

Hitachi Adaptable Modular Storage 2300 Dynamically Provisioned 13,280 Mailbox Exchange 2010 Mailbox Resiliency Storage Solution

Tested with: ESRP – Storage Version 3.0

Test Date: February-March 2011

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Overview

This document provides information on a Hitachi Adaptable Modular Storage 2300 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 13,280 users and eight servers. This testing used a Hitachi Adaptable Modular Storage 2300 Revision 2 (AMS 2300) 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 2300.

Testing used eight 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 eight DAGs, each containing two database copies and two servers (one simulated). The test configuration was capable of supporting 13,280 users with a 0.18 IOPS per user profile and user mailbox size of 3GB.

An AMS 2300 with the following was used for these tests:

- 189 600GB 15k RPM SAS disks
- 16GB of cache
- Eight 8Gb/sec paths

Hitachi Adaptable Modular Storage 2300 is a high-performance, highly reliable midrange storage system that can scale to 240 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 2300 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 2300 to meet the needs of a large Exchange Server deployment.

This solution uses Hitachi Dynamic Provisioning, which is enabled on AMS 2300 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 2300 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 2300. 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 eight DAGs, with each DAG configured with two servers (one simulated) to host active mailboxes in five databases.

To target the 13,280-user resiliency solution, a Hitachi Adaptable Modular Storage 2300 (AMS 2300) was configured with 189 disks (of a maximum of 240). Eight servers (one per DAG) were used, with each server configured with 1,660 mailboxes. There were 40 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](#).

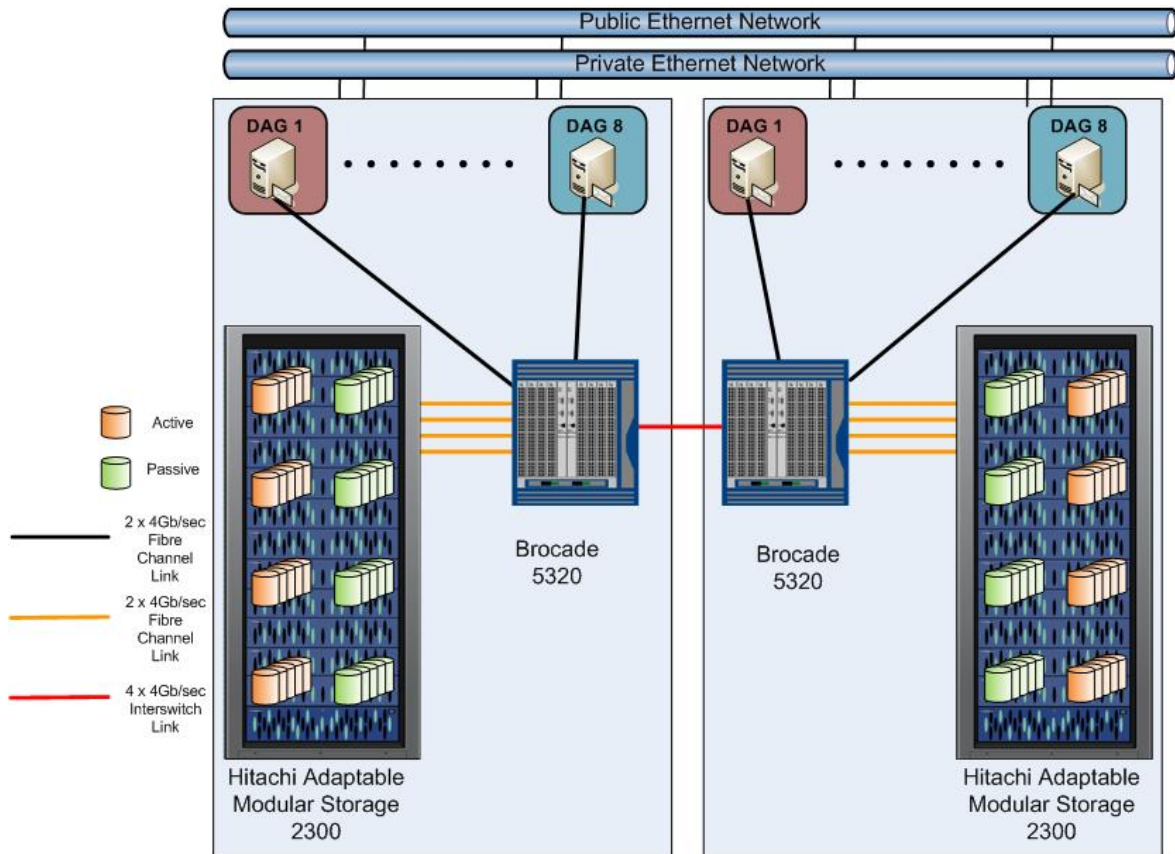


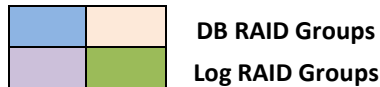
Figure 1

This solution enables organizations to consolidate Exchange Server 2010 DAG deployments on two AMS 2300 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 2300 were organized into RAID groups for use by the databases or logs. Each set of colored disks represents a RAID group. There were 189 disks used in these tests configured as 21 RAID groups (using RAID-5 8D+1P) for the Exchange databases and logs.

Table1. Adaptable Modular Storage 2300 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	20	20	20	20	20	20	20	20	20	21	21	21	21	21	21	21	21	21	S
RKA 9	17	18	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19	19
RKA 8	15	15	16	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17	17
RKA 7	13	13	13	14	14	14	14	14	14	14	14	14	15	15	15	15	15	15	15
RKA 6	11	11	11	11	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13
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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Disk tray RKA-0 was the internal 15-disk tray that wasn't used during these tests. Trays RKA-1 through tray RKA-10 each held 19 600GB 15K SAS disks. Tray RKA-10 had one disk used as a spare. There were actually five dense trays, but each is accessed as two separate trays, so trays 1 and 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 18 RAID-5 (8D+1P) RAID groups and the log pool was created from three RAID-5 (8D+1P) RAID groups. From the database pool, 40 DP-VOLs (each specified to have a 1,850GB size limit) were created for 40 databases (5 per server). From the log pool, 40 DP-VOLs (each specified to have a size limit of 185GB) were created for 40 logs (5 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.

Table 2. Adaptable Modular Storage 2300 Port to Server Layout

Server	Primary path	Secondary path
SUN170	0A	1A
SUN163	0B	1B
SUN164	0C	1C
SUN165	0D	1D
SUN166	1A	0A
SUN167	1B	0B
SUN171	1C	0C
SUN169	1D	0D

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.

Table 3. Adaptable Modular Storage 2300 Port to Database DP-VOL Layout

<i>Port</i>	<i>Database</i>	<i>DB DP-VOL</i>
0A	Database 1-5	0-4
0B	Database 6-10	5-9
0C	Database 11-15	10-14
0D	Database 16-20	15-19
1A	Database 21-25	20-24
1B	Database 26-30	25-29
1C	Database 31-35	30-34
1D	Database 36-40	35-39

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 2300 Port to Log DP-VOL Layout

<i>Port</i>	<i>Log</i>	<i>Log DP-VOL</i>
0A	Log 1-5	40-44
0B	Log 6-10	45-49
0C	Log 11-15	50-54
0D	Log 16-20	55-59
1A	Log 21-25	60-64
1B	Log 26-30	65-69
1C	Log 31-35	70-74
1D	Log 36-40	75-79

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.

Table 5. Adaptable Modular Storage 2300 Configuration Details

<i>Host</i>	<i>Pool</i>	<i>Port</i>	<i>DP-VOLs</i>	<i>Size (GB)</i>	<i>RAID Level</i>	<i>Description</i>
SUN170	0	0A/1A	0-4	1850	RAID-5	Database 1-5
SUN163	0	0B/1B	5-9	1850	RAID-5	Database 6-10
SUN164	0	0C/1C	10-14	1850	RAID-5	Database 11-15
SUN165	0	0D/1D	15-19	1850	RAID-5	Database 16-20
SUN166	0	1A/0A	20-24	1850	RAID-5	Database 21-25
SUN167	0	1B/0B	25-29	1850	RAID-5	Database 26-30

<i>Host</i>	<i>Pool</i>	<i>Port</i>	<i>DP-VOLs</i>	<i>Size (GB)</i>	<i>RAID Level</i>	<i>Description</i>
SUN171	0	1C/0C	30-34	1850	RAID-5	Database 31-35
SUN169	0	1D/0D	35-39	1850	RAID-5	Database 36-40
SUN170	1	0A/1A	40-44	185	RAID-5	Log 1-5
SUN163	1	0B/1B	45-49	185	RAID-5	Log 6-10
SUN164	1	0C/1C	50-54	185	RAID-5	Log 11-15
SUN165	1	0D/1D	55-59	185	RAID-5	Log 16-20
SUN166	1	1A/0A	60-64	185	RAID-5	Log 21-25
SUN167	1	1B/0B	65-69	185	RAID-5	Log 26-30
SUN171	1	1C/0C	70-74	185	RAID-5	Log 31-35
SUN169	1	1D/0D	75-79	185	RAID-5	Log 36-40

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 13,280 Exchange users with the following specifications:

- 16 Exchange servers (eight servers tested, eight servers simulated for the database copies)
- 8 Database Availability Groups each with two servers (one simulated) and two copies per database
- 2 Adaptable Modular Storage 2300s (one tested, using 8 8Gb/sec paths operated at 4Gbps)
- 0.15 IOPS per user (0.18 tested for 20 percent growth)
- 3GB mailbox size
- Mailbox resiliency provides high-availability and used as primary data protection mechanism.
- Adaptable Modular Storage RAID protection against physical failure or loss.
- 24x7 background database maintenance enabled.

Test Deployment

The following tables summarize the testing environment.

Table 6. Simulated Exchange Configuration

<i>Number of Exchange mailboxes simulated</i>	13,280
<i>Number of database availability groups (DAGs)</i>	8
<i>Number of servers per DAG</i>	2 (1 simulated)
<i>Number of active mailboxes per server</i>	1,660
<i>Number of databases per host</i>	5
<i>Number of copies per database</i>	2
<i>Number of mailboxes per database</i>	332.0
<i>Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)</i>	0.18
<i>Database LU size</i>	1850GB
<i>Log LU size</i>	185GB
<i>Total database size for performance testing</i>	39,840GB
<i>% storage capacity used by Exchange database**</i>	52.2%

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

Table 7. Storage Hardware

<i>Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)</i>	Fibre Channel
<i>Storage model and OS/firmware revision</i>	1 Hitachi Adaptable Modular Storage 2300 Firmware: 0897/A-Y WHQL listing: Hitachi Adaptable Modular Storage 2300
<i>Storage cache</i>	16GB
<i>Number of storage controllers</i>	2
<i>Number of storage ports</i>	8
<i>Maximum bandwidth of storage connectivity to host</i>	32Gb/sec (8x 4Gb/sec ports)
<i>Switch type/model/firmware revision</i>	Brocade 5320, Fabric OS v6.4.0b
<i>HBA model and firmware</i>	Emulex LightPulse LPe 11002-S FW : 2.82A3
<i>Number of HBAs per host</i>	2 dual-ported HBA per host, 1 4Gb/sec port used per HBA
<i>Host server type</i>	Sun Fire 4270 2 2.54GHz quad-core Intel Xeon CPUs, 32GB memory
<i>Total number of disks tested in solution</i>	189
<i>Maximum number of spindles that can be hosted in the storage</i>	240

Table 8. Storage Software

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

Table 9. Storage Disk Configuration (Mailbox Store Disks)

<i>Disk type, speed and firmware revision</i>	SAS 600GB 15K 5C53
<i>Raw capacity per disk (GB)</i>	600GB
<i>Number of physical disks in test</i>	162 (dynamic provisioning pool)
<i>Total raw storage capacity (GB)</i>	97,200
<i>Disk slice size (GB)</i>	N/A
<i>Number of slices per LU or number of disks per LU</i>	N/A
<i>RAID level</i>	RAID-5(8D+1P) at storage level
<i>Total formatted capacity</i>	76,320GB
<i>Storage capacity utilization</i>	78.5%
<i>Database capacity utilization</i>	76.1%

Table 10. Storage Disk Configuration (Transaction Log Disks)

<i>Disk type, speed and firmware revision</i>	SAS 600GB 15K 5C53
<i>Raw capacity per disk (GB)</i>	600GB
<i>Number of spindles in test</i>	27 (dynamic provisioning pool)
<i>Total raw storage capacity (GB)</i>	16,200
<i>Disk slice size (GB)</i>	N/A
<i>Number of slices per LU or number of disks per LU</i>	N/A
<i>RAID level</i>	RAID-5 (8D+1P) at storage level
<i>Total formatted capacity</i>	12,720GB

Replication Configuration

Table 11. Replication Configuration

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

Table 12. Replicated Storage Hardware

<i>Storage connectivity (Fiber Channel, SAS, SATA, iSCSI)</i>	Fibre Channel
<i>Storage model and OS/firmware revision</i>	1 Hitachi Adaptable Modular Storage 2300 Firmware: 0897/A-Y WHQL listing: Hitachi Adaptable Modular Storage 2300
<i>Storage cache</i>	16GB
<i>Number of storage controllers</i>	2
<i>Number of storage ports</i>	8
<i>Maximum bandwidth of storage connectivity to host</i>	32Gb/sec (8 x 4Gb/sec ports)
<i>Switch type/model/firmware revision</i>	Brocade 5320, Fabric OS v6.4.0b
<i>HBA model and firmware</i>	Emulex LightPulse LPe 11002-S FW : 2.82A3
<i>Number of HBAs per host</i>	2 dual-ported HBA per host, 1 4Gb/sec port used per HBA
<i>Host server type</i>	Sun Fire 4270 2 2.54GHz quad-core Intel Xeon CPUs, 32GB memory
<i>Total number of disks tested in solution</i>	189
<i>Maximum number of spindles that can be hosted in the storage</i>	240

Table 13. Replicated Storage Software

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

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

<i>Disk type, speed and firmware revision</i>	SAS 600GB 15K 5C53
<i>Raw capacity per disk (GB)</i>	600GB
<i>Number of physical disks in test</i>	162 (dynamic provisioning pool)
<i>Total raw storage capacity (GB)</i>	97,200
<i>Disk slice size (GB)</i>	N/A
<i>Number of slices per LU or number of disks per LU</i>	N/A
<i>RAID level</i>	RAID-5(8D+1P) at storage level
<i>Total formatted capacity</i>	76,320GB
<i>Storage capacity utilization</i>	78.5%
<i>Database capacity utilization</i>	76.1%

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

<i>Disk type, speed and firmware revision</i>	SAS 600GB 15K 5C53
<i>Raw capacity per disk (GB)</i>	600GB
<i>Number of spindles in test</i>	27 (dynamic provisioning pool)
<i>Total raw storage capacity (GB)</i>	16,200
<i>Disk slice size (GB)</i>	N/A
<i>Number of slices per LU or number of disks per LU</i>	N/A
<i>Raid level</i>	RAID-5(8D+1P) at storage level
<i>Total formatted capacity</i>	12,720GB

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 2300 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 AMS 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 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 (SUN170)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	604
<i>Database Disk Reads Per Second</i>	373
<i>Database Disk Writes Per Second</i>	231
<i>Average Database Disk Read Latency (ms)</i>	10.9
<i>Average Database Disk Write Latency (ms)</i>	3.8
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	187
<i>Average Log Disk Write Latency (ms)</i>	1.5

Table 17. Individual Server Metrics for Exchange Server (SUN163)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	591
<i>Database Disk Reads Per Second</i>	365
<i>Database Disk Writes Per Second</i>	226
<i>Average Database Disk Read Latency (ms)</i>	10.9
<i>Average Database Disk Write Latency (ms)</i>	3.9
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	180
<i>Average Log Disk Write Latency (ms)</i>	1.8

Table 18. Individual Server Metrics for Exchange Server (SUN164)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	604
<i>Database Disk Reads Per Second</i>	373
<i>Database Disk Writes Per Second</i>	231
<i>Average Database Disk Read Latency (ms)</i>	10.9
<i>Average Database Disk Write Latency (ms)</i>	3.8
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	187
<i>Average Log Disk Write Latency (ms)</i>	1.5

Table 19. Individual Server Metrics for Exchange Server (SUN165)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	598
<i>Database Disk Reads Per Second</i>	370
<i>Database Disk Writes Per Second</i>	229
<i>Average Database Disk Read Latency (ms)</i>	10.8
<i>Average Database Disk Write Latency (ms)</i>	3.9
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	182
<i>Average Log Disk Write Latency (ms)</i>	1.9

Table 20. Individual Server Metrics for Exchange Server (SUN166)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	573
<i>Database Disk Reads Per Second</i>	354
<i>Database Disk Writes Per Second</i>	219
<i>Average Database Disk Read Latency (ms)</i>	11.1
<i>Average Database Disk Write Latency (ms)</i>	4.0
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	174
<i>Average Log Disk Write Latency (ms)</i>	1.9

Table 21. Individual Server Metrics for Exchange Server (SUN167)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	589
<i>Database Disk Reads Per Second</i>	364
<i>Database Disk Writes Per Second</i>	225
<i>Average Database Disk Read Latency (ms)</i>	10.8
<i>Average Database Disk Write Latency (ms)</i>	3.9
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	179
<i>Average Log Disk Write Latency (ms)</i>	1.9

Table 22. Individual Server Metrics for Exchange Server (SUN171)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	612
<i>Database Disk Reads Per Second</i>	378
<i>Database Disk Writes Per Second</i>	234
<i>Average Database Disk Read Latency (ms)</i>	10.7
<i>Average Database Disk Write Latency (ms)</i>	3.8
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	189
<i>Average Log Disk Write Latency (ms)</i>	1.5

Table 23. Individual Server Metrics for Exchange Server (SUN169)

<i>Database I/O</i>	
<i>Database Disk Transfers Per Second</i>	591
<i>Database Disk Reads Per Second</i>	366
<i>Database Disk Writes Per Second</i>	225
<i>Average Database Disk Read Latency (ms)</i>	10.8
<i>Average Database Disk Write Latency (ms)</i>	3.8
<i>Transaction Log I/O</i>	
<i>Log Disk Writes Per Second</i>	179
<i>Average Log Disk Write Latency (ms)</i>	1.9

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 24. Aggregate Performance for Exchange Server 2010

Database I/O	
Database Disk Transfers Per Second	4762.555
Database Disk Reads Per Second	2942.790
Database Disk Writes Per Second	1819.765
Average Database Disk Read Latency (ms)	10.859
Average Database Disk Write Latency (ms)	3.849
Transaction Log I/O	
Log Disk Writes Per Second	1456.643
Average Log Disk Write Latency (ms)	1.730

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 25. Database Read-only Performance

MB Read Per Second Per Database	35.25
MB Read Per Second Total Per Server	176.253

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 26. Transaction Log Recovery/Replay Performance

Average Time to Play One Log File (sec)	1.549006
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Conclusion

This document details a tested and robust Exchange Server 2010 Resiliency solution capable of supporting 13,280 users with a 0.18 IOPS per user profile and user mailbox size of 3GB using eight DAGs each configured with 2 server nodes (one simulated).

A Hitachi Adaptable Modular Storage 2300 (AMS 2300), with 16GB of cache and eight 8Gb/sec Fibre Channel host paths, using Hitachi Dynamic Provisioning (with two Pools) and 189 600GB 15K RPM SAS disks in a RAID-5 (8D+1P) configuration was used for these tests.

Testing confirmed that an AMS 2300 is more than capable of delivering the IOPS and capacity requirements needed to support the active and replicated databases for 13,280 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: SUN170

Test Summary

Overall Test Result	Pass
Machine Name	SUN170
Test Description	
Test Start Time	2/23/2011 10:16:11 PM
Test End Time	2/24/2011 2:43:53 AM
Collection Start Time	2/23/2011 10:18:57 PM
Collection End Time	2/24/2011 12:18:55 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 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Performance Test\Performance_2011_2_23_22_16_23.blg C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Performance Test\DBChecksum_2011_2_24_2_43_53.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	604.091
Target Transactional I/O per Second	298.8
Initial Database Size (bytes)	6629639389184
Final Database Size (bytes)	6633623977984
Database Files (Count)	5

Jetstress System Parameters

<i>Thread Count</i>	4 (per database)
<i>Minimum Database Cache</i>	160.0 MB
<i>Maximum Database Cache</i>	1280.0 MB
<i>Insert Operations</i>	40%
<i>Delete Operations</i>	20%
<i>Replace Operations</i>	5%
<i>Read Operations</i>	35%
<i>Lazy Commits</i>	70%
<i>Run Background Database Maintenance</i>	True
<i>Number of Copies per Database</i>	2

Database Configuration

<i>Instance2924.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance2924.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance2924.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance2924.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
<i>Instance2924.5</i>	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2924.1	11.102	4.460	74.064	45.750	34544.402	34959.236	0.000	1.493	0.000	37.136	0.000	4698.970
Instance2924.2	10.782	3.923	73.934	45.725	34558.150	34999.986	0.000	1.506	0.000	37.555	0.000	4696.006
Instance2924.3	10.873	3.905	75.126	46.610	34587.154	34956.010	0.000	1.519	0.000	37.546	0.000	4687.941
Instance2924.4	10.807	3.235	75.258	46.602	34699.681	34910.736	0.000	1.434	0.000	37.547	0.000	4677.604
Instance2924.5	10.906	3.250	74.774	46.249	34317.178	35002.896	0.000	1.551	0.000	37.446	0.000	4728.748

Background Database Maintenance I/O Performance

<i>MSExchange Database ==> Instances</i>	<i>Database Maintenance IO Reads/sec</i>	<i>Database Maintenance IO Reads Average Bytes</i>
Instance2924.1	27.802	261777.889
Instance2924.2	28.143	261353.308
Instance2924.3	28.010	261848.824
Instance2924.4	28.141	261770.307
Instance2924.5	27.985	261864.299

Log Replication I/O Performance

<i>MSExchange Database ==> Instances</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Reads Average Bytes</i>
Instance2924.1	0.709	224142.040
Instance2924.2	0.715	222365.959
Instance2924.3	0.714	225226.963
Instance2924.4	0.713	226735.595
Instance2924.5	0.718	226735.595

Total I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2924.1	11.102	4.460	101.866	45.750	96563.563	34959.236	2.719	1.493	0.709	37.136	224142.040	4698.970
Instance2924.2	10.782	3.923	102.077	45.725	97086.828	34999.986	4.034	1.506	0.715	37.555	222365.959	4696.006
Instance2924.3	10.873	3.905	103.136	46.610	96307.936	34956.010	3.548	1.519	0.714	37.546	225226.963	4687.941
Instance2924.4	10.807	3.235	103.400	46.602	96499.498	34910.736	2.984	1.434	0.713	37.547	226735.595	4677.604
Instance2924.5	10.906	3.250	102.759	46.249	96286.942	35002.896	2.638	1.551	0.718	37.446	226735.595	4728.748

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.760	0.000	3.718
Available MBytes	29549.319	29542.000	29664.000
Free System Page Table Entries	33555132.977	33555129.000	33555133.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	64697830.400	64688128.000	64757760.000
Pool Paged Bytes	92436625.067	92372992.000	92499968.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log2/23/2011 10:16:11 PM -- Jetstress testing begins ...

2/23/2011 10:16:11 PM -- Prepare testing begins ...

2/23/2011 10:16:17 PM -- Attaching databases ...

2/23/2011 10:16:17 PM -- Prepare testing ends.

2/23/2011 10:16:17 PM -- Dispatching transactions begins ...

2/23/2011 10:16:17 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)

2/23/2011 10:16:17 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)

2/23/2011 10:16:23 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

2/23/2011 10:16:23 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

2/23/2011 10:16:29 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

2/23/2011 10:16:29 PM -- Performance logging begins (interval: 15000 ms).

2/23/2011 10:16:29 PM -- Attaining prerequisites:

2/23/2011 10:18:57 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1211589000.0 (lower bound: 1207960000.0, upper bound: none)

2/24/2011 12:18:57 AM -- Performance logging ends.

2/24/2011 2:43:45 AM -- JetInterop batch transaction stats: 55675, 55609, 55890, 55793 and 55431.

2/24/2011 2:43:45 AM -- Dispatching transactions ends.

2/24/2011 2:43:45 AM -- Shutting down databases ...

2/24/2011 2:43:53 AM -- Instance2924.1 (complete), Instance2924.2 (complete), Instance2924.3 (complete), Instance2924.4 (complete) and Instance2924.5 (complete)

2/24/2011 2:43:54 AM -- Performance logging begins (interval: 30000 ms).

2/24/2011 2:43:54 AM -- Verifying database checksums ...

2/24/2011 3:10:39 PM -- C:\dblungs\db1 (100% processed), C:\dblungs\db2 (100% processed), C:\dblungs\db3 (100% processed), C:\dblungs\db4 (100% processed) and C:\dblungs\db5 (100% processed)

2/24/2011 3:10:39 PM -- Performance logging ends.

2/24/2011 3:10:39 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB

Mbox\Sun170\Performance Test\DBChecksum_2011_2_24_2_43_53.blg has 1492 samples.

2/24/2011 3:10:46 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB

Mbox\Sun170\Performance Test\DBChecksum_2011_2_24_2_43_53.html is saved.

2/24/2011 3:10:46 PM -- Verifying log checksums ...

2/24/2011 3:10:48 PM -- C:\logluns\log1 (7 log(s) processed), C:\logluns\log2 (8 log(s) processed), C:\logluns\log3 (7 log(s) processed), C:\logluns\log4 (8 log(s) processed) and C:\logluns\log5 (8 log(s) processed)

2/24/2011 3:10:48 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB
Mbox\Sun170\Performance Test\Performance_2011_2_23_22_16_23.blg has 489 samples.
2/24/2011 3:10:48 PM -- Creating test report ...
2/24/2011 3:10:52 PM -- Instance2924.1 has 11.1 for I/O Database Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.1 has 1.5 for I/O Log Writes Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.1 has 1.5 for I/O Log Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.2 has 10.8 for I/O Database Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.2 has 1.5 for I/O Log Writes Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.2 has 1.5 for I/O Log Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.3 has 10.9 for I/O Database Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.3 has 1.5 for I/O Log Writes Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.3 has 1.5 for I/O Log Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.4 has 10.8 for I/O Database Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.4 has 1.4 for I/O Log Writes Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.4 has 1.4 for I/O Log Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.5 has 10.9 for I/O Database Reads Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.5 has 1.6 for I/O Log Writes Average Latency.
2/24/2011 3:10:52 PM -- Instance2924.5 has 1.6 for I/O Log Reads Average Latency.
2/24/2011 3:10:52 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
2/24/2011 3:10:52 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
2/24/2011 3:10:52 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB
Mbox\Sun170\Performance Test\Performance_2011_2_23_22_16_23.xml has 479 samples queried.

Performance Test Database Checksums Result: SUN170

Checksum Statistics - All

<i>Database</i>	<i>Seen pages</i>	<i>Bad pages</i>	<i>Correctable pages</i>	<i>Wrong page-number pages</i>	<i>File length / seconds taken</i>
C:\dbluns\db1\Jetstress001001.edb	40489810	0	0	0	1265306 MBytes / 44525 sec
C:\dbluns\db2\Jetstress002001.edb	40489298	0	0	0	1265290 MBytes / 36145 sec
C:\dbluns\db3\Jetstress003001.edb	40488018	0	0	0	1265250 MBytes / 44697 sec
C:\dbluns\db4\Jetstress004001.edb	40488018	0	0	0	1265250 MBytes / 36221 sec
C:\dbluns\db5\Jetstress005001.edb	40486994	0	0	0	1265218 MBytes / 44804 sec
(Sum)	202442138	0	0	0	6326316 MBytes / 44804 sec

Disk Subsystem Performance (of checksum)

<i>LogicalDisk</i>	<i>Avg. Disk sec/Read</i>	<i>Avg. Disk sec/Write</i>	<i>Disk Reads/sec</i>	<i>Disk Writes/sec</i>	<i>Avg. Disk Bytes/Read</i>
C:\dbluns\db1	0.110	0.000	454.752	0.000	65536.000
C:\dbluns\db2	0.094	0.000	560.308	0.000	65536.000
C:\dbluns\db3	0.109	0.000	453.031	0.000	65536.000
C:\dbluns\db4	0.094	0.000	558.927	0.000	65536.000
C:\dbluns\db5	0.108	0.000	451.583	0.000	65536.000

Memory System Performance (of checksum)

<i>Counter</i>	<i>Average</i>	<i>Minimum</i>	<i>Maximum</i>
% Processor Time	0.885	0.000	3.797
Available MBytes	30896.981	30882.000	30909.000
Free System Page Table Entries	33555131.043	33555131.000	33555133.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	65199411.475	64987136.000	65474560.000
Pool Paged Bytes	93707258.509	92487680.000	98975744.000

Test Log2/23/2011 10:16:11 PM -- Jetstress testing begins ...

2/23/2011 10:16:11 PM -- Prepare testing begins ...

2/23/2011 10:16:17 PM -- Attaching databases ...

2/23/2011 10:16:17 PM -- Prepare testing ends.

2/23/2011 10:16:17 PM -- Dispatching transactions begins ...

2/23/2011 10:16:17 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)

2/23/2011 10:16:17 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)

2/23/2011 10:16:23 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

2/23/2011 10:16:23 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

2/23/2011 10:16:29 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

2/23/2011 10:16:29 PM -- Performance logging begins (interval: 15000 ms).

2/23/2011 10:16:29 PM -- Attaining prerequisites:

2/23/2011 10:18:57 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1211589000.0 (lower bound: 1207960000.0, upper bound: none)

2/24/2011 12:18:57 AM -- Performance logging ends.

2/24/2011 2:43:45 AM -- JetInterop batch transaction stats: 55675, 55609, 55890, 55793 and 55431.

2/24/2011 2:43:45 AM -- Dispatching transactions ends.

2/24/2011 2:43:45 AM -- Shutting down databases ...

2/24/2011 2:43:53 AM -- Instance2924.1 (complete), Instance2924.2 (complete), Instance2924.3 (complete), Instance2924.4 (complete) and Instance2924.5 (complete)

2/24/2011 2:43:54 AM -- Performance logging begins (interval: 30000 ms).

2/24/2011 2:43:54 AM -- Verifying database checksums ...

2/24/2011 3:10:39 PM -- 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)

2/24/2011 3:10:39 PM -- Performance logging ends.
 2/24/2011 3:10:39 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB
 Mbox\Sun170\Performance Test\DBChecksum_2011_2_24_2_43_53.blg has 1492 samples.

Stress Test Result Report: SUN170

Test Summary

Overall Test Result	Pass
Machine Name	SUN170
Test Description	
Test Start Time	2/24/2011 10:23:49 PM
Test End Time	2/26/2011 10:01:57 PM
Collection Start Time	2/24/2011 10:26:35 PM
Collection End Time	2/25/2011 10:26:34 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 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Stress Test\Stress_2011_2_24_22_24_1.blg C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Stress Test\DBChecksum_2011_2_26_22_1_57.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	593.235
Target Transactional I/O per Second	298.8
Initial Database Size (bytes)	6633623977984
Final Database Size (bytes)	6675206307840
Database Files (Count)	5

Jetstress System Parameters

<i>Thread Count</i>	4 (per database)
<i>Minimum Database Cache</i>	160.0 MB
<i>Maximum Database Cache</i>	1280.0 MB
<i>Insert Operations</i>	40%
<i>Delete Operations</i>	20%
<i>Replace Operations</i>	5%
<i>Read Operations</i>	35%
<i>Lazy Commits</i>	70%
<i>Run Background Database Maintenance</i>	True
<i>Number of Copies per Database</i>	2

Database Configuration

<i>Instance2844.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance2844.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance2844.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance2844.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
<i>Instance2844.5</i>	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2844.1	11.125	4.488	73.151	45.249	34547.792	34938.698	0.000	1.504	0.000	36.586	0.000	4657.353
Instance2844.2	10.882	3.935	73.425	45.434	34572.959	34959.841	0.000	1.499	0.000	36.678	0.000	4679.561
Instance2844.3	10.904	3.914	73.345	45.402	34605.144	34959.089	0.000	1.505	0.000	36.638	0.000	4677.828
Instance2844.4	10.901	3.254	73.446	45.480	34588.618	34962.993	0.000	1.500	0.000	36.795	0.000	4688.329
Instance2844.5	10.885	3.199	73.094	45.208	34656.082	34967.614	0.000	1.509	0.000	36.518	0.000	4672.736

Background Database Maintenance I/O Performance

<i>MSExchange Database ==> Instances</i>	<i>Database Maintenance IO Reads/sec</i>	<i>Database Maintenance IO Reads Average Bytes</i>
Instance2844.1	28.017	261831.687
Instance2844.2	28.126	261820.522
Instance2844.3	28.100	261836.265
Instance2844.4	28.067	261823.970
Instance2844.5	28.131	261840.524

Log Replication I/O Performance

<i>MSExchange Database ==> Instances</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Reads Average Bytes</i>
Instance2844.1	0.691	222331.093
Instance2844.2	0.696	223510.654
Instance2844.3	0.695	223617.064
Instance2844.4	0.700	224968.176
Instance2844.5	0.692	224194.674

Total I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2844.1	11.125	4.488	101.168	45.249	97490.520	34938.698	3.588	1.504	0.691	36.586	222331.093	4657.353
Instance2844.2	10.882	3.935	101.551	45.434	97512.508	34959.841	3.769	1.499	0.696	36.678	223510.654	4679.561
Instance2844.3	10.904	3.914	101.446	45.402	97548.166	34959.089	3.341	1.505	0.695	36.638	223617.064	4677.828
Instance2844.4	10.901	3.254	101.513	45.480	97416.722	34962.993	3.816	1.500	0.700	36.795	224968.176	4688.329
Instance2844.5	10.885	3.199	101.225	45.208	97791.710	34967.614	3.198	1.509	0.692	36.518	224194.674	4672.736

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.890	0.000	5.646
Available MBytes	29550.207	29540.000	29680.000
Free System Page Table Entries	33555642.986	33555635.000	33555643.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	63217107.138	62484480.000	63381504.000
Pool Paged Bytes	94356349.686	91422720.000	100777984.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log2/24/2011 10:23:49 PM -- Jetstress testing begins ...

2/24/2011 10:23:49 PM -- Prepare testing begins ...

2/24/2011 10:23:55 PM -- Attaching databases ...

2/24/2011 10:23:55 PM -- Prepare testing ends.

2/24/2011 10:23:55 PM -- Dispatching transactions begins ...

2/24/2011 10:23:55 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)

2/24/2011 10:23:55 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)

2/24/2011 10:24:01 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).

2/24/2011 10:24:01 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).

2/24/2011 10:24:07 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

2/24/2011 10:24:07 PM -- Performance logging begins (interval: 15000 ms).

2/24/2011 10:24:07 PM -- Attaining prerequisites:

2/24/2011 10:26:35 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1210114000.0 (lower bound: 1207960000.0, upper bound: none)

2/25/2011 10:26:36 PM -- Performance logging ends.

2/26/2011 10:01:49 PM -- JetInterop batch transaction stats: 581761, 582933, 582793, 582851 and 580587.

2/26/2011 10:01:49 PM -- Dispatching transactions ends.

2/26/2011 10:01:49 PM -- Shutting down databases ...

2/26/2011 10:01:57 PM -- Instance2844.1 (complete), Instance2844.2 (complete), Instance2844.3 (complete), Instance2844.4 (complete) and Instance2844.5 (complete)

2/26/2011 10:01:58 PM -- Performance logging begins (interval: 30000 ms).

2/26/2011 10:01:58 PM -- Verifying database checksums ...

2/27/2011 10:34:00 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)

2/27/2011 10:34:00 AM -- Performance logging ends.

2/27/2011 10:34:00 AM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Stress Test\DBChecksum_2011_2_26_22_1_57.blg has 1503 samples.

2/27/2011 10:34:08 AM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Stress Test\DBChecksum_2011_2_26_22_1_57.html is saved.

2/27/2011 10:34:08 AM -- Verifying log checksums ...

2/27/2011 10:34:09 AM -- C:\logluns\log1 (7 log(s) processed), C:\logluns\log2 (6 log(s) processed), C:\logluns\log3 (7 log(s) processed), C:\logluns\log4 (8 log(s) processed) and C:\logluns\log5 (7 log(s) processed)

2/27/2011 10:34:09 AM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Stress Test\Stress_2011_2_24_22_24_1.blg has 5761 samples.
 2/27/2011 10:34:09 AM -- Creating test report ...
 2/27/2011 10:34:40 AM -- Instance2844.1 has 11.1 for I/O Database Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.1 has 1.5 for I/O Log Writes Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.1 has 1.5 for I/O Log Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.2 has 10.9 for I/O Database Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.2 has 1.5 for I/O Log Writes Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.2 has 1.5 for I/O Log Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.3 has 10.9 for I/O Database Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.3 has 1.5 for I/O Log Writes Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.3 has 1.5 for I/O Log Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.4 has 10.9 for I/O Database Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.4 has 1.5 for I/O Log Writes Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.4 has 1.5 for I/O Log Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.5 has 10.9 for I/O Database Reads Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.5 has 1.5 for I/O Log Writes Average Latency.
 2/27/2011 10:34:40 AM -- Instance2844.5 has 1.5 for I/O Log Reads Average Latency.
 2/27/2011 10:34:40 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 2/27/2011 10:34:40 AM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 2/27/2011 10:34:40 AM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Stress Test\Stress_2011_2_24_22_24_1.xml has 5751 samples queried.

Stress Test Database Checksums Result: SUN170

Checksum Statistics - All

<i>Database</i>	<i>Seen pages</i>	<i>Bad pages</i>	<i>Correctable pages</i>	<i>Wrong page-number pages</i>	<i>File length / seconds taken</i>
C:\dbluns\db1\Jetstress001001.edb	40742738	0	0	0	1273210 MBytes / 44986 sec
C:\dbluns\db2\Jetstress002001.edb	40743762	0	0	0	1273242 MBytes / 36821 sec
C:\dbluns\db3\Jetstress003001.edb	40741458	0	0	0	1273170 MBytes / 45044 sec
C:\dbluns\db4\Jetstress004001.edb	40743250	0	0	0	1273226 MBytes / 36833 sec
C:\dbluns\db5\Jetstress005001.edb	40739922	0	0	0	1273122 MBytes / 45121 sec
(Sum)	203711130	0	0	0	6365972 MBytes / 45121 sec

Disk Subsystem Performance (of checksum)

<i>LogicalDisk</i>	<i>Avg. Disk sec/Read</i>	<i>Avg. Disk sec/Write</i>	<i>Disk Reads/sec</i>	<i>Disk Writes/sec</i>	<i>Avg. Disk Bytes/Read</i>
C:\dbluns\db1	0.111	0.000	452.656	0.000	65536.000
C:\dbluns\db2	0.095	0.000	553.331	0.000	65536.000
C:\dbluns\db3	0.111	0.000	451.961	0.000	65536.000
C:\dbluns\db4	0.094	0.000	553.295	0.000	65536.000
C:\dbluns\db5	0.109	0.000	451.281	0.000	65536.000

Memory System Performance (of checksum)

<i>Counter</i>	<i>Average</i>	<i>Minimum</i>	<i>Maximum</i>
% Processor Time	0.871	0.000	3.989
Available MBytes	30893.667	30879.000	30908.000
Free System Page Table Entries	33555643.392	33555643.000	33555645.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	64872518.856	64794624.000	65007616.000
Pool Paged Bytes	96436436.567	93966336.000	98660352.000

Test Log2/24/2011 10:23:49 PM -- Jetstress testing begins ...

2/24/2011 10:23:49 PM -- Prepare testing begins ...

2/24/2011 10:23:55 PM -- Attaching databases ...

2/24/2011 10:23:55 PM -- Prepare testing ends.

2/24/2011 10:23:55 PM -- Dispatching transactions begins ...

2/24/2011 10:23:55 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)

2/24/2011 10:23:55 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)

2/24/2011 10:24:01 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).

2/24/2011 10:24:01 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).

2/24/2011 10:24:07 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

2/24/2011 10:24:07 PM -- Performance logging begins (interval: 15000 ms).

2/24/2011 10:24:07 PM -- Attaining prerequisites:

2/24/2011 10:26:35 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1210114000.0 (lower bound: 1207960000.0, upper bound: none)

2/25/2011 10:26:36 PM -- Performance logging ends.

2/26/2011 10:01:49 PM -- JetInterop batch transaction stats: 581761, 582933, 582793, 582851 and 580587.

2/26/2011 10:01:49 PM -- Dispatching transactions ends.

2/26/2011 10:01:49 PM -- Shutting down databases ...

2/26/2011 10:01:57 PM -- Instance2844.1 (complete), Instance2844.2 (complete), Instance2844.3 (complete), Instance2844.4 (complete) and Instance2844.5 (complete)

2/26/2011 10:01:58 PM -- Performance logging begins (interval: 30000 ms).

2/26/2011 10:01:58 PM -- Verifying database checksums ...

2/27/2011 10:34:00 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)

2/27/2011 10:34:00 AM -- Performance logging ends.
 2/27/2011 10:34:00 AM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Stress
 Test\DBCchecksum_2011_2_26_22_1_57.blg has 1503 samples.

Backup Test Result Report: SUN170

Database Backup Statistics - All

<i>Database Instance</i>	<i>Database Size (MBytes)</i>	<i>Elapsed Backup Time</i>	<i>MBytes Transferred/sec</i>
Instance2844.1	1273202.59	10:19:34	34.25
Instance2844.2	1273234.59	09:56:32	35.57
Instance2844.3	1273162.59	09:59:52	35.37
Instance2844.4	1273218.59	09:48:14	36.07
Instance2844.5	1273114.59	09:58:08	35.47

Jetstress System Parameters

<i>Thread Count</i>	4 (per database)
<i>Minimum Database Cache</i>	160.0 MB
<i>Maximum Database Cache</i>	1280.0 MB
<i>Insert Operations</i>	40%
<i>Delete Operations</i>	20%
<i>Replace Operations</i>	5%
<i>Read Operations</i>	35%
<i>Lazy Commits</i>	70%

Database Configuration

<i>Instance2844.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance2844.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance2844.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance2844.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
<i>Instance2844.5</i>	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2844.1	11.540	0.000	136.819	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2844.2	9.815	0.000	142.191	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2844.3	9.877	0.000	141.428	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2844.4	9.586	0.000	144.269	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2844.5	9.786	0.000	141.837	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	0.563	0.000	1.958
Available MBytes	30889.773	30876.000	30892.000
Free System Page Table Entries	33555643.113	33555643.000	33555645.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	64981375.793	64978944.000	64995328.000
Pool Paged Bytes	98861836.821	97812480.000	101502976.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log2/27/2011 8:31:37 PM -- Jetstress testing begins ...
 2/27/2011 8:31:37 PM -- Prepare testing begins ...
 2/27/2011 8:31:43 PM -- Attaching databases ...
 2/27/2011 8:31:43 PM -- Prepare testing ends.
 2/27/2011 8:31:52 PM -- Performance logging begins (interval: 30000 ms).
 2/27/2011 8:31:52 PM -- Backing up databases ...
 2/28/2011 6:51:27 AM -- Performance logging ends.
 2/28/2011 6:51:27 AM -- Instance2844.1 (100% processed), Instance2844.2 (100% processed),
 Instance2844.3 (100% processed), Instance2844.4 (100% processed) and Instance2844.5 (100%
 processed)
 2/28/2011 6:51:27 AM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Backup
 Test\DatabaseBackup_2011_2_27_20_31_43.blg has 1238 samples.
 2/28/2011 6:51:27 AM -- Creating test report ...

Soft Recovery Test Result Report: SUN170

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance2844.1	500	805.4138146
Instance2844.2	502	796.9273997
Instance2844.3	504	810.187423
Instance2844.4	500	809.9222225
Instance2844.5	509	811.5134253

Database Configuration

<i>Instance2844.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance2844.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance2844.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance2844.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
<i>Instance2844.5</i>	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2844.1	23.581	15.867	754.215	3.704	35520.118	32768.000	14.232	0.000	5.561	0.000	232516.611	0.000
Instance2844.2	23.315	14.571	762.651	3.790	35454.062	32768.000	14.257	0.000	5.686	0.000	232533.998	0.000
Instance2844.3	23.560	15.889	751.097	3.713	35571.375	32768.000	13.648	0.002	5.561	0.004	232458.779	2.547
Instance2844.4	22.758	15.779	755.127	3.719	35556.756	32768.000	15.174	0.002	5.584	0.015	232502.067	2.547
Instance2844.5	23.512	15.047	753.101	3.711	35620.350	32604.975	14.956	0.000	5.573	0.000	230141.465	0.000

Background Database Maintenance I/O Performance

<i>MSExchange Database ==> Instances</i>	<i>Database Maintenance IO Reads/sec</i>	<i>Database Maintenance IO Reads Average Bytes</i>
Instance2844.1	20.621	261989.398
Instance2844.2	20.442	261825.919
Instance2844.3	20.804	261849.834
Instance2844.4	20.678	261812.440
Instance2844.5	20.878	261883.788

Total I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2844.1	23.581	15.867	774.836	3.704	41547.235	32768.000	14.232	0.000	5.561	0.000	232516.611	0.000
Instance2844.2	23.315	14.571	783.093	3.790	41363.248	32768.000	14.257	0.000	5.686	0.000	232533.998	0.000
Instance2844.3	23.560	15.889	771.901	3.713	41670.048	32768.000	13.648	0.002	5.561	0.004	232458.779	2.547
Instance2844.4	22.758	15.779	775.805	3.719	41587.202	32768.000	15.174	0.002	5.584	0.015	232502.067	2.547
Instance2844.5	23.512	15.047	773.979	3.711	41723.639	32604.975	14.956	0.000	5.573	0.000	230141.465	0.000

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.721	0.000	10.724
Available MBytes	29528.762	29509.000	30670.000
Free System Page Table Entries	33555610.995	33555610.000	33555611.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72348722.693	67145728.000	73170944.000
Pool Paged Bytes	102019274.772	101900288.000	102117376.000
Database Page Fault Stalls/sec	0.004	0.000	0.746

Test Log2/28/2011 8:03:44 PM -- Jetstress testing begins ...

2/28/2011 8:03:44 PM -- Prepare testing begins ...

2/28/2011 8:03:50 PM -- Attaching databases ...

2/28/2011 8:03:50 PM -- Prepare testing ends.

2/28/2011 8:03:50 PM -- Dispatching transactions begins ...

2/28/2011 8:03:50 PM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)

2/28/2011 8:03:50 PM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)

2/28/2011 8:03:56 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

2/28/2011 8:03:56 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

2/28/2011 8:04:00 PM -- Operation mix: Sessions 4, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

2/28/2011 8:04:00 PM -- Performance logging begins (interval: 15000 ms).

2/28/2011 8:04:00 PM -- Generating log files ...

2/28/2011 9:42:35 PM -- C:\logluns\log1 (100.2% generated), C:\logluns\log2 (100.6% generated), C:\logluns\log3 (101.0% generated), C:\logluns\log4 (100.2% generated) and C:\logluns\log5 (102.0% generated)

2/28/2011 9:42:35 PM -- Performance logging ends.

2/28/2011 9:42:35 PM -- JetInterop batch transaction stats: 22247, 22118, 22202, 22074 and 22427.

2/28/2011 9:42:35 PM -- Dispatching transactions ends.

2/28/2011 9:42:35 PM -- Shutting down databases ...

2/28/2011 9:42:37 PM -- Instance2844.1 (complete), Instance2844.2 (complete), Instance2844.3 (complete), Instance2844.4 (complete) and Instance2844.5 (complete)

2/28/2011 9:42:37 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Soft Recovery\Performance_2011_2_28_20_3_56.blg has 394 samples.

2/28/2011 9:42:37 PM -- Creating test report ...

2/28/2011 9:42:38 PM -- Instance2844.1 has 10.9 for I/O Database Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.1 has 1.4 for I/O Log Writes Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.1 has 1.4 for I/O Log Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.2 has 10.8 for I/O Database Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.2 has 1.3 for I/O Log Writes Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.2 has 1.3 for I/O Log Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.3 has 10.7 for I/O Database Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.3 has 1.4 for I/O Log Writes Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.3 has 1.4 for I/O Log Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.4 has 10.8 for I/O Database Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.4 has 1.3 for I/O Log Writes Average Latency.
 2/28/2011 9:42:38 PM -- Instance2844.4 has 1.3 for I/O Log Reads Average Latency.
 2/28/2011 9:42:38 PM -- Instance2844.5 has 10.7 for I/O Database Reads Average Latency.
 2/28/2011 9:42:38 PM -- Instance2844.5 has 1.3 for I/O Log Writes Average Latency.
 2/28/2011 9:42:38 PM -- Instance2844.5 has 1.3 for I/O Log Reads Average Latency.
 2/28/2011 9:42:38 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 2/28/2011 9:42:38 PM -- Test has 0 Database Page Fault Stalls/sec samples higher than 0.
 2/28/2011 9:42:38 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Soft
 Recovery\Performance_2011_2_28_20_3_56.xml has 393 samples queried.
 2/28/2011 9:42:38 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Soft
 Recovery\Performance_2011_2_28_20_3_56.html is saved.
 2/28/2011 10:47:19 PM -- Performance logging begins (interval: 4000 ms).
 2/28/2011 10:47:19 PM -- Recovering databases ...
 2/28/2011 11:00:50 PM -- Performance logging ends.
 2/28/2011 11:00:50 PM -- Instance2844.1 (805.4138146), Instance2844.2 (796.9273997),
 Instance2844.3 (810.187423), Instance2844.4 (809.9222225) and Instance2844.5 (811.5134253)
 2/28/2011 11:00:51 PM -- C:\ESRP 3 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Soft
 Recovery\SoftRecovery_2011_2_28_22_47_15.blg has 202 samples.
 2/28/2011 11:00:51 PM -- Creating test report ...

Soft Recovery Test Performance Result: SUN170

Test Summary

Overall Test Result	Pass
Machine Name	SUN170
Test Description	
Test Start Time	2/28/2011 8:03:44 PM
Test End Time	2/28/2011 9:42:37 PM
Collection Start Time	2/28/2011 8:04:15 PM
Collection End Time	2/28/2011 9:42:33 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 AMS2300 Res R5 HDP 600GB SAS 3GB Mbox\Sun170\Soft Recovery\Performance_2011_2_28_20_3_56.blg

Database Sizing and Throughput

<i>Achieved Transactional I/O per Second</i>	653.094
<i>Capacity Percentage</i>	100%
<i>Throughput Percentage</i>	100%
<i>Initial Database Size (bytes)</i>	6675206307840
<i>Final Database Size (bytes)</i>	6676791754752
<i>Database Files (Count)</i>	5

Jetstress System Parameters

<i>Thread Count</i>	4 (per database)
<i>Minimum Database Cache</i>	160.0 MB
<i>Maximum Database Cache</i>	1280.0 MB
<i>Insert Operations</i>	40%
<i>Delete Operations</i>	20%
<i>Replace Operations</i>	5%
<i>Read Operations</i>	35%
<i>Lazy Commits</i>	70%

Database Configuration

<i>Instance2844.1</i>	Log Path: C:\logluns\log1 Database: C:\dbluns\db1\Jetstress001001.edb
<i>Instance2844.2</i>	Log Path: C:\logluns\log2 Database: C:\dbluns\db2\Jetstress002001.edb
<i>Instance2844.3</i>	Log Path: C:\logluns\log3 Database: C:\dbluns\db3\Jetstress003001.edb
<i>Instance2844.4</i>	Log Path: C:\logluns\log4 Database: C:\dbluns\db4\Jetstress004001.edb
<i>Instance2844.5</i>	Log Path: C:\logluns\log5 Database: C:\dbluns\db5\Jetstress005001.edb

Transactional I/O Performance

<i>MSExchange Database => Instances</i>	<i>I/O Database Reads Average Latency (msec)</i>	<i>I/O Database Writes Average Latency (msec)</i>	<i>I/O Database Reads/sec</i>	<i>I/O Database Writes/sec</i>	<i>I/O Database Reads Average Bytes</i>	<i>I/O Database Writes Average Bytes</i>	<i>I/O Log Reads Average Latency (msec)</i>	<i>I/O Log Writes Average Latency (msec)</i>	<i>I/O Log Reads/sec</i>	<i>I/O Log Writes/sec</i>	<i>I/O Log Reads Average Bytes</i>	<i>I/O Log Writes Average Bytes</i>
Instance2844.1	10.897	6.952	81.368	49.437	32768.307	34884.664	0.000	1.352	0.000	39.923	0.000	4674.469
Instance2844.2	10.779	5.683	80.981	49.296	32768.000	34920.053	0.000	1.320	0.000	40.168	0.000	4675.126
Instance2844.3	10.747	5.727	81.095	49.213	32768.000	34962.191	0.000	1.363	0.000	40.518	0.000	4647.521
Instance2844.4	10.776	4.218	80.659	49.074	32768.213	34898.491	0.000	1.295	0.000	40.000	0.000	4685.018
Instance2844.5	10.719	4.120	82.058	49.913	32768.000	34943.949	0.000	1.340	0.000	40.798	0.000	4659.240

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.886	0.000	5.769
Available MBytes	29545.256	29526.000	30549.000
Free System Page Table Entries	33555644.122	33555642.000	33555645.000
Transition Pages Repurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	65224828.751	64966656.000	65310720.000
Pool Paged Bytes	101647146.883	101605376.000	101769216.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

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2/28/2011 9:42:38 PM -- Instance2844.2 has 1.3 for I/O Log Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.3 has 10.7 for I/O Database Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.3 has 1.4 for I/O Log Writes Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.3 has 1.4 for I/O Log Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.4 has 10.8 for I/O Database Reads Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.4 has 1.3 for I/O Log Writes Average Latency.

2/28/2011 9:42:38 PM -- Instance2844.4 has 1.3 for I/O Log Reads Average Latency.
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