



Sun StorageTek 2530 2000 Mailbox Exchange 2007 Storage Solution



Tested with: ESRP – Storage Version 2.0
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Overview

This document provides information on Sun Microsystem's storage solution for Microsoft Exchange 2007 Server, based the *Microsoft Exchange Solution Reviewed Program (ESRP) – Storage* program*. For any questions or comments regarding the contents of this document, see Contact for Additional Information.

*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 details on the *Microsoft ESRP – Storage* program, please click <http://www.microsoft.com/technet/prodtechnol/exchange/2007/esrp.msp>

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Features

This document describes a Microsoft Exchange 2007 primary storage solution on the Sun Microsystems StorageTek 2530 array. The targeted number of users in this environment is 2000. The tested user profile was 0.5 IOPS (0.42 + 20%) per mailbox with a limit of 270MB. This solution can be scaled by adding additional arrays. The ST2530 is an excellent chose for medium to large sized businesses.

Solution Description

The tested solution consists of (1) Sun StorageTek 2530 RAID Unit with (12) 146GB 15,000 rpm SAS 4Gb/s. This solution can expand to (2) Expansion units for a total of 5.26 (raw) / 2.63 TB (usable, RAID 5 with hot spares) SAS. Optional drives are also available in 73GB 15,000 rpm or 300GB 15,000 rpm configurations. For more detailed specs, please see:

http://www.sun.com/storagetek/disk_systems/workgroup/2530/



The Sun StorageTek 2530 Array is listed on the Windows Server Catalog of tested products here:

<http://www.windowsservercatalog.com/item.aspx?idItem=53b769e5-acbd-4119-7d29-27a55a49306f>

RAID Module LUNs

Sun StorageTek 2530 RAID Module LUNs can be managed through Sun StorageTek Common Array Manager (CAM). RAID levels 0, 1, (1+0), 3 and 5 are supported.

Tested Configuration

The LUN layout of this solution is as follows. Two LUNs were created. One LUN was created for sequential writes (4 drive RAID 10) and a second volume (8 drive RAID 10) for random access. This solution is comprised of a single 4-drive RAID 10 volume for the logs and a single 8-drive RAID 10 volume for the database.

The profile used for the database volume is as follows:
Segment Size: 64k

The I/O activity to the log is 100% small sequential writes. The I/O activity to the database is mostly random. By separating the two distinct I/O characteristics to different LUNs, performance will increase.

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 2007 solution. Other factors which affect the server scalability are: 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, and client usage profiles. All these factors are beyond the scope for ESRP-Storage. Therefore, the number of mailboxes

hosted per server as part of the tested configuration may not necessarily be viable for some customer deployment.

For more information on identifying and addressing performance bottlenecks in an Exchange 2007 system, please refer to Microsoft's Troubleshooting Microsoft Exchange 2007 Server Performance, available at <http://go.microsoft.com/fwlink/?LinkId=23454>.

Targeted Customer Profile

This solution is targeted towards a 2000 user Exchange 2007 deployment.

- Medium to large organization
- One Exchange 2007 Server
- .42 IOPS + 20% headroom User I/O profile (0.5 tested)
- 270MB mailbox quota

Tested Deployment

The following tables summarize the testing environment:

Simulated Exchange Configuration:

Number of Exchange mailboxes simulated	2000
Number of hosts	1
Number of mailboxes/host	2000
Number of storage groups/host	1
Number of mailbox stores/storage group	1
Number of mailboxes/mailbox store	2000
Number of mailbox store LUNs/storage group	1
Simulated profile: I/O's per second per mailbox (IOPS, include 20% headroom)	.5 (very heavy workload)
Database LUN size	544 GB
Log LUN size	242 GB
Total database size for performance testing	537.1 GB
% storage capacity used by Exchange database**	66%

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

Primary Storage Hardware

Storage Connectivity (Fiber Channel, SAS, SATA, iSCSI)	SAS
Storage model and OS/firmware revision	StorageTek 2530 06.17.52.10 http://www.windowsservercatalog.com/item.aspx?idItem=53b769e5-acbd-4119-7d29-27a55a49306f
Storage cache	680MB
Number of storage controllers	2
Number of storage ports	2
Maximum bandwidth of storage connectivity to host	18Gb/s (up to 6 3Gb/s host connections per controller)
Switch type/model/firmware revision	N/A
HBA model and firmware	SG-XPCIE8SAS-E-Z 01.18.00.00
Number of HBA's/host	2
Host server type	Sun Microsystems, Inc. SunFire x4200M2 2 Dual-Core AMD Opteron 2216 Processors 12,288MB RAM
Total number of disks tested in solution	12
Maximum number of spindles can be hosted in the storage	As Configured: 12 Maximum Configuration: 36

Primary Storage Software

HBA driver	1.21.26.0
HBA QueueTarget Setting	N/A
HBA QueueDepth Setting	N/A
Multi-Pathing	SMIA-WSX64-01.01.32.04 MPIO DSM
Host OS	Microsoft Windows Server 2003, Enterprise Edition x64 SP2
ESE.dll file version	08.00.0685.024
Replication solution name/version	N/A

Primary Storage Disk Configuration (Mailbox Store Disks)

Disk type, speed and firmware revision	146 GB 15,000-rpm 3 Gb/sec - 0791
Raw capacity per disk (GB)	136.7GB
Number of physical disks in test	8
total raw storage capacity (GB)	1094GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	8
Raid level	RAID 10
Total formatted capacity	544GB
Storage capacity utilization	49%
Database capacity utilization	33%

Primary Storage Disk Configuration (Transactional Log Disks)

Disk type, speed and firmware rev	146 GB 15,000-rpm 3 Gb/sec - 079
Raw capacity per disk (GB)	136.7GB
Number of Spindles in test	4
total raw storage capacity (GB)	550.8
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	4
Raid level	RAID 10
Total formatted capacity	244GB

Best Practices

Exchange 2007 server is a disk-intensive application. Based on the testing run using the ESRP framework, we would recommend the following to improve the storage performance.

For Exchange 2007 best practices on storage design, please visit <http://technet.microsoft.com/en-us/library/bb124518.aspx>

Core Storage

1. Use the Microsoft Diskpart utility to align the sectors of all Exchange 2007 storage volumes before formatting. The Diskpart value should be set to 64.
2. Do not share Exchange 2007 disks with any other applications that are I/O intensive. This will have a negative effect on your disk subsystem performance.
3. When possible, separate the sequential writes of logs from the random access of database volumes.
4. Primary focus should be on the speed of the disks and not size.

Contact for Additional Information

<http://www.sun.com/exchange>

Test Result Summary

This section provides a high level summary of the test data from ESRP and the link to the detailed reports which are generated by ESRP testing framework. Please click on the underlined headings below to view the report for each test.

Reliability

A number of tests in the framework are to check Reliability tests runs for 24 hours. The goal is to verify the storage can handle high IO load for a long period of time. Both log and database files will be analyzed for integrity after the stress test to ensure no database/log corruption.

The following list provides an overview:

- No errors were reported in the saved eventlog file
- No errors were reported during the database and log checksum process

Primary Storage Performance Results

The Primary Storage performance testing is designed to exercise the storage with maximum sustainable Exchange type of IO for 2 hours. The test is to show how long it takes for the storage to respond to an IO under load. The data below is the sum of all of the logical disk I/O's and average of all the logical disks I/O latency in the 2 hours test duration. Each server is listed separately and the aggregate numbers across all servers is listed as well.

Individual Server Metrics:

The sum of I/O's across Storage Groups and the average latency across all Storage Groups on a per server basis.

Database I/O	
Average Database Disk Transfers/sec	1056.447
Average Database Disk Reads/sec	639.729
Average Database Disk Writes/sec	416.719
Average Database Disk Read Latency (ms)	17
Average Database Disk Write Latency (ms)	3
Transaction Log I/O	
Average Log Disk Writes/sec	228.711
Average Log Disk Write Latency (ms)	1

Streaming Backup/Recovery Performance

For the Version 1.0 release, only streaming backup type is supported for testing in the framework. There are two tests in this section. First one is to measure the read IO performance metrics by running checksum on all the databases and log files. The second test is to measure the end to end performance when the databases are backed up to disks.

Database Read-only Performance

The test is to measure the maximum rate at which databases could be streaming backed up. The following table shows the average rate for a single database file.

MB read/sec per storage group_	159.95
MB read/sec total	159.95

Log Read-only Performance

The test is to measure 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 1 MB in size.

Average time to play one Log file (sec)	.602
-----------------------------------------	------

Conclusion

This document is developed by storage solution providers, and reviewed by Microsoft Exchange Product team. The test results/data presented in this document is based on the tests introduced in the ESRP test framework. Customer should not quote the data directly for his/her pre-deployment verification. It is still necessary to go through the exercises to validate the storage design for a specific customer environment.

ESRP program is not designed to be a benchmarking program; tests are not designed to getting the maximum throughput for a giving solution. Rather, it is focused on producing recommendations from vendors for Exchange application. So the data presented in this document should not be used for direct comparisons among the solutions.

Appendix

Microsoft Exchange Server **Jetstress**

Performance Test Result Report

Test Summary

Overall Test Pass

Result

Machine ISV-4100E

Name

Test

Description

Test Start 11/8/2007 2:23:03 PM

Time

Test End 11/8/2007 4:46:02 PM

Time

Jetstress 08.01.0112.000

Version

Ese Version 08.00.0685.024

Operating Microsoft Windows Server 2003 Service Pack 2 (5.2.3790.131072)

System

Performance Log C:\Program Files\Exchange2007\Exchange2007\Performance_2007_11_8_14_23_4.blg
C:\Program Files\Exchange2007\Exchange2007\DBChecksum_2007_11_8_16_46_2.blg

Database Sizing and Throughput

Achieved I/O per Second 1056.447
Planned I/O per Second 1000
Initial database size 499121405952
Final database size 507296235520
Database files (count) 1

Jetstress System Parameters

Thread count 64 (per-storage group)
Log buffers 9000
Minimum database cache 32.0 MB
Maximum database cache 256.0 MB
Insert operations 25%
Delete operations 10%
Replace operations 50%
Read operations 15%
Lazy commits 80%

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (F:)	0.017	0.003	639.729	416.719	(n/a)
Log (H:)	8.35073068893528E-07	0.000	0.000	228.711	11850.170

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.842	1.484	4.766
Available MBytes	6792.404	6664.000	6916.000
Free System Page Table Entries	16754076.000	16754076.000	16754076.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	51026781.867	50995200.000	51150848.000
Pool Paged Bytes	44474513.067	44339200.000	45436928.000
Database Page Fault Stalls/sec	0.004	0.000	0.200

Test Log 11/8/2007 2:23:03 PM -- Jetstress testing begins ...

11/8/2007 2:23:03 PM -- Prepare testing begins ...

11/8/2007 2:23:04 PM -- Attaching databases ...

11/8/2007 2:23:04 PM -- Prepare testing ends.

11/8/2007 2:23:04 PM -- Dispatching transactions begins ...

11/8/2007 2:23:04 PM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)

11/8/2007 2:23:04 PM -- Database flush thresholds: (start: 2.6 MB, stop: 5.1 MB)

11/8/2007 2:23:04 PM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).

11/8/2007 2:23:04 PM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).

11/8/2007 2:23:05 PM -- Operation mix: Sessions 64, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.
 11/8/2007 2:23:05 PM -- Performance logging begins (interval: 15000 ms).
 11/8/2007 2:23:05 PM -- Attaining prerequisites:
 11/8/2007 2:24:27 PM -- \Database(JetstressWin)\Database Cache Size, Last: 241811500.0 (lower bound: 241591900.0, upper bound: none)
 11/8/2007 4:24:29 PM -- Performance logging ends.
 11/8/2007 4:24:29 PM -- JetInterop batch transaction stats: 171855.
 11/8/2007 4:24:30 PM -- Dispatching transactions ends.
 11/8/2007 4:24:30 PM -- Shutting down databases ...
 11/8/2007 4:46:02 PM -- Instance340.1 (complete)
 11/8/2007 4:46:02 PM -- Performance logging begins (interval: 15000 ms).
 11/8/2007 4:46:02 PM -- Verifying database checksums ...
 11/8/2007 5:17:35 PM -- F: (100% processed)
 11/8/2007 5:17:36 PM -- Performance logging ends.
 11/8/2007 5:17:36 PM -- [C:\Program Files\Exchange2007\Exchange2007\DBChecksum_2007_11_8_16_46_2.blg](#) has 126 samples.
 11/8/2007 5:17:37 PM -- [C:\Program Files\Exchange2007\Exchange2007\DBChecksum_2007_11_8_16_46_2.html](#) is saved.
 11/8/2007 5:17:37 PM -- Verifying log checksums ...
 11/8/2007 5:17:38 PM -- H:\ (21 logs passed)
 11/8/2007 5:17:38 PM -- [C:\Program Files\Exchange2007\Exchange2007\Performance_2007_11_8_14_23_4.blg](#) has 485 samples.
 11/8/2007 5:17:38 PM -- Creating test report ...
 11/8/2007 5:17:41 PM -- Volume F: has 0.0166 for Avg. Disk sec/Read.
 11/8/2007 5:17:41 PM -- Volume H: has 0.0004 for Avg. Disk sec/Write.
 11/8/2007 5:17:41 PM -- Volume H: has 0.0000 for Avg. Disk sec/Read.
 11/8/2007 5:17:41 PM -- Test has 0.200038740758139 Maximum Database Page Fault Stalls/sec.
 11/8/2007 5:17:41 PM -- Test has 20 Database Page Fault Stalls/sec samples higher than 0.

Microsoft Exchange Server **Jetstress**

Streaming backup Test Result Report

Streaming Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance3676.1	557915.90	00:58:08	159.95

Jetstress System Parameters

Thread count 64 (per-storage group)
Log buffers 9000
Minimum database cache 32.0 MB
Maximum database cache 256.0 MB
Insert operations 25%
Delete operations 10%
Replace operations 50%
Read operations 15%

Lazy commits 80%

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (G:)	0.001	8.34782608695652E-06	1280.245	0.003	(n/a)
Log (F:)	0.000	1.00869565217391E-05	0.000	0.001	35.617

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	6.674	5.690	10.208
Available MBytes	7029.009	7020.000	7032.000
Free System Page Table Entries	16753166.000	16753166.000	16753166.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	54410310.621	54394880.000	54460416.000
Pool Paged Bytes	65139005.793	64708608.000	66609152.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log1/10/2008 6:57:25 AM -- Jetstress testing begins ...
1/10/2008 6:57:25 AM -- Prepare testing begins ...
1/10/2008 6:57:26 AM -- Attaching databases ...
1/10/2008 6:57:26 AM -- Prepare testing ends.
1/10/2008 6:57:26 AM -- Performance logging begins (interval: 30000 ms).
1/10/2008 6:57:26 AM -- Streaming backup databases ...
1/10/2008 7:55:35 AM -- Performance logging ends.
1/10/2008 7:55:35 AM -- Instance3676.1 (100% processed)
1/10/2008 7:55:35 AM -- [C:\Program Files\Exchange2007\Exchange2007\StreamingBackup_2008_1_10_6_57_26.blg](#) has 116 samples.
1/10/2008 7:55:35 AM -- Creating test report ...

Microsoft Exchange Server Jetstress

SoftRecovery Test Result Report

Test Summary

Overall **Pass**

Test Result

Machine ISV-4100E

Name

Test

Description

Test Start Time 1/10/2008 8:04:14 AM

Time

Test End 1/10/2008 11:34:47 AM

Time

Jetstress 08.01.0112.000

Version

Ese Version 08.00.0685.024

Operating System Microsoft Windows Server 2003 Service Pack 2 (5.2.3790.131072)

Performance Log [C:\Program](#)

[Files\Exchange2007\Exchange2007\Performance_2008_1_10_8_4_15.blg](#)

[C:\Program](#)

[Files\Exchange2007\Exchange2007\DBChecksum_2008_1_10_11_34_47.blg](#)

Database Sizing and Throughput

Achieved I/O per Second 1091.18

Planned I/O per Second 1000

Initial database size 585017327616

Final database size 585017327616

Database files (count) 1

Jetstress System Parameters

Thread count 64 (per-storage group)

Log buffers 9000

Minimum database cache 32.0 MB

Maximum database cache 256.0 MB

Insert operations 25%

Delete operations 10%

Replace operations 50%

Read operations 15%

Lazy commits 80%

Disk Subsystem Performance

LogicalDisk	Avg. Disk sec/Read	Avg. Disk sec/Write	Disk Reads/sec	Disk Writes/sec	Avg. Disk Bytes/Write
Database (G:)	0.008	0.001	272.546	818.635	(n/a)
Log (F:)	0.000	0.001	0.000	144.239	2094.836

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	2.307	1.276	8.325
Available MBytes	6645.524	6554.000	7058.000
Free System Page Table Entries	16753090.218	16753076.000	16753166.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	54277540.771	54218752.000	54366208.000

Pool Paged Bytes	62565834.007	57761792.000	66584576.000
Database Page Fault Stalls/sec	0.007	0.000	0.133

Test Log1/10/2008 6:57:25 AM -- Jetstress testing begins ...
1/10/2008 6:57:25 AM -- Prepare testing begins ...
1/10/2008 6:57:26 AM -- Attaching databases ...
1/10/2008 6:57:26 AM -- Prepare testing ends.
1/10/2008 6:57:26 AM -- Performance logging begins (interval: 30000 ms).
1/10/2008 6:57:26 AM -- Streaming backup databases ...
1/10/2008 7:55:35 AM -- Performance logging ends.
1/10/2008 7:55:35 AM -- Instance3676.1 (100% processed)
1/10/2008 7:55:35 AM -- [C:\Program Files\Exchange2007\Exchange2007\StreamingBackup_2008_1_10_6_57_26.blg](#) has 116 samples.
1/10/2008 7:55:35 AM -- Creating test report ...
1/10/2008 7:55:36 AM -- [C:\Program Files\Exchange2007\Exchange2007\StreamingBackup_2008_1_10_6_57_26.html](#) is saved.
1/10/2008 7:55:36 AM -- Jetstress testing ends.
1/10/2008 8:04:14 AM -- Jetstress testing begins ...
1/10/2008 8:04:14 AM -- Prepare testing begins ...
1/10/2008 8:04:15 AM -- Attaching databases ...
1/10/2008 8:04:15 AM -- Prepare testing ends.
1/10/2008 8:04:15 AM -- Dispatching transactions begins ...
1/10/2008 8:04:15 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
1/10/2008 8:04:15 AM -- Database flush thresholds: (start: 2.6 MB, stop: 5.1 MB)
1/10/2008 8:04:15 AM -- Database read latency thresholds: (average: 0.02 seconds/read, maximum: 0.05 seconds/read).
1/10/2008 8:04:15 AM -- Log write latency thresholds: (average: 0.01 seconds/write, maximum: 0.05 seconds/write).
1/10/2008 8:04:15 AM -- Operation mix: Sessions 64, Inserts 25%, Deletes 10%, Replaces 50%, Reads 15%, Lazy Commits 80%.
1/10/2008 8:04:15 AM -- Performance logging begins (interval: 15000 ms).
1/10/2008 8:04:15 AM -- Generating log files ...
1/10/2008 9:13:04 AM -- F:\ (100.2% generated)
1/10/2008 9:13:05 AM -- Performance logging ends.
1/10/2008 9:13:05 AM -- JetInterop batch transaction stats: 90310.
1/10/2008 9:13:14 AM -- Dispatching transactions ends.
1/10/2008 9:13:14 AM -- Shutting down databases ...
1/10/2008 11:34:47 AM -- Instance3676.1 (complete)
1/10/2008 11:34:48 AM -- Performance logging begins (interval: 30000 ms).
1/10/2008 11:34:48 AM -- Verifying database checksums ...
1/10/2008 12:10:32 PM -- G:\ (100% processed)
1/10/2008 12:10:33 PM -- Performance logging ends.
1/10/2008 12:10:33 PM -- [C:\Program Files\Exchange2007\Exchange2007\DBCchecksum_2008_1_10_11_34_47.blg](#) has 71 samples.
1/10/2008 12:10:34 PM -- [C:\Program Files\Exchange2007\Exchange2007\DBCchecksum_2008_1_10_11_34_47.html](#) is saved.
1/10/2008 12:10:34 PM -- Verifying log checksums ...
1/10/2008 12:10:38 PM -- F:\ (100 logs passed)
1/10/2008 12:10:38 PM -- [C:\Program Files\Exchange2007\Exchange2007\Performance_2008_1_10_8_4_15.blg](#) has 275 samples.
1/10/2008 12:10:38 PM -- Creating test report ...
1/10/2008 12:10:40 PM -- Volume G: has 0.0078 for Avg. Disk sec/Read.
1/10/2008 12:10:40 PM -- Volume F: has 0.0006 for Avg. Disk sec/Write.
1/10/2008 12:10:40 PM -- Volume F: has 0.0000 for Avg. Disk sec/Read.
1/10/2008 12:10:40 PM -- Test has 0.13330620866413 Maximum Database Page Fault

Stalls/sec.

1/10/2008 12:10:40 PM -- Test has 26 Database Page Fault Stalls/sec samples higher than 0.

1/10/2008 12:10:40 PM -- [C:\Program](#)

[Files\Exchange2007\Exchange2007\Performance_2008_1_10_8_4_15.xml](#) has 274 samples queried.