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Hitachi Adaptable Modular Storage 2100 Dynamically Provisioned 33,920 Mailbox Exchange 2010 Mailbox Resiliency Storage Solution

Tested with: ESRP – Storage Version 3.0

Test Date: January-February 2011

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Table of Contents

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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 33,920 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-5 (8D+1P) 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 33,920 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:

- 108 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 five databases.

To target the 33,920-user resiliency solution, a Hitachi Adaptable Modular Storage 2100 (AMS 2100) was configured with 108 disks (of a maximum of 120). Four servers (one per DAG) were used, with each server configured with 8,480 mailboxes. There were 20 active databases and the simulated database copies for the tests.

Each DAG contained two copies of the five 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.

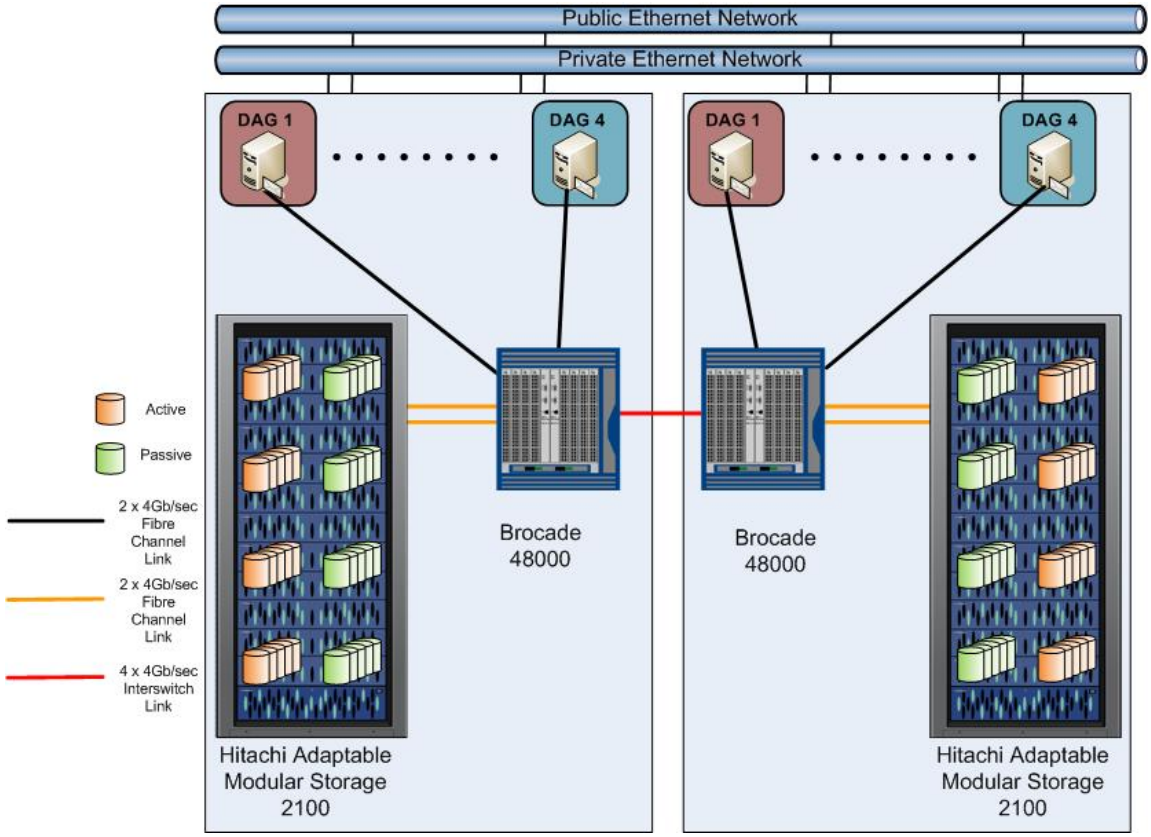


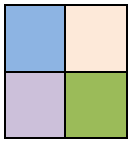
Figure 1

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-5 (8D+1P) RAID group. There were 108 disks used in these tests configured as 12 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	11	11	11	11	12	12	12	12	12	12	12	12	12	0	0	0	0	0	0
RKA 5	9	9	9	9	9	10	10	10	10	10	10	10	10	10	11	11	11	11	11
RKA 4	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	9	9	9	9
RKA 3	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	7	7	7
RKA 2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	5	5
RKA 1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3
RKA 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				



DB RAID Groups
Log RAID Groups

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 6 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 ten RAID-5 (8D+1P) RAID groups and the log pool was created from two RAID-5 (8D+1P) RAID groups. From the database pool, 20 DP-VOLs (each specified to have a 2,000GB size limit) were created for 20 databases (five per server). From the log pool, 20 DP-VOLs (each specified to have a size limit of 200GB) were created for 20 logs (five 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 1-5	0-4
0B	Databases 6-10	5-9
1A	Databases 11-15	10-14
1B	Databases 16-20	15-19

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

Port	*Log*	*Log DP-VOL*
0A	Log 1-5	20-24
0B	Log 6-10	25-29
1A	Log 11-15	30-34
1B	Log 16-20	35-39

Table 5 provides the detailed specifications for the storage configuration which uses RAID-5 (8D+1P) 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	0-4	2000	Databases 1-5
Sun159	0	0B/1B	5-9	2000	Databases 6-10
Sun160	0	1A/0A	10-14	2000	Databases 11-15
Sun161	0	1B/0B	15-19	2000	Databases 16-20
Sun158	1	0A/1A	20-24	200	Log 1-5
Sun159	1	0B/1B	25-29	200	Log 6-10
Sun160	1	1A/0A	30-34	200	Log 11-15
Sun161	1	1B/0B	35-39	200	Log 16-20

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 33,920 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.
- 24×7 background database maintenance enabled.

Test Deployment

The following tables summarize the testing environment.

Table 6. Simulated Exchange Configuration

Number of Exchange mailboxes simulated	33,920
Number of database availability groups (DAGs)	4
Number of servers per DAG	2 (1 simulated)
Number of active mailboxes per server	8,480
Number of databases per host	5
Number of copies per database	2
Number of mailboxes per database	1696
Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)	0.12
Database LU size	2000GB
Log LU siz	200GB
Total database size for performance testing	33,920GB
% 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	108
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	90 (dynamic provisioning pool)
Total raw storage capacity (GB)	54,000
Disk slice size (GB)	N /A
Number of slices per LU or number of disks per LU	N/A
RAID level	RAID-5 (8D+1P) at storage level
Total formatted capacity	42,400GB
Storage capacity utilization	78.5%
Database capacity utilization	74.1%

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	18 (dynamic provisioning pool)
Total raw storage capacity (GB)	10,800
Disk slice size (GB)	N/A
Number of slices per LU or number of disks per LU	N/A
RAID level	RAID-5(8D+1P) at storage level
Total formatted capacity	8,480GB

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/ (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	108
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	90 (dynamic provisioning pool)
total raw storage capacity (GB)	54,000
Disk slice size (GB)	N /A
Number of slices per LU or number of disks per LU	N/A
Raid level	RAID-5(8D+1P) at storage level
Total formatted capacity	42,400GB
Storage capacity utilization	78.5%
Database capacity utilization	74.1%

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	18 (dynamic provisioning pool)
Total raw storage capacity (GB)	10,800
Disk slice size (GB)	N/A
Number of slices per LU or number of disks per LU	N/A
Raid level	RAID-5(8D+1P) at storage level
Total formatted capacity	8,480GB

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 (24×7) 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 I/Os and average of all the logical disks I/O latency in the two-hour test duration.

Individual Server Metrics

Individual server metrics show the sum of 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)

Database I/O	
Database Disk Transfers Per Second	1195
Database Disk Reads Per Second	761
Database Disk Writes Per Second	434
Average Database Disk Read Latency (ms)	15.1
Average Database Disk Write Latency (ms)	3.8
Transaction Log I/O	
Log Disk Writes Per Second	355
Average Log Disk Write Latency (ms)	1.7

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

Database I/O	
Database Disk Transfers Per Second	1253
Database Disk Reads Per Second	798
Database Disk Writes Per Second	455
Average Database Disk Read Latency (ms)	14.9
Average Database Disk Write Latency (ms)	3.7
Transaction Log I/O	
Log Disk Writes Per Second	375
Average Log Disk Write Latency (ms)	1.4

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

Database I/O	
Database Disk Transfers Per Second	1218
Database Disk Reads Per Second	776
Database Disk Writes Per Second	442
Average Database Disk Read Latency (ms)	15.0
Average Database Disk Write Latency (ms)	3.7
Transaction Log I/O	
Log Disk Writes Per Second	364
Average Log Disk Write Latency (ms)	1.5

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

Database I/O	
Database Disk Transfers Per Second	1212
Database Disk Reads Per Second	772
Database Disk Writes Per Second	440
Average Database Disk Read Latency (ms)	14.9
Average Database Disk Write Latency (ms)	3.6
Transaction Log I/O	
Log Disk Writes Per Second	359
Average Log Disk Write Latency (ms)	1.5

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	4878.631
Database Disk Reads Per Second	3107.501
Database Disk Writes Per Second	1771.130
Average Database Disk Read Latency (ms)	14.959
Average Database Disk Write Latency (ms)	3.702
Transaction Log I/O	
Log Disk Writes Per Second	1453.676
Average Log Disk Write Latency (ms)	1.517

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	55.02
MB Read Per Second Total Per Server	275.10

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)	1.03755

Conclusion

This document details a tested and robust Exchange Server 2010 Resiliency solution capable of supporting 33,920 users with a 0.12 IOPS per user profile and user mailbox size of 1GB using four DAGs 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 108 600GB 15K RPM SAS disks in a RAID-5 (8D+1P) 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 33,920 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 A — RAID-5 Drive Failure and Rebuild

These ESRP tests used RAID-5 (8D+1P) rather than RAID-6 (for example, 4D+2P) or RAID-10 (for example, 4D+4D).

RAID-5 is a more capacity-efficient RAID level than the others. It loses only 12.5 percent of the usable space when using 8D+1P. This compares to 33 percent for 4D+2P or 50 percent for 4D+4D.

One downside with the use of parity RAID instead of mirrored and striped (RAID-10) is that the internal disk write penalty for writes is higher. For SAS or Fibre Channel disks, RAID-5 requires four physical disk I/Os on the backend for every host write. In comparison, RAID-10 requires two physical I/Os and RAID-6 requires six physical I/Os for each host write.

The other downside is the rebuild time for the RAID group after a sudden disk failure. The Hitachi Adaptable Modular Storage 2000 family always scans the storage system looking for soft fails, because excessive soft fails is a predictor of a hard failure. If the number of soft fails exceeds the user-set failure threshold in a 24-hour period, an Adaptable Modular Storage 2000 family storage system does the following, in order:

1. Executes a disk-to-disk copy to a global hot spare to avoid a RAID-5 or RAID-6 rebuild.
2. Marks the disk as failed.
3. Replaces the disk.

If a hard fail does occur, the following happens:

- When using RAID-10, the contents of the good disk are mirrored onto a spare disk. These “hot spares” are user-defined in several disk enclosures on a storage system.
- When using RAID-5 or RAID-6, all disks in the RAID group must be read to recreate the missing data and parity that was on the failed disk onto the spare disk. This rebuild mode is called corrective copy. An associated array setting called [Drive] Restore Options determines how aggressive the rebuild operation is while there are still ongoing host I/Os. This setting has three levels: aggressive, moderate, and background.

Lab tests were conducted on a RAID-6 group using Fibre Channel disks with an aggressive restore option setting. A RAID-6 (8D+2P) group corrective copy operation takes about 30 minutes to complete without any host workload on the LUs from that RAID group. When there was a sustained 100 percent sequential write workloads to the LUs from the same RAID group, the rebuild time increased to 18 hours. The host performance on a LU from that RAID group was measured at 154MB/sec (normal state) and 95MB/sec (corrective copy state). Had this been RAID-5, the corrective copy times would have been reduced.

Appendix B — Test Reports

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

Performance Test Result Report: SUN158

Test Summary

Overall Test Result	Pass
Machine Name	SUN158
Test Description	
Test Start Time	1/19/2011 2:40:52 AM
Test End Time	1/19/2011 7:29:43 PM
Collection Start Time	1/19/2011 2:42:25 AM
Collection End Time	1/19/2011 4:42:21 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 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Performance Test\Performance_2011_1_19_2_41_3.blg C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Performance Test\DBChecksum_2011_1_19_19_29_43.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1195.338
Target Transactional I/O per Second	1017.6
Initial Database Size (bytes)	9105852661760
Final Database Size (bytes)	9134239711232
Database Files (Count)	5

Jetstress System Parameters

Thread Count	10 (per database)
Minimum Database Cache	160.0 MB
Maximum Database Cache	1280.0 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

Instance3796.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance3796.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance3796.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance3796.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
Instance3796.5	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

MS Exchange 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*
Instance3796.1	15.768	4.986	152.116	86.676	33577.848	37059.482	0.000	1.986	0.000	70.479	0.000	5026.608
Instance3796.2	14.682	3.761	152.286	86.844	33785.017	37089.739	0.000	1.309	0.000	71.691	0.000	5039.577
Instance3796.3	15.177	4.225	153.752	87.783	33644.554	37046.779	0.000	1.893	0.000	71.518	0.000	5036.485
Instance3796.4	14.684	2.903	151.872	86.495	33782.584	37035.899	0.000	1.287	0.000	71.142	0.000	4963.765
Instance3796.5	15.147	3.157	151.368	86.147	33649.684	37043.639	0.000	1.823	0.000	70.132	0.000	5035.133

Background Database Maintenance I/O Performance

MS Exchange Database ==> Instances	*Database Maintenance IO Reads/sec*	*Database Maintenance IO Reads Average Bytes*
Instance3796.1	26.674	261912.907
Instance3796.2	27.201	261928.582
Instance3796.3	26.074	261956.626
Instance3796.4	27.264	261927.099
Instance3796.5	26.134	261918.058

Log Replication I/O Performance

MS Exchange Database ==> Instances	*I/O Log Reads/sec*	*I/O Log Reads Average Bytes*
Instance3796.1	1.448	232555.019
Instance3796.2	1.477	232074.159
Instance3796.3	1.475	232560.287
Instance3796.4	1.445	232563.399
Instance3796.5	1.445	232492.621

Total I/O Performance

MS Exchange 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*
Instance3796.1	15.768	4.986	178.791	86.676	67643.998	37059.482	5.889	1.986	1.448	70.479	232555.019	5026.608
Instance3796.2	14.682	3.761	179.487	86.844	68360.231	37089.739	2.493	1.309	1.477	71.691	232074.159	5039.577
Instance3796.3	15.177	4.225	179.825	87.783	66748.379	37046.779	6.115	1.893	1.475	71.518	232560.287	5036.485
Instance3796.4	14.684	2.903	179.136	86.495	68505.495	37035.899	2.475	1.287	1.445	71.142	232563.399	4963.765
Instance3796.5	15.147	3.157	177.502	86.147	67257.772	37043.639	9.840	1.823	1.445	70.132	232492.621	5035.133

Host System Performance

Counter	*Average*	*Minimum*	*Maximum*
% Processor Time	1.235	0.000	4.231
Available MBytes	29413.190	29407.000	29531.000
Free System Page Table Entries	33555131.254	33555126.000	33555133.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	67037806.933	66834432.000	67170304.000
Pool Paged Bytes	96415547.733	96354304.000	96505856.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log1/19/2011 2:40:52 AM -- Jetstress testing begins ...
1/19/2011 2:40:52 AM -- Prepare testing begins ...
1/19/2011 2:40:57 AM -- Attaching databases ...
1/19/2011 2:40:57 AM -- Prepare testing ends.
1/19/2011 2:40:57 AM -- Dispatching transactions begins ...
1/19/2011 2:40:57 AM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
1/19/2011 2:40:57 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
1/19/2011 2:41:03 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
1/19/2011 2:41:03 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
1/19/2011 2:41:10 AM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
1/19/2011 2:41:10 AM -- Performance logging begins (interval: 15000 ms).
1/19/2011 2:41:10 AM -- Attaining prerequisites:
1/19/2011 2:42:25 AM -- \MS Exchange Database(JetstressWin)\Database Cache Size, Last: 1215693000.0 (lower bound: 1207960000.0, upper bound: none)
1/19/2011 4:42:25 AM -- Performance logging ends.
1/19/2011 7:29:31 PM -- JetInterop batch transaction stats: 404663, 406305, 406290, 404140 and 405255.
1/19/2011 7:29:32 PM -- Dispatching transactions ends.
1/19/2011 7:29:32 PM -- Shutting down databases ...
1/19/2011 7:29:43 PM -- Instance3796.1 (complete), Instance3796.2 (complete), Instance3796.3 (complete), Instance3796.4 (complete) and Instance3796.5 (complete)
1/19/2011 7:29:44 PM -- Performance logging begins (interval: 30000 ms).
1/19/2011 7:29:44 PM -- Verifying database checksums ...
1/20/2011 5:10:04 AM -- C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed), C:\dbluns\db4 (100% processed) and C:\dbluns\db5 (100% processed)
1/20/2011 5:10:04 AM -- Performance logging ends.
1/20/2011 5:10:04 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Performance Test\DBChecksum_2011_1_19_19_29_43.blg has 1160 samples.
1/20/2011 5:10:09 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Performance Test\DBChecksum_2011_1_19_19_29_43.html is saved.
1/20/2011 5:10:09 AM -- Verifying log checksums ...
1/20/2011 5:10:10 AM -- C:\logluns\log1 (11 log(s) processed), C:\logluns\log2 (13 log(s) processed), C:\logluns\log3 (12 log(s) processed), C:\logluns\log4 (12 log(s) processed) and C:\logluns\log5 (14 log(s) processed)
1/20/2011 5:10:10 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920

Users\Sun158\Performance Test\Performance_2011_1_19_2_41_3.blg has 484 samples.
1/20/2011 5:10:10 AM -- Creating test report ...
1/20/2011 5:10:13 AM -- Instance3796.1 has 15.8 for I/O Database Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.1 has 2.0 for I/O Log Writes Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.1 has 2.0 for I/O Log Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.2 has 14.7 for I/O Database Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.2 has 1.3 for I/O Log Writes Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.2 has 1.3 for I/O Log Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.3 has 15.2 for I/O Database Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.3 has 1.9 for I/O Log Writes Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.3 has 1.9 for I/O Log Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.4 has 14.7 for I/O Database Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.4 has 1.3 for I/O Log Writes Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.4 has 1.3 for I/O Log Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.5 has 15.1 for I/O Database Reads Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.5 has 1.8 for I/O Log Writes Average Latency.
1/20/2011 5:10:13 AM -- Instance3796.5 has 1.8 for I/O Log Reads Average Latency.
1/20/2011 5:10:13 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
1/20/2011 5:10:13 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
1/20/2011 5:10:13 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Performance Test\Performance_2011_1_19_2_41_3.xml has 479 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	55750258	0	0	0	1742195 MBytes / 34717 sec
C:\dbluns\db2\Jetstress002001.edb	55751794	0	0	0	1742243 MBytes / 28720 sec
C:\dbluns\db3\Jetstress003001.edb	55751538	0	0	0	1742235 MBytes / 34753 sec
C:\dbluns\db4\Jetstress004001.edb	55750514	0	0	0	1742203 MBytes / 28601 sec
C:\dbluns\db5\Jetstress005001.edb	55750770	0	0	0	1742211 MBytes / 34819 sec
(Sum)	278754874	0	0	0	8711089 MBytes / 34819 sec

Disk Subsystem Performance (of checksum)

Logical Disk	*Avg. Disk sec/Read*	*Avg. Disk sec/Write*	*Disk Reads/sec*	*Disk Writes/sec*	*Avg. Disk Bytes/Read*
C:\dbluns\db1	0.068	0.000	802.279	0.000	65536.000
C:\dbluns\db2	0.058	0.000	970.035	0.000	65536.000
C:\dbluns\db3	0.068	0.000	800.314	0.000	65536.000
C:\dbluns\db4	0.057	0.000	974.738	0.000	65536.000
C:\dbluns\db5	0.067	0.000	800.408	0.000	65536.000

Memory System Performance (of checksum)

Counter	*Average*	*Minimum*	*Maximum*
% Processor Time	1.569	0.000	4.707
Available MBytes	30757.096	30689.000	30783.000
Free System Page Table Entries	33555308.388	33555129.000	33555645.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	67633865.269	67276800.000	67923968.000
Pool Paged Bytes	99009345.324	97103872.000	126824448.000

Test Log1/19/2011 2:40:52 AM -- Jetstress testing begins ...
1/19/2011 2:40:52 AM -- Prepare testing begins ...
1/19/2011 2:40:57 AM -- Attaching databases ...
1/19/2011 2:40:57 AM -- Prepare testing ends.
1/19/2011 2:40:57 AM -- Dispatching transactions begins ...
1/19/2011 2:40:57 AM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
1/19/2011 2:40:57 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
1/19/2011 2:41:03 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
1/19/2011 2:41:03 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
1/19/2011 2:41:10 AM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
1/19/2011 2:41:10 AM -- Performance logging begins (interval: 15000 ms).
1/19/2011 2:41:10 AM -- Attaining prerequisites:
1/19/2011 2:42:25 AM -- \MS Exchange Database(JetstressWin)\Database Cache Size, Last: 1215693000.0 (lower bound: 1207960000.0, upper bound: none)
1/19/2011 4:42:25 AM -- Performance logging ends.
1/19/2011 7:29:31 PM -- JetInterop batch transaction stats: 404663, 406305, 406290, 404140 and 405255.
1/19/2011 7:29:32 PM -- Dispatching transactions ends.
1/19/2011 7:29:32 PM -- Shutting down databases ...
1/19/2011 7:29:43 PM -- Instance3796.1 (complete), Instance3796.2 (complete), Instance3796.3 (complete), Instance3796.4 (complete) and Instance3796.5 (complete)
1/19/2011 7:29:44 PM -- Performance logging begins (interval: 30000 ms).
1/19/2011 7:29:44 PM -- Verifying database checksums ...
1/20/2011 5:10:04 AM -- C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed), C:\dbluns\db4 (100% processed) and C:\dbluns\db5 (100% processed)
1/20/2011 5:10:04 AM -- Performance logging ends.
1/20/2011 5:10:04 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Performance Test\DBChecksum_2011_1_19_19_29_43.blg has 1160 samples.

Stress Test Result Report: SUN158

Test Summary

Overall Test Result	Pass
Machine Name	SUN158
Test Description	
Test Start Time	1/20/2011 8:31:31 PM
Test End Time	1/23/2011 7:37:51 PM
Collection Start Time	1/20/2011 8:33:09 PM
Collection End Time	1/21/2011 8:33:01 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 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Stress Test\Stress_2011_1_20_20_31_42.blg C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Stress Test\DBChecksum_2011_1_23_19_37_51.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1196.617
Target Transactional I/O per Second	1017.6
Initial Database Size (bytes)	9134239711232
Final Database Size (bytes)	9254624624640
Database Files (Count)	5

Jetstress System Parameters

Thread Count	10 (per database)
Minimum Database Cache	160.0 MB
Maximum Database Cache	1280.0 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

Instance3796.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance3796.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance3796.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance3796.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
Instance3796.5	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

MS Exchange 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*
Instance3796.1	16.261	5.172	151.193	88.517	33665.945	35003.317	0.000	1.993	0.000	67.004	0.000	5017.871
Instance3796.2	14.359	3.806	151.020	88.459	33948.339	34992.597	0.000	1.266	0.000	67.830	0.000	4951.757
Instance3796.3	14.957	4.440	150.777	88.286	33799.209	35001.766	0.000	1.928	0.000	66.845	0.000	5022.181
Instance3796.4	14.356	2.886	150.694	88.301	33967.882	34999.840	0.000	1.267	0.000	67.760	0.000	4952.643
Instance3796.5	14.931	3.323	150.977	88.392	33783.035	34998.281	0.000	1.906	0.000	66.869	0.000	5020.502

Background Database Maintenance I/O Performance

MS Exchange Database ==> Instances	*Database Maintenance IO Reads/sec*	*Database Maintenance IO Reads Average Bytes*
Instance3796.1	26.539	261922.550
Instance3796.2	28.255	261910.148
Instance3796.3	26.883	261918.884
Instance3796.4	28.293	261920.963
Instance3796.5	26.994	261913.545

Log Replication I/O Performance

MS Exchange Database ==> Instances	*I/O Log Reads/sec*	*I/O Log Reads Average Bytes*
Instance3796.1	1.373	232433.752
Instance3796.2	1.372	232520.500
Instance3796.3	1.372	232425.599
Instance3796.4	1.372	232525.678
Instance3796.5	1.372	232473.947

Total I/O Performance

MS Exchange 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*
Instance3796.1	16.261	5.172	177.731	88.517	67748.824	35003.317	8.505	1.993	1.373	67.004	232433.752	5017.871
Instance3796.2	14.359	3.806	179.276	88.459	69877.039	34992.597	2.202	1.266	1.372	67.830	232520.500	4951.757
Instance3796.3	14.957	4.440	177.661	88.286	68318.018	35001.766	7.697	1.928	1.372	66.845	232425.599	5022.181
Instance3796.4	14.356	2.886	178.987	88.301	70001.117	34999.840	2.258	1.267	1.372	67.760	232525.678	4952.643
Instance3796.5	14.931	3.323	177.971	88.392	68384.772	34998.281	7.827	1.906	1.372	66.869	232473.947	5020.502

Host System Performance

Counter	*Average*	*Minimum*	*Maximum*
% Processor Time	1.445	0.000	5.951
Available MBytes	29361.849	29347.000	29404.000
Free System Page Table Entries	33555131.386	33555123.000	33555133.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	68733403.409	68206592.000	68927488.000
Pool Paged Bytes	106318708.226	105361408.000	109240320.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log1/20/2011 8:31:31 PM -- Jetstress testing begins ...
1/20/2011 8:31:31 PM -- Prepare testing begins ...
1/20/2011 8:31:36 PM -- Attaching databases ...
1/20/2011 8:31:36 PM -- Prepare testing ends.
1/20/2011 8:31:36 PM -- Dispatching transactions begins ...
1/20/2011 8:31:36 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
1/20/2011 8:31:36 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
1/20/2011 8:31:42 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
1/20/2011 8:31:42 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
1/20/2011 8:31:49 PM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
1/20/2011 8:31:49 PM -- Performance logging begins (interval: 15000 ms).
1/20/2011 8:31:49 PM -- Attaining prerequisites:
1/20/2011 8:33:09 PM -- \MS Exchange Database(JetstressWin)\Database Cache Size, Last: 1216668000.0 (lower bound: 1207960000.0, upper bound: none)
1/21/2011 8:33:10 PM -- Performance logging ends.
1/23/2011 7:37:36 PM -- JetInterop batch transaction stats: 1702704, 1701516, 1704615, 1701798 and 1703489.
1/23/2011 7:37:38 PM -- Dispatching transactions ends.
1/23/2011 7:37:38 PM -- Shutting down databases ...
1/23/2011 7:37:51 PM -- Instance3796.1 (complete), Instance3796.2 (complete), Instance3796.3 (complete), Instance3796.4 (complete) and Instance3796.5 (complete)
1/23/2011 7:37:52 PM -- Performance logging begins (interval: 30000 ms).
1/23/2011 7:37:52 PM -- Verifying database checksums ...
1/24/2011 5:26:43 AM -- C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed), C:\dbluns\db4 (100% processed) and C:\dbluns\db5 (100% processed)
1/24/2011 5:26:43 AM -- Performance logging ends.
1/24/2011 5:26:43 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Stress Test\DBChecksum_2011_1_23_19_37_51.blg has 1177 samples.
1/24/2011 5:26:47 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Stress Test\DBChecksum_2011_1_23_19_37_51.html is saved.
1/24/2011 5:26:47 AM -- Verifying log checksums ...
1/24/2011 5:26:47 AM -- C:\logluns\log1 (11 log(s) processed), C:\logluns\log2 (13 log(s) processed), C:\logluns\log3 (12 log(s) processed), C:\logluns\log4 (13 log(s) processed) and C:\logluns\log5 (11 log(s) processed)
1/24/2011 5:26:47 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920

Users\Sun158\Stress Test\Stress_2011_1_20_20_31_42.blg has 5756 samples.
1/24/2011 5:26:47 AM -- Creating test report ...
1/24/2011 5:27:19 AM -- Instance3796.1 has 16.3 for I/O Database Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.1 has 2.0 for I/O Log Writes Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.1 has 2.0 for I/O Log Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.2 has 14.4 for I/O Database Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.2 has 1.3 for I/O Log Writes Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.2 has 1.3 for I/O Log Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.3 has 15.0 for I/O Database Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.3 has 1.9 for I/O Log Writes Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.3 has 1.9 for I/O Log Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.4 has 14.4 for I/O Database Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.4 has 1.3 for I/O Log Writes Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.4 has 1.3 for I/O Log Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.5 has 14.9 for I/O Database Reads Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.5 has 1.9 for I/O Log Writes Average Latency.
1/24/2011 5:27:19 AM -- Instance3796.5 has 1.9 for I/O Log Reads Average Latency.
1/24/2011 5:27:19 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
1/24/2011 5:27:19 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
1/24/2011 5:27:19 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Stress Test\Stress_2011_1_20_20_31_42.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	56484722	0	0	0	1765147 MBytes / 35248 sec
C:\dbluns\db2\Jetstress002001.edb	56486770	0	0	0	1765211 MBytes / 28858 sec
C:\dbluns\db3\Jetstress003001.edb	56487026	0	0	0	1765219 MBytes / 35268 sec
C:\dbluns\db4\Jetstress004001.edb	56484722	0	0	0	1765147 MBytes / 28816 sec
C:\dbluns\db5\Jetstress005001.edb	56485490	0	0	0	1765171 MBytes / 35330 sec
(Sum)	282428730	0	0	0	8825897 MBytes / 35330 sec

Disk Subsystem Performance (of checksum)

Logical Disk	*Avg. Disk sec/Read*	*Avg. Disk sec/Write*	*Disk Reads/sec*	*Disk Writes/sec*	*Avg. Disk Bytes/Read*
C:\dbluns\db1	0.068	0.000	800.729	0.000	65536.000
C:\dbluns\db2	0.057	0.000	978.544	0.000	65536.000
C:\dbluns\db3	0.068	0.000	800.883	0.000	65536.000
C:\dbluns\db4	0.057	0.000	980.213	0.000	65536.000
C:\dbluns\db5	0.067	0.000	799.110	0.000	65536.000

Memory System Performance (of checksum)

Counter	*Average*	*Minimum*	*Maximum*
% Processor Time	1.594	0.000	5.311
Available MBytes	30723.969	30702.000	30737.000
Free System Page Table Entries	33555636.907	33555131.000	33555643.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	68770841.230	68743168.000	68931584.000
Pool Paged Bytes	106826895.551	105951232.000	108433408.000

Test Log1/20/2011 8:31:31 PM -- Jetstress testing begins ...
1/20/2011 8:31:31 PM -- Prepare testing begins ...
1/20/2011 8:31:36 PM -- Attaching databases ...
1/20/2011 8:31:36 PM -- Prepare testing ends.
1/20/2011 8:31:36 PM -- Dispatching transactions begins ...
1/20/2011 8:31:36 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
1/20/2011 8:31:36 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
1/20/2011 8:31:42 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
1/20/2011 8:31:42 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
1/20/2011 8:31:49 PM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
1/20/2011 8:31:49 PM -- Performance logging begins (interval: 15000 ms).
1/20/2011 8:31:49 PM -- Attaining prerequisites:
1/20/2011 8:33:09 PM -- \MS Exchange Database(JetstressWin)\Database Cache Size, Last: 1216668000.0 (lower bound: 1207960000.0, upper bound: none)
1/21/2011 8:33:10 PM -- Performance logging ends.
1/23/2011 7:37:36 PM -- JetInterop batch transaction stats: 1702704, 1701516, 1704615, 1701798 and 1703489.
1/23/2011 7:37:38 PM -- Dispatching transactions ends.
1/23/2011 7:37:38 PM -- Shutting down databases ...
1/23/2011 7:37:51 PM -- Instance3796.1 (complete), Instance3796.2 (complete), Instance3796.3 (complete), Instance3796.4 (complete) and Instance3796.5 (complete)
1/23/2011 7:37:52 PM -- Performance logging begins (interval: 30000 ms).
1/23/2011 7:37:52 PM -- Verifying database checksums ...
1/24/2011 5:26:43 AM -- C:\dbluns\db1 (100% processed), C:\dbluns\db2 (100% processed), C:\dbluns\db3 (100% processed), C:\dbluns\db4 (100% processed) and C:\dbluns\db5 (100% processed)
1/24/2011 5:26:43 AM -- Performance logging ends.
1/24/2011 5:26:43 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Stress Test\DBChecksum_2011_1_23_19_37_51.blg has 1177 samples.

Backup Test Result Report: SUN 158

Database Backup Statistics - All

Database Instance	*Database Size (MBytes)*	*Elapsed Backup Time*	*MBytes Transferred/sec*
Instance3060.1	1765139.59	08:39:40	56.61
Instance3060.2	1765203.59	08:55:16	54.96
Instance3060.3	1765211.59	09:01:24	54.34
Instance3060.4	1765139.59	08:51:51	55.31
Instance3060.5	1765163.59	09:01:40	54.31

Jetstress System Parameters

Thread Count	10 (per database)
Minimum Database Cache	160.0 MB
Maximum Database Cache	1280.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance3060.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance3060.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance3060.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance3060.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
Instance3060.5	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

MS Exchange 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*
Instance3060.1	6.471	0.000	226.389	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3060.2	6.659	0.000	219.815	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3060.3	6.893	0.000	217.210	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3060.4	6.622	0.000	221.241	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3060.5	6.930	0.000	216.743	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Host System Performance

Counter	*Average*	*Minimum*	*Maximum*
% Processor Time	0.958	0.000	3.940
Available MBytes	30910.570	30800.000	30923.000
Free System Page Table Entries	33555131.074	33555131.000	33555133.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	63359842.898	62701568.000	63737856.000
Pool Paged Bytes	95618125.604	88883200.000	122028032.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log1/24/2011 8:36:38 PM -- Jetstress testing begins ...
1/24/2011 8:36:38 PM -- Prepare testing begins ...
1/24/2011 8:36:44 PM -- Attaching databases ...
1/24/2011 8:36:44 PM -- Prepare testing ends.
1/24/2011 8:36:53 PM -- Performance logging begins (interval: 30000 ms).
1/24/2011 8:36:53 PM -- Backing up databases ...
1/25/2011 5:38:34 AM -- Performance logging ends.
1/25/2011 5:38:34 AM -- Instance3060.1 (100% processed), Instance3060.2 (100% processed), Instance3060.3 (100% processed), Instance3060.4 (100% processed) and Instance3060.5 (100% processed)
1/25/2011 5:38:34 AM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Backup Test\DatabaseBackup_2011_1_24_20_36_44.blg has 1082 samples.
1/25/2011 5:38:34 AM -- Creating test report ...

Soft Recovery Test Result Report: SUN158

Soft-Recovery Statistics - All

Database Instance	*Log files replayed*	*Elapsed seconds*
Instance3060.1	502	546.0477591
Instance3060.2	500	526.6881251
Instance3060.3	502	532.5225353
Instance3060.4	504	524.3013209
Instance3060.5	501	530.666132

Database Configuration

Instance3060.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance3060.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance3060.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance3060.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
Instance3060.5	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

MS Exchange 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*
Instance3060.1	22.912	15.193	1185.094	5.514	35538.575	32768.000	4.283	0.000	8.280	0.000	232672.722	0.000
Instance3060.2	22.649	15.495	1248.432	5.724	35317.076	32768.000	3.653	0.000	8.598	0.000	232513.677	0.000
Instance3060.3	22.931	15.929	1247.189	5.669	35416.305	32768.000	4.027	0.000	8.507	0.000	232532.440	0.000
Instance3060.4	23.110	16.380	1258.005	5.788	35424.128	32768.000	3.715	0.000	8.682	0.000	232608.851	0.000
Instance3060.5	22.821	14.503	1226.199	5.677	35407.278	32768.000	4.120	0.000	8.515	0.000	232554.542	0.000

Background Database Maintenance I/O Performance

MS Exchange Database ==> Instances	*Database Maintenance IO Reads/sec*	*Database Maintenance IO Reads Average Bytes*
Instance3060.1	27.754	261962.504
Instance3060.2	27.382	261979.830
Instance3060.3	27.268	261984.602
Instance3060.4	27.372	261946.270
Instance3060.5	27.343	261960.190

Total I/O Performance

MS Exchange 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*
Instance3060.1	22.912	15.193	1212.847	5.514	40719.840	32768.000	4.283	0.000	8.280	0.000	232672.722	0.000
Instance3060.2	22.649	15.495	1275.815	5.724	40181.847	32768.000	3.653	0.000	8.598	0.000	232513.677	0.000
Instance3060.3	22.931	15.929	1274.457	5.669	40263.982	32768.000	4.027	0.000	8.507	0.000	232532.440	0.000
Instance3060.4	23.110	16.380	1285.377	5.788	40247.918	32768.000	3.715	0.000	8.682	0.000	232608.851	0.000
Instance3060.5	22.821	14.503	1253.542	5.677	40348.929	32768.000	4.120	0.000	8.515	0.000	232554.542	0.000

Host System Performance

Counter	*Average*	*Minimum*	*Maximum*
% Processor Time	2.689	0.000	7.709
Available MBytes	29515.154	29487.000	30679.000
Free System Page Table Entries	33555132.993	33555132.000	33555133.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	74025321.412	67346432.000	74551296.000
Pool Paged Bytes	101280075.294	101236736.000	101318656.000
Database Page Fault Stalls/sec	0.015	0.000	0.748

Test Log1/26/2011 8:10:34 PM -- Jetstress testing begins ...
1/26/2011 8:10:34 PM -- Prepare testing begins ...
1/26/2011 8:10:39 PM -- Attaching databases ...
1/26/2011 8:10:39 PM -- Prepare testing ends.
1/26/2011 8:10:39 PM -- Dispatching transactions begins ...
1/26/2011 8:10:39 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
1/26/2011 8:10:39 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
1/26/2011 8:10:45 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
1/26/2011 8:10:45 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
1/26/2011 8:10:50 PM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
1/26/2011 8:10:50 PM -- Performance logging begins (interval: 15000 ms).
1/26/2011 8:10:50 PM -- Generating log files ...
1/26/2011 9:01:07 PM -- C:\logluns\log1 (100.4% generated), C:\logluns\log2 (100.2% generated), C:\logluns\log3 (100.6% generated), C:\logluns\log4 (101.0% generated) and C:\logluns\log5 (100.4% generated)
1/26/2011 9:01:07 PM -- Performance logging ends.
1/26/2011 9:01:07 PM -- JetInterop batch transaction stats: 22060, 21797, 22072, 21874 and 21914.
1/26/2011 9:01:07 PM -- Dispatching transactions ends.
1/26/2011 9:01:07 PM -- Shutting down databases ...
1/26/2011 9:01:09 PM -- Instance3060.1 (complete), Instance3060.2 (complete), Instance3060.3 (complete), Instance3060.4 (complete) and Instance3060.5 (complete)
1/26/2011 9:01:09 PM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Soft Recovery\Performance_2011_1_26_20_10_45.blg has 201 samples.
1/26/2011 9:01:09 PM -- Creating test report ...
1/26/2011 9:01:09 PM -- Instance3060.1 has 16.5 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.1 has 1.7 for I/O Log Writes Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.1 has 1.7 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.2 has 15.1 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.2 has 1.3 for I/O Log Writes Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.2 has 1.3 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.3 has 15.0 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.3 has 1.7 for I/O Log Writes Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.3 has 1.7 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.4 has 15.1 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.4 has 1.3 for I/O Log Writes Average Latency.

1/26/2011 9:01:09 PM -- Instance3060.4 has 1.3 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.5 has 15.0 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.5 has 1.7 for I/O Log Writes Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.5 has 1.7 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
1/26/2011 9:01:09 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
1/26/2011 9:01:10 PM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Soft Recovery\Performance_2011_1_26_20_10_45.xml has 200 samples queried.
1/26/2011 9:01:10 PM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Soft Recovery\Performance_2011_1_26_20_10_45.html is saved.
1/26/2011 9:04:35 PM -- Performance logging begins (interval: 4000 ms).
1/26/2011 9:04:35 PM -- Recovering databases ...
1/26/2011 9:13:41 PM -- Performance logging ends.
1/26/2011 9:13:41 PM -- Instance3060.1 (546.0477591), Instance3060.2 (526.6881251), Instance3060.3 (532.5225353), Instance3060.4 (524.3013209) and Instance3060.5 (530.666132)
1/26/2011 9:13:42 PM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Soft Recovery\SoftRecovery_2011_1_26_21_4_31.blg has 136 samples.
1/26/2011 9:13:42 PM -- Creating test report ...

Soft Recovery Test Performance Result: SUN158

Test Summary

Overall Test Result	Pass
Machine Name	SUN158
Test Description	
Test Start Time	1/26/2011 8:10:34 PM
Test End Time	1/26/2011 9:01:09 PM
Collection Start Time	1/26/2011 8:11:05 PM
Collection End Time	1/26/2011 9:01:07 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 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Soft Recovery\Performance_2011_1_26_20_10_45.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1309.377
Capacity Percentage	100%
Throughput Percentage	100%
Initial Database Size (bytes)	9254624624640
Final Database Size (bytes)	9256201682944
Database Files (Count)	5

Jetstress System Parameters

Thread Count	10 (per database)
Minimum Database Cache	160.0 MB
Maximum Database Cache	1280.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance3060.1	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
Instance3060.2	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
Instance3060.3	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
Instance3060.4	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
Instance3060.5	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

MS Exchange 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*
Instance3060.1	16.530	6.468	166.244	96.613	32768.866	34885.961	0.000	1.684	0.000	72.344	0.000	5040.489
Instance3060.2	15.081	5.164	164.778	95.668	32768.000	34922.413	0.000	1.315	0.000	72.314	0.000	5027.633
Instance3060.3	15.017	5.385	166.046	96.552	32768.000	34884.796	0.000	1.693	0.000	71.819	0.000	5078.981
Instance3060.4	15.108	3.782	165.113	95.963	32768.000	34892.041	0.000	1.335	0.000	73.231	0.000	5002.489
Instance3060.5	15.028	3.696	166.012	96.388	32768.102	34903.410	0.000	1.668	0.000	71.940	0.000	5050.167

Host System Performance

Counter	*Average*	*Minimum*	*Maximum*
% Processor Time	1.398	0.000	3.034
Available MBytes	29521.910	29502.000	30442.000
Free System Page Table Entries	33555132.104	33555131.000	33555133.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	65716387.025	64221184.000	65929216.000
Pool Paged Bytes	98978087.483	98275328.000	102412288.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log1/26/2011 8:10:34 PM -- Jetstress testing begins ...
1/26/2011 8:10:34 PM -- Prepare testing begins ...
1/26/2011 8:10:39 PM -- Attaching databases ...
1/26/2011 8:10:39 PM -- Prepare testing ends.
1/26/2011 8:10:39 PM -- Dispatching transactions begins ...
1/26/2011 8:10:39 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
1/26/2011 8:10:39 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
1/26/2011 8:10:45 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
1/26/2011 8:10:45 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
1/26/2011 8:10:50 PM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
1/26/2011 8:10:50 PM -- Performance logging begins (interval: 15000 ms).
1/26/2011 8:10:50 PM -- Generating log files ...
1/26/2011 9:01:07 PM -- C:\logluns\log1 (100.4% generated), C:\logluns\log2 (100.2% generated), C:\logluns\log3 (100.6% generated), C:\logluns\log4 (101.0% generated) and C:\logluns\log5 (100.4% generated)
1/26/2011 9:01:07 PM -- Performance logging ends.
1/26/2011 9:01:07 PM -- JetInterop batch transaction stats: 22060, 21797, 22072, 21874 and 21914.
1/26/2011 9:01:07 PM -- Dispatching transactions ends.
1/26/2011 9:01:07 PM -- Shutting down databases ...
1/26/2011 9:01:09 PM -- Instance3060.1 (complete), Instance3060.2 (complete), Instance3060.3 (complete), Instance3060.4 (complete) and Instance3060.5 (complete)
1/26/2011 9:01:09 PM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Soft Recovery\Performance_2011_1_26_20_10_45.blg has 201 samples.
1/26/2011 9:01:09 PM -- Creating test report ...
1/26/2011 9:01:09 PM -- Instance3060.1 has 16.5 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.1 has 1.7 for I/O Log Writes Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.1 has 1.7 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.2 has 15.1 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.2 has 1.3 for I/O Log Writes Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.2 has 1.3 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.3 has 15.0 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.3 has 1.7 for I/O Log Writes Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.3 has 1.7 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.4 has 15.1 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.4 has 1.3 for I/O Log Writes Average Latency.

1/26/2011 9:01:09 PM -- Instance3060.4 has 1.3 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.5 has 15.0 for I/O Database Reads Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.5 has 1.7 for I/O Log Writes Average Latency.
1/26/2011 9:01:09 PM -- Instance3060.5 has 1.7 for I/O Log Reads Average Latency.
1/26/2011 9:01:09 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
1/26/2011 9:01:09 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
1/26/2011 9:01:10 PM -- C:\ESRP 3 AMS2100 Res R5 HDP 600GB SAS 1GB Mbox 33,920 Users\Sun158\Soft Recovery\Performance_2011_1_26_20_10_45.xml has 200 samples queried.

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