1/2010 10:17:03 AM—Instance496.3 has 8.5 for I/O Database Reads Average Latency.
 11/1/2010 10:17:03 AM—Instance496.3 has 1.1 for I/O Log Writes Average Latency.
 11/1/2010 10:17:03 AM—Instance496.3 has 1.1 for I/O Log Reads Average Latency.
 11/1/2010 10:17:03 AM—Instance496.4 has 9.2 for I/O Database Reads Average Latency.
 11/1/2010 10:17:03 AM—Instance496.4 has 1.1 for I/O Log Writes Average Latency.
 11/1/2010 10:17:03 AM—Instance496.4 has 1.1 for I/O Log Reads Average Latency.
 11/1/2010 10:17:03 AM—Test has 0 Maximum Database Page Fault Stalls/sec.
 11/1/2010 10:17:03 AM—Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 11/1/2010 10:17:03 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_11_1_2_35_43.xml has 478 samples queried.

Performance Test Database Checksums Result: SUN158

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\dbluns\db1\Jetstress001001.edb	43468882	0	0	0	1358402 MBytes / 12144 sec
C:\dbluns\db2\Jetstress002001.edb	43468370	0	0	0	1358386 MBytes / 19756 sec
C:\dbluns\db3\Jetstress003001.edb	43468626	0	0	0	1358394 MBytes / 12141 sec
C:\dbluns\db4\Jetstress004001.edb	43468626	0	0	0	1358394 MBytes / 19370 sec
(Sum)	173874504	0	0	0	5433578 MBytes / 19756 sec

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Read
C:\dbluns\db1	0.040	0.000	1789.321	0.000	65536.000
C:\dbluns\db2	0.059	0.000	1100.119	0.000	65536.000
C:\dbluns\db3	0.040	0.000	1789.776	0.000	65536.000
C:\dbluns\db4	0.058	0.000	1121.759	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	1.537	0.000	4.619
Available MBytes	30891.927	30874.000	30903.000
Free System Page Table Entries	33555131.170	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	63630438.711	63414272.000	64061440.000
Pool Paged Bytes	91338011.234	90431488.000	95129600.000

Test Log10/31/2010 11:59:57 PM—Jetstress testing begins ...
10/31/2010 11:59:57 PM—Prepare testing begins ...
11/1/2010 12:00:01 AM—Attaching databases ...
11/1/2010 12:00:01 AM—Prepare testing ends.
11/1/2010 12:00:01 AM—Dispatching transactions begins ...
11/1/2010 12:00:01 AM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
11/1/2010 12:00:01 AM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
11/1/2010 12:00:06 AM—Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
11/1/2010 12:00:06 AM—Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
11/1/2010 12:00:11 AM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
11/1/2010 12:00:11 AM—Performance logging begins (interval: 15000 ms).
11/1/2010 12:00:11 AM—Attaining prerequisites:
11/1/2010 12:01:44 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 971223000.0 (lower bound: 966367600.0, upper bound: none)
11/1/2010 2:01:44 AM—Performance logging ends.
11/1/2010 2:24:07 AM—JetInterop batch transaction stats: 54645, 54128, 54537 and 54714.
11/1/2010 2:24:07 AM—Dispatching transactions ends.
11/1/2010 2:24:07 AM—Shutting down databases ...
11/1/2010 2:24:08 AM—Instance496.1 (complete), Instance496.2 (complete), Instance496.3 (complete) and Instance496.4 (complete)
11/1/2010 2:24:09 AM—Performance logging begins (interval: 30000 ms).
11/1/2010 2:24:09 AM—Verifying database checksums ...
11/1/2010 2:27:57 AM—C:\dbluns\db1 (2% processed), C:\dbluns\db2 (1% processed), C:\dbluns\db3 (2% processed) and C:\dbluns\db4 (1% processed)
11/1/2010 2:27:57 AM—Verifying log checksums ...
11/1/2010 2:27:57 AM—C:\logluns\log1 (0 log(s) processed), C:\logluns\log2 (0 log(s) processed),

C:\logluns\log3 (0 log(s) processed) and C:\logluns\log4 (0 log(s) processed)
 11/1/2010 2:27:57 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_11_1_0_0_6.blg has 485 samples.
 11/1/2010 2:27:57 AM—Creating test report ...
 11/1/2010 2:27:58 AM—Instance496.1 has 8.0 for I/O Database Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.1 has 1.2 for I/O Log Writes Average Latency.
 11/1/2010 2:27:58 AM—Instance496.1 has 1.2 for I/O Log Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.2 has 9.3 for I/O Database Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.2 has 1.1 for I/O Log Writes Average Latency.
 11/1/2010 2:27:58 AM—Instance496.2 has 1.1 for I/O Log Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.3 has 8.5 for I/O Database Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.3 has 1.2 for I/O Log Writes Average Latency.
 11/1/2010 2:27:58 AM—Instance496.3 has 1.2 for I/O Log Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.4 has 9.3 for I/O Database Reads Average Latency.
 11/1/2010 2:27:58 AM—Instance496.4 has 1.1 for I/O Log Writes Average Latency.
 11/1/2010 2:27:58 AM—Instance496.4 has 1.1 for I/O Log Reads Average Latency.
 11/1/2010 2:27:58 AM—Test has 0 Maximum Database Page Fault Stalls/sec.
 11/1/2010 2:27:58 AM—Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 11/1/2010 2:27:58 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_11_1_0_0_6.xml has 478 samples queried.
 11/1/2010 2:27:59 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Performance_2010_11_1_0_0_6.html is saved.
 11/1/2010 2:27:59 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\Application_2010_11_1_2_27_59.evt is saved.
 11/1/2010 2:27:59 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\System_2010_11_1_2_27_59.evt is saved.
 11/1/2010 2:27:59 AM—Jetstress testing ends.
 11/1/2010 2:35:34 AM—Jetstress testing begins ...
 11/1/2010 2:35:34 AM—Prepare testing begins ...
 11/1/2010 2:35:38 AM—Attaching databases ...
 11/1/2010 2:35:38 AM—Prepare testing ends.
 11/1/2010 2:35:38 AM—Dispatching transactions begins ...
 11/1/2010 2:35:38 AM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 11/1/2010 2:35:38 AM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 11/1/2010 2:35:43 AM—Database read latency thresholds: (average: 20 msec/read, maximum:
 100 msec/read).
 11/1/2010 2:35:43 AM—Log write latency thresholds: (average: 10 msec/write, maximum: 100
 msec/write).
 11/1/2010 2:35:49 AM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%,
 Reads 35%, Lazy Commits 70%.
 11/1/2010 2:35:49 AM—Performance logging begins (interval: 15000 ms).
 11/1/2010 2:35:49 AM—Attaining prerequisites:
 11/1/2010 2:37:23 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last:
 973885400.0 (lower bound: 966367600.0, upper bound: none)
 11/1/2010 4:37:24 AM—Performance logging ends.
 11/1/2010 4:47:37 AM—JetInterop batch transaction stats: 48778, 49012, 49055 and 48727.
 11/1/2010 4:47:37 AM—Dispatching transactions ends.
 11/1/2010 4:47:37 AM—Shutting down databases ...
 11/1/2010 4:47:38 AM—Instance496.1 (complete), Instance496.2 (complete), Instance496.3
 (complete) and Instance496.4 (complete)
 11/1/2010 4:47:39 AM—Performance logging begins (interval: 30000 ms).
 11/1/2010 4:47:39 AM—Verifying database checksums ...
 11/1/2010 10:16:56 AM—C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed),

C:\dbluns\db3 (100% processed) and C:\dbluns\db4 (100% processed)
 11/1/2010 10:16:56 AM—Performance logging ends.
 11/1/2010 10:16:56 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Performance Test\DBChecksum_2010_11_1_4_47_38.blg has 658 samples.

Stress Test Result Report: SUN158

Test Summary

Overall Test Result	Pass
Machine Name	SUN158
Test Description	
Test Start Time	11/7/2010 7:26:57 PM
Test End Time	11/8/2010 7:29:16 PM
Collection Start Time	11/7/2010 7:28:48 PM
Collection End Time	11/8/2010 7:28:40 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 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_7_19_27_7.blg C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\DBChecksum_2010_11_8_19_29_16.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	838.148
Target Transactional I/O per Second	636
Initial Database Size (bytes)	5725797744640
Final Database Size (bytes)	5754654556160
Database Files (Count)	4

Jetstress System Parameters

Thread Count	5 (per database)
Minimum Database Cache	128.0 MB
Maximum Database Cache	1024.0 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

Instance496.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance496.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance496.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance496.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.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
Instance496.1	8.830	3.521	130.723	78.576	33469.273	34984.570	0.000	0.898	0.000	62.644	0.000	4768.867
Instance496.2	9.214	3.170	131.119	78.840	33411.694	34990.373	0.000	0.901	0.000	62.925	0.000	4771.133
Instance496.3	9.203	2.778	130.665	78.558	33425.839	34993.646	0.000	0.904	0.000	62.596	0.000	4779.281
Instance496.4	9.208	2.243	130.939	78.728	33412.556	34992.254	0.000	0.903	0.000	62.810	0.000	4771.988

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance496.1	30.565	261792.941
Instance496.2	29.689	261786.129
Instance496.3	29.734	261781.987
Instance496.4	29.678	261769.133

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance496.1	1.216	232520.305
Instance496.2	1.222	232562.073
Instance496.3	1.217	232561.152
Instance496.4	1.220	232561.792

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance496.1	8.830	3.521	161.288	78.576	76737.303	34984.570	1.518	0.898	1.216	62.644	232520.305	4768.867
Instance496.2	9.214	3.170	160.808	78.840	75575.099	34990.373	1.503	0.901	1.222	62.925	232562.073	4771.133
Instance496.3	9.203	2.778	160.399	78.558	75757.099	34993.646	1.477	0.904	1.217	62.596	232561.152	4779.281
Instance496.4	9.208	2.243	160.617	78.728	75607.218	34992.254	1.479	0.903	1.220	62.810	232561.792	4771.988

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.189	0.000	5.166
Available MBytes	29670.313	29633.000	29683.000
Free System Page Table Entries	33555131.208	33555123.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	66645759.599	66408448.000	66830336.000
Pool Paged Bytes	102664277.823	101478400.000	104964096.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 11/1/2010 8:55:18 PM—Jetstress testing begins ...
 11/1/2010 8:55:18 PM—Prepare testing begins ...
 11/1/2010 8:55:22 PM—Attaching databases ...
 11/1/2010 8:55:22 PM—Prepare testing ends.
 11/1/2010 8:55:22 PM—Dispatching transactions begins ...
 11/1/2010 8:55:22 PM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 11/1/2010 8:55:22 PM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 11/1/2010 8:55:27 PM—Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 11/1/2010 8:55:27 PM—Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 11/1/2010 8:55:32 PM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 11/1/2010 8:55:32 PM—Performance logging begins (interval: 15000 ms).
 11/1/2010 8:55:32 PM—Attaining prerequisites:
 11/1/2010 8:57:09 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 968282100.0 (lower bound: 966367600.0, upper bound: none)
 11/2/2010 8:57:09 PM—Performance logging ends.
 11/2/2010 9:02:03 PM—JetInterop batch transaction stats: 503665, 505162, 504934 and 503387.
 11/2/2010 9:02:03 PM—Dispatching transactions ends.
 11/2/2010 9:02:03 PM—Shutting down databases ...
 11/2/2010 9:02:05 PM—Instance496.1 (complete), Instance496.2 (complete), Instance496.3 (complete) and Instance496.4 (complete)
 11/2/2010 9:02:06 PM—Performance logging begins (interval: 30000 ms).
 11/2/2010 9:02:06 PM—Verifying database checksums ...
 11/2/2010 9:07:44 PM—C:\dbluns\db1 (0% processed), C:\dbluns\db2 (0% processed), C:\dbluns\db3 (0% processed) and C:\dbluns\db4 (0% processed)
 11/2/2010 9:07:45 PM—Verifying log checksums ...
 11/2/2010 9:07:45 PM—C:\logluns\log1 (0 log(s) processed), C:\logluns\log2 (0 log(s) processed), C:\logluns\log3 (0 log(s) processed) and C:\logluns\log4 (0 log(s) processed)
 11/2/2010 9:07:45 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_1_20_55_27.blg has 5757 samples.
 11/2/2010 9:07:45 PM—Creating test report ...
 11/2/2010 9:08:13 PM—Instance496.1 has 9.1 for I/O Database Reads Average Latency.
 11/2/2010 9:08:13 PM—Instance496.1 has 0.9 for I/O Log Writes Average Latency.
 11/2/2010 9:08:13 PM—Instance496.1 has 0.9 for I/O Log Reads Average Latency.
 11/2/2010 9:08:13 PM—Instance496.2 has 9.5 for I/O Database Reads Average Latency.
 11/2/2010 9:08:13 PM—Instance496.2 has 0.9 for I/O Log Writes Average Latency.

11/2/2010 9:08:13 PM—Instance496.2 has 0.9 for I/O Log Reads Average Latency.
 11/2/2010 9:08:13 PM—Instance496.3 has 9.5 for I/O Database Reads Average Latency.
 11/2/2010 9:08:13 PM—Instance496.3 has 0.9 for I/O Log Writes Average Latency.
 11/2/2010 9:08:13 PM—Instance496.3 has 0.9 for I/O Log Reads Average Latency.
 11/2/2010 9:08:13 PM—Instance496.4 has 9.5 for I/O Database Reads Average Latency.
 11/2/2010 9:08:13 PM—Instance496.4 has 0.9 for I/O Log Writes Average Latency.
 11/2/2010 9:08:13 PM—Instance496.4 has 0.9 for I/O Log Reads Average Latency.
 11/2/2010 9:08:13 PM—Test has 0 Maximum Database Page Fault Stalls/sec.
 11/2/2010 9:08:13 PM—Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 11/2/2010 9:08:13 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_1_20_55_27.xml has 5750 samples queried.
 11/2/2010 9:08:13 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_1_20_55_27.html is saved.
 11/2/2010 9:08:13 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Application_2010_11_2_21_8_13.evt is saved.
 11/2/2010 9:08:13 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\System_2010_11_2_21_8_13.evt is saved.
 11/2/2010 9:08:13 PM—Jetstress testing ends.
 11/7/2010 7:26:57 PM—Jetstress testing begins ...
 11/7/2010 7:26:57 PM—Prepare testing begins ...
 11/7/2010 7:27:01 PM—Attaching databases ...
 11/7/2010 7:27:01 PM—Prepare testing ends.
 11/7/2010 7:27:01 PM—Dispatching transactions begins ...
 11/7/2010 7:27:01 PM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 11/7/2010 7:27:01 PM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 11/7/2010 7:27:07 PM—Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 11/7/2010 7:27:07 PM—Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 11/7/2010 7:27:14 PM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 11/7/2010 7:27:14 PM—Performance logging begins (interval: 15000 ms).
 11/7/2010 7:27:14 PM—Attaining prerequisites:
 11/7/2010 7:28:48 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 973328400.0 (lower bound: 966367600.0, upper bound: none)
 11/8/2010 7:28:49 PM—Performance logging ends.
 11/8/2010 7:29:14 PM—JetInterop batch transaction stats: 510408, 512604, 510248 and 511630.
 11/8/2010 7:29:15 PM—Dispatching transactions ends.
 11/8/2010 7:29:15 PM—Shutting down databases ...
 11/8/2010 7:29:16 PM—Instance496.1 (complete), Instance496.2 (complete), Instance496.3 (complete) and Instance496.4 (complete)
 11/8/2010 7:29:17 PM—Performance logging begins (interval: 30000 ms).
 11/8/2010 7:29:17 PM—Verifying database checksums ...
 11/9/2010 2:30:05 AM—C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed) and C:\dbluns\db4 (100% processed)
 11/9/2010 2:30:05 AM—Performance logging ends.
 11/9/2010 2:30:05 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\DBChecksum_2010_11_8_19_29_16.blg has 841 samples.
 11/9/2010 2:30:08 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\DBChecksum_2010_11_8_19_29_16.html is saved.
 11/9/2010 2:30:08 AM—Verifying log checksums ...
 11/9/2010 2:30:09 AM—C:\logluns\log1 (12 log(s) processed), C:\logluns\log2 (12 log(s) processed), C:\logluns\log3 (12 log(s) processed) and C:\logluns\log4 (12 log(s) processed)

11/9/2010 2:30:09 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_7_19_27_7.blg has 5757 samples.
 11/9/2010 2:30:09 AM—Creating test report ...
 11/9/2010 2:30:35 AM—Instance496.1 has 8.8 for I/O Database Reads Average Latency.
 11/9/2010 2:30:35 AM—Instance496.1 has 0.9 for I/O Log Writes Average Latency.
 11/9/2010 2:30:35 AM—Instance496.1 has 0.9 for I/O Log Reads Average Latency.
 11/9/2010 2:30:35 AM—Instance496.2 has 9.2 for I/O Database Reads Average Latency.
 11/9/2010 2:30:35 AM—Instance496.2 has 0.9 for I/O Log Writes Average Latency.
 11/9/2010 2:30:35 AM—Instance496.2 has 0.9 for I/O Log Reads Average Latency.
 11/9/2010 2:30:35 AM—Instance496.3 has 9.2 for I/O Database Reads Average Latency.
 11/9/2010 2:30:35 AM—Instance496.3 has 0.9 for I/O Log Writes Average Latency.
 11/9/2010 2:30:35 AM—Instance496.3 has 0.9 for I/O Log Reads Average Latency.
 11/9/2010 2:30:35 AM—Instance496.4 has 9.2 for I/O Database Reads Average Latency.
 11/9/2010 2:30:35 AM—Instance496.4 has 0.9 for I/O Log Writes Average Latency.
 11/9/2010 2:30:35 AM—Instance496.4 has 0.9 for I/O Log Reads Average Latency.
 11/9/2010 2:30:35 AM—Test has 0 Maximum Database Page Fault Stalls/sec.
 11/9/2010 2:30:35 AM—Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 11/9/2010 2:30:35 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_7_19_27_7.xml has 5750 samples queried.

Stress Test Database Checksums Result: SUN158

Checksum Statistics - All

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length / seconds taken
C:\dbluns\db1\Jetstress001001.edb	43903826	0	0	0	1371994 MBytes / 23969 sec
C:\dbluns\db2\Jetstress002001.edb	43904338	0	0	0	1372010 MBytes / 25247 sec
C:\dbluns\db3\Jetstress003001.edb	43904850	0	0	0	1372026 MBytes / 24069 sec
C:\dbluns\db4\Jetstress004001.edb	43905106	0	0	0	1372034 MBytes / 25176 sec
(Sum)	175618120	0	0	0	5488066 MBytes / 25247 sec

Disk Subsystem Performance (of checksum)

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Read
C:\dbluns\db1	0.075	0.000	915.271	0.000	65536.000
C:\dbluns\db2	0.076	0.000	869.317	0.000	65536.000
C:\dbluns\db3	0.075	0.000	910.241	0.000	65536.000
C:\dbluns\db4	0.072	0.000	870.532	0.000	65536.000

Memory System Performance (of checksum)

Counter	Average	Minimum	Maximum
% Processor Time	1.453	0.000	5.158
Available MBytes	30758.508	30741.000	30772.000
Free System Page Table Entries	33555316.886	33555129.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	66927636.699	66781184.000	67231744.000
Pool Paged Bytes	101918892.899	101814272.000	104124416.000

Test Log 11/1/2010 8:55:18 PM—Jetstress testing begins ...

11/1/2010 8:55:18 PM—Prepare testing begins ...

11/1/2010 8:55:22 PM—Attaching databases ...

11/1/2010 8:55:22 PM—Prepare testing ends.

11/1/2010 8:55:22 PM—Dispatching transactions begins ...

11/1/2010 8:55:22 PM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)

11/1/2010 8:55:22 PM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)

11/1/2010 8:55:27 PM—Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).

11/1/2010 8:55:27 PM—Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).

11/1/2010 8:55:32 PM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

11/1/2010 8:55:32 PM—Performance logging begins (interval: 15000 ms).

11/1/2010 8:55:32 PM—Attaining prerequisites:

11/1/2010 8:57:09 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 968282100.0 (lower bound: 966367600.0, upper bound: none)

11/2/2010 8:57:09 PM—Performance logging ends.

11/2/2010 9:02:03 PM—JetInterop batch transaction stats: 503665, 505162, 504934 and 503387.

11/2/2010 9:02:03 PM—Dispatching transactions ends.

11/2/2010 9:02:03 PM—Shutting down databases ...

11/2/2010 9:02:05 PM—Instance496.1 (complete), Instance496.2 (complete), Instance496.3 (complete) and Instance496.4 (complete)

11/2/2010 9:02:06 PM—Performance logging begins (interval: 30000 ms).

11/2/2010 9:02:06 PM—Verifying database checksums ...

11/2/2010 9:07:44 PM—C:\dbluns\db1 (0% processed), C:\dbluns\db2 (0% processed), C:\dbluns\db3 (0% processed) and C:\dbluns\db4 (0% processed)

11/2/2010 9:07:45 PM—Verifying log checksums ...

11/2/2010 9:07:45 PM—C:\logluns\log1 (0 log(s) processed), C:\logluns\log2 (0 log(s) processed), C:\logluns\log3 (0 log(s) processed) and C:\logluns\log4 (0 log(s) processed)

11/2/2010 9:07:45 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_1_20_55_27.blg has 5757 samples.

11/2/2010 9:07:45 PM—Creating test report ...

11/2/2010 9:08:13 PM—Instance496.1 has 9.1 for I/O Database Reads Average Latency.

11/2/2010 9:08:13 PM—Instance496.1 has 0.9 for I/O Log Writes Average Latency.

11/2/2010 9:08:13 PM—Instance496.1 has 0.9 for I/O Log Reads Average Latency.

11/2/2010 9:08:13 PM—Instance496.2 has 9.5 for I/O Database Reads Average Latency.

11/2/2010 9:08:13 PM—Instance496.2 has 0.9 for I/O Log Writes Average Latency.

11/2/2010 9:08:13 PM—Instance496.2 has 0.9 for I/O Log Reads Average Latency.

11/2/2010 9:08:13 PM—Instance496.3 has 9.5 for I/O Database Reads Average Latency.

11/2/2010 9:08:13 PM—Instance496.3 has 0.9 for I/O Log Writes Average Latency.

11/2/2010 9:08:13 PM—Instance496.3 has 0.9 for I/O Log Reads Average Latency.
11/2/2010 9:08:13 PM—Instance496.4 has 9.5 for I/O Database Reads Average Latency.
11/2/2010 9:08:13 PM—Instance496.4 has 0.9 for I/O Log Writes Average Latency.
11/2/2010 9:08:13 PM—Instance496.4 has 0.9 for I/O Log Reads Average Latency.
11/2/2010 9:08:13 PM—Test has 0 Maximum Database Page Fault Stalls/sec.
11/2/2010 9:08:13 PM—Test has 0 Database Page Fault Stalls/sec samples higher than 0.
11/2/2010 9:08:13 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_1_20_55_27.xml has 5750 samples queried.
11/2/2010 9:08:13 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Stress_2010_11_1_20_55_27.html is saved.
11/2/2010 9:08:13 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\Application_2010_11_2_21_8_13.evt is saved.
11/2/2010 9:08:13 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\System_2010_11_2_21_8_13.evt is saved.
11/2/2010 9:08:13 PM—Jetstress testing ends.
11/7/2010 7:26:57 PM—Jetstress testing begins ...
11/7/2010 7:26:57 PM—Prepare testing begins ...
11/7/2010 7:27:01 PM—Attaching databases ...
11/7/2010 7:27:01 PM—Prepare testing ends.
11/7/2010 7:27:01 PM—Dispatching transactions begins ...
11/7/2010 7:27:01 PM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
11/7/2010 7:27:01 PM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
11/7/2010 7:27:07 PM—Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
11/7/2010 7:27:07 PM—Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
11/7/2010 7:27:14 PM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
11/7/2010 7:27:14 PM—Performance logging begins (interval: 15000 ms).
11/7/2010 7:27:14 PM—Attaining prerequisites:
11/7/2010 7:28:48 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 973328400.0 (lower bound: 966367600.0, upper bound: none)
11/8/2010 7:28:49 PM—Performance logging ends.
11/8/2010 7:29:14 PM—JetInterop batch transaction stats: 510408, 512604, 510248 and 511630.
11/8/2010 7:29:15 PM—Dispatching transactions ends.
11/8/2010 7:29:15 PM—Shutting down databases ...
11/8/2010 7:29:16 PM—Instance496.1 (complete), Instance496.2 (complete), Instance496.3 (complete) and Instance496.4 (complete)
11/8/2010 7:29:17 PM—Performance logging begins (interval: 30000 ms).
11/8/2010 7:29:17 PM—Verifying database checksums ...
11/9/2010 2:30:05 AM—C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed) and C:\dbluns\db4 (100% processed)
11/9/2010 2:30:05 AM—Performance logging ends.
11/9/2010 2:30:05 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Stress Test\DBChecksum_2010_11_8_19_29_16.blg has 841 samples.

Backup Test Result Report: SUN 158

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance4000.1	1371986.59	05:36:41	67.91
Instance4000.2	1372002.59	05:21:55	71.03
Instance4000.3	1372018.59	05:47:31	65.80
Instance4000.4	1372026.59	03:53:53	97.77

Jetstress System Parameters

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

Database Configuration

Instance4000.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance4000.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance4000.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance4000.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.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
Instance4000.1	6.512	0.000	271.644	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance4000.2	5.934	0.000	283.992	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance4000.3	5.995	0.000	263.046	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance4000.4	4.118	0.000	390.937	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	1.101	0.000	4.710
Available MBytes	30781.101	30722.000	30789.000
Free System Page Table Entries	33555243.484	33555129.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	66608172.265	66576384.000	66736128.000
Pool Paged Bytes	105532058.928	104689664.000	107978752.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 11/9/2010 11:26:10 PM—Jetstress testing begins ...
 11/9/2010 11:26:10 PM—Prepare testing begins ...
 11/9/2010 11:26:14 PM—Attaching databases ...
 11/9/2010 11:26:14 PM—Prepare testing ends.
 11/9/2010 11:26:22 PM—Performance logging begins (interval: 30000 ms).
 11/9/2010 11:26:22 PM—Backing up databases ...
 11/10/2010 5:13:53 AM—Performance logging ends.
 11/10/2010 5:13:53 AM—Instance4000.1 (100% processed), Instance4000.2 (100% processed),
 Instance4000.3 (100% processed) and Instance4000.4 (100% processed)
 11/10/2010 5:13:53 AM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox
 Raid1+0\Sun158\Backup Test\DatabaseBackup_2010_11_9_23_26_14.blg has 694 samples.
 11/10/2010 5:13:53 AM—Creating test report ...

Soft Recovery Test Result Report: SUN158

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance4000.1	503	611.0218732
Instance4000.2	500	617.6518848
Instance4000.3	507	557.4513791
Instance4000.4	504	628.2599035

Database Configuration

Instance4000.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance4000.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance4000.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance4000.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.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
Instance4000.1	16.986	11.376	999.562	4.935	35592.939	31899.974	3.724	0.000	7.403	0.000	225583.355	0.000
Instance4000.2	18.651	12.116	987.185	4.867	35679.096	32338.256	3.760	0.000	7.301	0.000	228709.142	0.000
Instance4000.3	17.206	11.383	1124.143	5.470	35546.274	32530.551	3.746	0.002	8.213	0.022	230752.164	1.855
Instance4000.4	18.441	12.634	994.607	4.821	35664.024	32662.637	3.924	0.001	7.231	0.005	230081.279	1.646

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance4000.1	28.712	261918.263
Instance4000.2	28.452	261859.292
Instance4000.3	29.317	262007.929
Instance4000.4	28.461	261820.659

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance4000.1	16.986	11.376	1028.274	4.935	41912.414	31899.974	3.724	0.000	7.403	0.000	225583.355	0.000
Instance4000.2	18.651	12.116	1015.637	4.867	42015.319	32338.256	3.760	0.000	7.301	0.000	228709.142	0.000
Instance4000.3	17.206	11.383	1153.460	5.470	41302.124	32530.551	3.746	0.002	8.213	0.022	230752.164	1.855
Instance4000.4	18.441	12.634	1023.068	4.821	41955.501	32662.637	3.924	0.001	7.231	0.005	230081.279	1.646

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	3.539	0.000	23.401
Available MBytes	29677.596	29658.000	30628.000
Free System Page Table Entries	33555132.401	33555131.000	33555133.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	73743215.590	67997696.000	74645504.000
Pool Paged Bytes	106084575.179	106041344.000	106119168.000
Database Page Fault Stalls/sec	0.006	0.000	0.994

Test Log 11/10/2010 7:34:51 PM—Jetstress testing begins ...
 11/10/2010 7:34:51 PM—Prepare testing begins ...
 11/10/2010 7:34:56 PM—Attaching databases ...
 11/10/2010 7:34:56 PM—Prepare testing ends.
 11/10/2010 7:34:56 PM—Dispatching transactions begins ...
 11/10/2010 7:34:56 PM—Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 11/10/2010 7:34:56 PM—Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 11/10/2010 7:35:01 PM—Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 11/10/2010 7:35:01 PM—Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 11/10/2010 7:35:05 PM—Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 11/10/2010 7:35:05 PM—Performance logging begins (interval: 15000 ms).
 11/10/2010 7:35:05 PM—Generating log files ...
 11/10/2010 8:32:52 PM—C:\logluns\log1 (100.8% generated), C:\logluns\log2 (100.2% generated), C:\logluns\log3 (101.6% generated) and C:\logluns\log4 (100.8% generated)
 11/10/2010 8:32:52 PM—Performance logging ends.
 11/10/2010 8:32:52 PM—JetInterop batch transaction stats: 22000, 21754, 22173 and 22007.
 11/10/2010 8:32:53 PM—Dispatching transactions ends.
 11/10/2010 8:32:53 PM—Shutting down databases ...
 11/10/2010 8:32:54 PM—Instance4000.1 (complete), Instance4000.2 (complete), Instance4000.3 (complete) and Instance4000.4 (complete)
 11/10/2010 8:32:54 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_11_10_19_35_1.blg has 231 samples.
 11/10/2010 8:32:54 PM—Creating test report ...
 11/10/2010 8:32:54 PM—Instance4000.1 has 9.0 for I/O Database Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.1 has 1.0 for I/O Log Writes Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.1 has 1.0 for I/O Log Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.2 has 9.2 for I/O Database Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.2 has 1.0 for I/O Log Writes Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.2 has 1.0 for I/O Log Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.3 has 9.0 for I/O Database Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.3 has 1.0 for I/O Log Writes Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.3 has 1.0 for I/O Log Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.4 has 9.2 for I/O Database Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.4 has 1.0 for I/O Log Writes Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.4 has 1.0 for I/O Log Reads Average Latency.

11/10/2010 8:32:54 PM—Test has 0 Maximum Database Page Fault Stalls/sec.
 11/10/2010 8:32:54 PM—Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 11/10/2010 8:32:54 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_11_10_19_35_1.xml has 230 samples queried.
 11/10/2010 8:32:54 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_11_10_19_35_1.html is saved.
 11/10/2010 8:33:18 PM—Performance logging begins (interval: 2000 ms).
 11/10/2010 8:33:18 PM—Recovering databases ...
 11/10/2010 8:43:47 PM—Performance logging ends.
 11/10/2010 8:43:47 PM—Instance4000.1 (611.0218732), Instance4000.2 (617.6518848), Instance4000.3 (557.4513791) and Instance4000.4 (628.2599035)
 11/10/2010 8:43:47 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Soft Recovery\SoftRecovery_2010_11_10_20_33_15.blg has 312 samples.
 11/10/2010 8:43:47 PM—Creating test report ...

Soft Recovery Test Performance Result: SUN158

Test Summary

Overall Test Result	Pass
Machine Name	SUN158
Test Description	
Test Start Time	11/10/2010 7:34:51 PM
Test End Time	11/10/2010 8:32:54 PM
Collection Start Time	11/10/2010 7:35:20 PM
Collection End Time	11/10/2010 8:32:52 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 1GB MailBox Raid1+0\Sun158\Soft Recovery\Performance_2010_11_10_19_35_1.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	894.654
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	5754654556160
Final Database Size (bytes)	5755896070144
Database Files (Count)	4

Jetstress System Parameters

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

Database Configuration

Instance4000.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance4000.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance4000.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance4000.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.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
Instance4000.1	8.969	4.845	139.351	83.671	32768.845	34959.537	0.000	0.966	0.000	66.293	0.000	4817.147
Instance4000.2	9.204	3.941	139.059	83.466	32768.000	34965.073	0.000	0.968	0.000	65.627	0.000	4841.316
Instance4000.3	9.016	2.448	140.774	84.688	32768.000	34957.698	0.000	0.975	0.000	66.966	0.000	4817.488
Instance4000.4	9.175	2.564	139.692	83.952	32768.148	34939.261	0.000	0.972	0.000	66.651	0.000	4806.388

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	1.190	0.000	3.514
Available MBytes	29680.922	29646.000	30461.000
Free System Page Table Entries	33555151.602	33555123.000	33555645.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	67195092.779	66633728.000	67366912.000
Pool Paged Bytes	106482665.835	105902080.000	106696704.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log 11/10/2010 7:34:51 PM—Jetstress testing begins ...
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 11/10/2010 7:34:56 PM—Prepare testing ends.
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 11/10/2010 8:32:54 PM—Instance4000.2 has 9.2 for I/O Database Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.2 has 1.0 for I/O Log Writes Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.2 has 1.0 for I/O Log Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.3 has 9.0 for I/O Database Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.3 has 1.0 for I/O Log Writes Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.3 has 1.0 for I/O Log Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.4 has 9.2 for I/O Database Reads Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.4 has 1.0 for I/O Log Writes Average Latency.
 11/10/2010 8:32:54 PM—Instance4000.4 has 1.0 for I/O Log Reads Average Latency.

11/10/2010 8:32:54 PM—Test has 0 Maximum Database Page Fault Stalls/sec.

11/10/2010 8:32:54 PM—Test has 0 Database Page Fault Stalls/sec samples higher than 0.

11/10/2010 8:32:54 PM—C:\ESRP v 3.0 AMS2100 600GB SAS 1GB MailBox Raid1+0\Sun158\Soft
Recovery\Performance_2010_11_10_19_35_1.xml has 230 samples queried.

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