Synology FlashStation FS3017

20,000 Mailbox Resiliency Exchange 2013 Storage Solution

Synology®

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Overview

This document provides information on Synology's Flash Station FS3017 storage solution for Microsoft Exchange Server, based on the Microsoft Exchange Solution Reviewed Program (ESRP) – Storage program[1]. For any questions or comments regarding the contents of this document, Contact Synology.

1. 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 **https://technet.microsoft.com/en-us/office/dn756396**

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Features

Synology FlashStation FS3017, Synology's all-flash storage solution is designed for lightning-fast computing environments. FS3017 is a highly reliable, cost-efficient, and ultra-high performance all-flash storage solution with comprehensive business applications for enterprise users. Synology FlashStation FS3017 simplifies data management and optimizes virtualization environments, with minimal time investment in setup and maintenance.

FS3017 delivers over 200,000 4K Random Write IOPS, making it ideal for Microsoft Exchange Server, virtualization and database applications, which require ultra-high performance and low latency.

More information on FS3017 is available at **https://www.synology.com/en-global/products/FS3017**

Feature highlights:

- 200,000 4K Random Write IOPS[1], ultra-high performance with low latency
- Dual Intel Xeon 6-core CPU and 64GB DDR4 ECC RDIMM, expandable up to 512GB
- Dual onboard 10GBase-T ports, capable of installing optional 10GbE/25GbE/40GbE NICs with iSCSI over RDMA
- Complete virtualization solution for VMware, Windows Hyper-V, Citrix and OpenStack
- Advanced Btrfs file system offering 65,000 system-wide snapshots and 1,024 snapshots per shared folder
- Scale up to 72 drives with 2 x Synology Expansion Unit RX2417sas[2]
- Supports Synology High Availability to ensure seamless transition between clustered servers in the event of one node failing, maximizing service uptime with minimum impact
- Backed with Synology's 5-year limited warranty & Synology Replacement Service (SRS)

1. Performance figures may vary depending on environment, usage and configuration.
2. FS3017 supports up to 2 Synology Expansion Unit RX2417sas devices when the optional FS3017 Expansion Card is installed.

Solution Description

The following section outlines the Exchange 2013 mailbox resiliency solution that Synology implemented to run the ESRP tests.

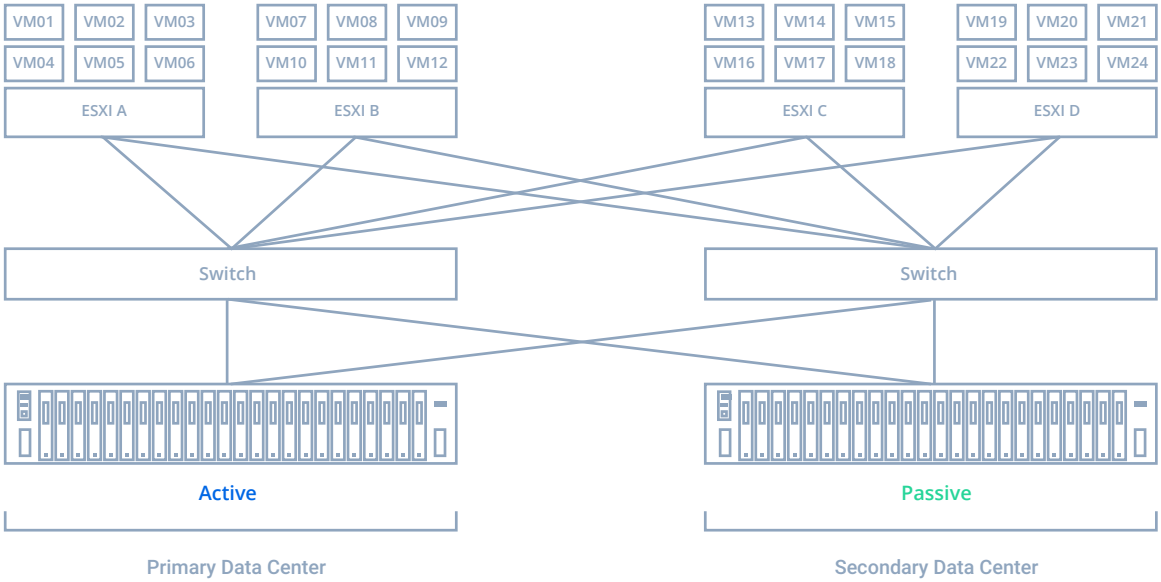

Figure 1: Solution configuration

- 20,000 active user mailboxes
- 1.0 IOPS/mailbox
- 1,024 MB capacity per mailbox
- 12 virtualized Microsoft Exchange Servers, each with 1,667 active users
- Native Database Availability Group (DAG) replication for mailbox resiliency and high availability with 2 database copies maintained
- 1 FlashStation FS3017 main unit
- 21.74TB effective capacity for Microsoft Exchange
- 24 SSDs installed: each 12 SSDs into the RAID6 configuration, with 2 sets of RAID6 arrays created in total
- 2 built-in 10GbE RJ45 ports
- Synology DiskStation Manager (DSM) version 6.1 -15095

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. 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 system, please refer to Microsoft's Troubleshooting Microsoft Exchange Server Performance, available at **http://technet.microsoft.com/en-us/library/dd335215.aspx**

Targeted Customer Profile

The FlashStation FS3017 solution for Microsoft Exchange 2013 from Synology is designed for reliability, cost-efficient and ultra-high performance. It is scalable for any size organization that wants to deploy Microsoft Exchange Server on premise in physical or virtual environments. The characteristics of this solution include:

- 20,000 active user mailboxes
- 1.0 IOPS per user mailbox
- 1,024 MB capacity per user mailbox
- 12 virtualized Microsoft Exchange Servers, each with 1,667 active users
- Native Database Availability Group (DAG) replication for mailbox resiliency and high availability with 2 database copies maintained
- 24x7 background database maintenance (BDM) enabled
- 1 FlashStation FS3017 main unit

Tested Deployment

The following tables summarize the testing environment:

° Simulated Exchange Configuration:

Number of Exchange mailboxes simulated	20000
Number of Database Availability Groups (DAGs)	2
Number of servers/DAG	12
Number of active mailboxes/server	1667
Number of databases/host	2
Number of copies/database	2
Number of mailboxes/database	834
Simulated profile: I/O's per second per mailbox (IOPS, include 20% headroom)	1 (no headroom)
Database LUN size	880GB
Log LUN size	100GB
Total database size for performance testing	20.625TB (880x24)
% storage capacity used by Exchange database[1]	98.8% (20.64/20.88)

1. 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.

- Storage Hardware

Storage Connectivity (Fiber Channel, SAS, SATA, iSCSI)	iSCSI
Storage model and OS/firmware revision	Synology FlashStation FS3017, DSM 6.1 -15095
Storage cache	1142TB at maximum
Number of storage controllers	1
Number of storage ports	2 x 10GbE (RJ45), PCIe 3.0 slots for optional 10GbE/25GbE/40GbE network interface cards
Maximum bandwidth of storage connectivity to host	Built-in 2x 10Gbps
Switch type/model/firmware revision	NETGEAR ProSafe XS712T FW: 6.1.0.12
HBA model and firmware	N/A
Number of HBAs/host	1
Host server type	2 x Intel Xeon E5-2620 six-core 2.4GHz
Host server DRAM	64GB DDR4 ECC RDIMM
Total number of disks tested in solution	24 SSDs
Maximum number of spindles that can be hosted in the storage	N/A

- Storage Disk Configuration (Mailbox Store Disks)

Disk type, speed and firmware revision	Intel DC S3710 FW: G2010150
Raw capacity per disk (GB)	1.2TB (1200 GB)
Number of physical disks in test	24
Total raw storage capacity (GB)	28800 GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	N/A
RAID level	RAID6
Total formatted capacity	21.74TB
Storage capacity utilization	83% (Formatted capacity/Total raw capacity)
Database capacity utilization	71.7% (Database size / Total raw capacity)

Best Practices

Microsoft Exchange Server is a disk-intensive application. Based on the testing run using the ESRP framework, Synology recommends the following to improve the storage performance.20,000 active user mailboxes

- Use identical drives for better performance optimization and capacity utilization.
- Optimize performance by balancing the workload of both CPUs with even disk groups.
- Create two sets of RAID6 arrays, each RAID6 with one single volume.
- Enable RDMA of the optional Network Interface Card for better performance under the iSCSI environment.
- Do not share Exchange 2013 disks with other IO intensive applications to avoid potential performance impact.

For the Microsoft Exchange 2013 best practices on storage design, please visit **https://technet.microsoft.com/en-us/library/dd346703.aspx**

Backup Strategy

Synology recommends the following Microsoft Exchange Server backup strategies for FS3017.

For local backup, utilize the Snapshot Replication package to have schedulable, near-instantaneous data protection for your Microsoft Exchange Server. It replicates up to 65,000 system-wide backup copies to offsite servers and local volumes, bringing near-instantaneous data protection and ensuring data in iSCSI LUNs remain available in the event of a disaster. This package can provide instant recovery for Microsoft Exchange Server mailboxes.

For local and remote backup, utilize the Hyper Backup package to have an intuitive and integrated backup/restoration solution which allows you to retain/retrieve copies of your precious data and restore applications and system configurations from a point in time. The following backup destinations are supported:

- Local shared folders
- Remote Synology NAS (installation of Hyper Backup Vault required on the destination NAS)
- Remote rsync servers
- Remote OpenStack Swift servers
- Public clouds (e.g. Microsoft Azure)

With block-level incremental backup and cross-version deduplication, Synology Hyper Backup provides multi-version backup with optimized storage space utilization and allows multiple backup destinations to other Database Available Groups (DAGs).

Contact for Additional Information

This ESRP is executed in Synology labs. You may reach us through any of the following channels.

- Support: **support@synology.com**
- Sales: **inquiries@synology.com**

Test Result Summary

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

Reliability

A number of tests in the framework are to check Reliability 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 are analyzed for integrity after the stress test to ensure no database or log corruption.

Results:

1. No errors reported in the saved event log file.
2. No errors reported in the checksum process for the database and log files.

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 request 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.

- Host 1:

Database I/O	
Database Disks Transfers/sec	1964.756
Database Disks Reads/sec	1324.592
Database Disks Writes/sec	658.324
Average Database Disk Read Latency (ms)	3.1545
Average Database Disk Write Latency (ms)	2.038
Transaction Log I/O	
Log Disks Writes/sec	306.321
Average Log Disk Write Latency (ms)	0.345

- Host 2

Database I/O	
Database Disks Transfers/sec	2037.54
Database Disks Reads/sec	1373.482
Database Disks Writes/sec	682.24
Average Database Disk Read Latency (ms)	3.0825
Average Database Disk Write Latency (ms)	2.0535
Transaction Log I/O	
Log Disks Writes/sec	317.251
Average Log Disk Write Latency (ms)	0.352

- Host 3

Database I/O	
Database Disks Transfers/sec	2013.513
Database Disks Reads/sec	1356.828
Database Disks Writes/sec	674.859
Average Database Disk Read Latency (ms)	3.13
Average Database Disk Write Latency (ms)	2.051
Transaction Log I/O	
Log Disks Writes/sec	313.309
Average Log Disk Write Latency (ms)	0.3495

- Host 4

Database I/O	
Database Disks Transfers/sec	1947.951
Database Disks Reads/sec	1313.272
Database Disks Writes/sec	652.863
Average Database Disk Read Latency (ms)	3.119
Average Database Disk Write Latency (ms)	2.0255
Transaction Log I/O	
Log Disks Writes/sec	304.538
Average Log Disk Write Latency (ms)	0.3485

- Host 5

Database I/O	
Database Disks Transfers/sec	2026.945
Database Disks Reads/sec	1365.509
Database Disks Writes/sec	679.608
Average Database Disk Read Latency (ms)	3.1115
Average Database Disk Write Latency (ms)	0.3485
Transaction Log I/O	
Log Disks Writes/sec	315.716
Average Log Disk Write Latency (ms)	0.3485

- Host 6

Database I/O	
Database Disks Transfers/sec	2026.474
Database Disks Reads/sec	1366.517
Database Disks Writes/sec	678.135
Average Database Disk Read Latency (ms)	3.0965
Average Database Disk Write Latency (ms)	2.06
Transaction Log I/O	
Log Disks Writes/sec	313.734
Average Log Disk Write Latency (ms)	0.3535

- Host 7

Database I/O	
Database Disks Transfers/sec	2066.425
Database Disks Reads/sec	1392.834
Database Disks Writes/sec	691.789
Average Database Disk Read Latency (ms)	3.0375
Average Database Disk Write Latency (ms)	4.024
Transaction Log I/O	
Log Disks Writes/sec	321.677
Average Log Disk Write Latency (ms)	0.3425

- Host 8

Database I/O	
Database Disks Transfers/sec	2085.72
Database Disks Reads/sec	1387.133
Database Disks Writes/sec	698.587
Average Database Disk Read Latency (ms)	3.026
Average Database Disk Write Latency (ms)	2.021
Transaction Log I/O	
Log Disks Writes/sec	324.621
Average Log Disk Write Latency (ms)	0.346

- Host 9

Database I/O	
Database Disks Transfers/sec	2032.94
Database Disks Reads/sec	1371.195
Database Disks Writes/sec	679.94
Average Database Disk Read Latency (ms)	3.0255
Average Database Disk Write Latency (ms)	2.0025
Transaction Log I/O	
Log Disks Writes/sec	317.004
Average Log Disk Write Latency (ms)	0.344

- Host 10

Database I/O	
Database Disks Transfers/sec	2044.807
Database Disks Reads/sec	1379.542
Database Disks Writes/sec	683.457
Average Database Disk Read Latency (ms)	3.008
Average Database Disk Write Latency (ms)	1.996
Transaction Log I/O	
Log Disks Writes/sec	317.333
Average Log Disk Write Latency (ms)	0.3455

- Host 11

Database I/O	
Database Disks Transfers/sec	2098.539
Database Disks Reads/sec	1414.596
Database Disks Writes/sec	702.142
Average Database Disk Read Latency (ms)	3.013
Average Database Disk Write Latency (ms)	1.9925
Transaction Log I/O	
Log Disks Writes/sec	325.198
Average Log Disk Write Latency (ms)	0.3415

- Host 12

Database I/O	
Database Disks Transfers/sec	2036.919
Database Disks Reads/sec	1373.246
Database Disks Writes/sec	681.862
Average Database Disk Read Latency (ms)	3.0235
Average Database Disk Write Latency (ms)	2.007
Transaction Log I/O	
Log Disks Writes/sec	317.348
Average Log Disk Write Latency (ms)	0.346

- Aggregate Performance across all servers Metrics

The sum of I/O's across servers in solution and the average latency across all all servers in solution.

Database I/O	
Database Disks Transfers/sec	24,382.529
Database Disks Reads/sec	16,418.746
Database Disks Writes/sec	8,163.806
Average Database Disk Read Latency (ms)	3.069
Average Database Disk Write Latency (ms)	2.052
Transaction Log I/O	
Log Disks Writes/sec	3,794.05
Average Log Disk Write Latency (ms)	0.347

Database Backup/Recovery Performance

There are two test reports in this section. The first one is to measure the sequential read rate of the database files, and the second is to measure the recovery/replay performance (playing transaction logs into the database).

° Database Read-only Performance

The test measures the maximum rate at which databases could be backed up via VSS. The following table shows the average backup transfer rate for a single database file and on a single server.

For additional detailed test results, please see Appendix: Jetstress Test Reports.

- Host 1:

MB read/sec per database	95.11 MB/s
MB read/sec total per server	190.21 MB/s

- Host 2:

MB read/sec per database	94.04 MB/s
MB read/sec total per server	188.08 MB/s

- Host 3:

MB read/sec per database	94.56 MB/s
MB read/sec total per server	189.13 MB/s

- Host 4:

MB read/sec per database	94.21 MB/s
MB read/sec total per server	188.42 MB/s

- Host 5:

MB read/sec per database	94.90 MB/s
MB read/sec total per server	189.80 MB/s

- Host 6:

MB read/sec per database	95.89 MB/s
MB read/sec total per server	191.78 MB/s

- Host 7:

MB read/sec per database	99.12 MB/s
MB read/sec total per server	198.24 MB/s

- Host 8:

MB read/sec per database	99.00 MB/s
MB read/sec total per server	198.00 MB/s

- Host 9:

MB read/sec per database	97.11 MB/s
MB read/sec total per server	194.22 MB/s

- Host 10:

MB read/sec per database	97.65 MB/s
MB read/sec total per server	195.29 MB/s

- Host 11:

MB read/sec per database	95.56 MB/s
MB read/sec total per server	191.11 MB/s

- Host 12:

MB read/sec per database	96.80 MB/s
MB read/sec total per server	193.60 MB/s

Database Read-only Performance Summary

Average MB read/sec per database	96.16 MB/s
Average MB read/sec total per server	192.32 MB/s
MB read/sec total of all 12 servers	2,307.88 MB/s

Conclusion

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

The FS3017 used in this ESRP demonstrates the following.

- 20,000 mailboxes contained in just 2U of rack space
- 1 IOPS per mailbox with enough head room for growth and for running other workloads

ESRP program is not designed to be a benchmarking program. Its tests are not designed for getting the maximum throughput for a given solution. Rather, they are focused on producing recommendations from Synology for the Exchange application. Therefore, the data presented in this document should not be used for direct comparisons among the solutions.

Appendix A: 2-Hour Performance Test

Microsoft Exchange Jetstress 2013

Performance Test Result Report

Test Summary

Overall Test Result	**Pass**
Machine Name	WIN-5JQOAMP1SPE
Test Description	
Test Start Time	4/21/2017 12:00:13 PM
Test End Time	4/21/2017 2:23:08 PM
Collection Start Time	4/21/2017 12:00:44 PM
Collection End Time	4/21/2017 2:00:42 PM
Jetstress Version	15.01.0466.031
ESE Version	15.00.0516.026
Operating System	Windows Server 2012 R2 Standard Evaluation (6.2.9200.0)
Performance Log	C:\Users\Administrator\Desktop\ESRP 1\20000_1_10G_12_24d_128IO_vol2_thin_mix_E8T\Performance_2017_4_21_12_0_18.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1964.756
Target Transactional I/O per Second	1667
Initial Database Size (bytes)	1793547436032
Final Database Size (bytes)	1797490081792
Database Files (Count)	2

Jetstress System Parameters

Thread Count	8
Minimum Database Cache	64.0 MB
Maximum Database Cache	512.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2

Database Configuration

Instance2220.1 Log path: G:\
Database: E:\Jetstress001001.edb

Instance2220.2 Log path: H:\
Database: F:\Jetstress002001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2220.1	3.908	2.282	652.742	326.282	33057.696	34506.903	0.000	0.402	0.000	151.499	0.000	7760.473
Instance2220.2	2.401	1.794	653.690	332.042	33026.407	34455.677	0.000	0.288	0.000	154.822	0.000	7692.524

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2220.1	9.062	261773.658
Instance2220.2	9.097	261716.578

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2220.1	3.464	232076.263
Instance2220.2	3.445	232073.577

Appendix B: 24-Hour Performance Test

Microsoft Exchange Jetstress 2013

Stress Test Result Report

Test Summary

Overall Test Result	**Pass**
Machine Name	WIN-5JQOAMP1SPE
Test Description	
Test Start Time	4/22/2017 8:10:24 PM
Test End Time	4/23/2017 8:14:32 PM
Collection Start Time	4/22/2017 8:10:46 PM
Collection End Time	4/23/2017 8:10:33 PM
Jetstress Version	15.01.0466.031
ESE Version	15.00.0516.026
Operating System	Windows Server 2012 R2 Standard Evaluation (6.2.9200.0)
Performance Log	C:\Users\Administrator\Desktop\ESRP 1\20000_1_10G_12_24d_128IO_vol2_thin_mix_E8T\Stress_2017_4_22_20_10_30.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1739.108
Target Transactional I/O per Second	1667
Initial Database Size (bytes)	1833879863296
Final Database Size (bytes)	1869254623232
Database Files (Count)	2

Jetstress System Parameters

Thread Count	8
Minimum Database Cache	64.0 MB
Maximum Database Cache	512.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2

Database Configuration

Instance2220.1 Log path: G:\
Database: E:\Jetstress001001.edb

Instance2220.2 Log path: H:\
Database: F:\Jetstress002001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2220.1	4.292	2.398	580.905	290.085	33047.865	34099.034	0.000	0.406	0.000	132.696	0.000	7668.637
Instance2220.2	2.852	1.813	577.126	290.992	33058.477	34099.611	0.000	0.269	0.000	134.971	0.000	7632.081

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2220.1	9.044	261685.956
Instance2220.2	9.085	261736.433

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2220.1	2.971	232357.520
Instance2220.2	2.972	232319.067

Appendix C: Database Backup Test

Microsoft Exchange Jetstress 2013

Database backup Test Result Report

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance2220.1	891346.09	02:37:41	94.20
Instance2220.2	891298.09	02:34:43	96.01
Avg			95.11
Sum			190.21

Jetstress System Parameters

Thread Count	8
Minimum Database Cache	64.0 MB
Maximum Database Cache	512.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance2220.1 Log path: G:\
Database: E:\Jetstress001001.edb

Instance2220.2 Log path: H:\
Database: F:\Jetstress002001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2220.1	4.206	0.000	376.002	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance2220.2	4.048	0.000	383.397	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	52.531	41.697	76.055
Available MBytes	1374.473	682.000	3353.000
Free System Page Table Entries	16630853.743	16630569.000	16630972.000
Transition Pages RePurposed/sec	1.682	0.000	321.299
Pool Nonpaged Bytes	98341527.162	90697728.000	101171200.000
Pool Paged Bytes	89930319.644	89739264.000	90157056.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

4/24/2017 12:55:21 AM -- Preparing for testing ...
4/24/2017 12:55:25 AM -- Attaching databases ...
4/24/2017 12:55:25 AM -- Preparations for testing are complete.
4/24/2017 12:55:28 AM -- Performance logging started (interval: 30000 ms).
4/24/2017 12:55:28 AM -- Backing up databases ...
4/24/2017 3:33:10 AM -- Performance logging has ended.
4/24/2017 3:33:10 AM -- Instance2220.1 (100% processed) and Instance2220.2 (100% processed)
4/24/2017 3:33:10 AM -- C:\Users\Administrator\Desktop\ESRP 1\20000_1_10G_12_24d_128IO_vol2_thin_mix_E8T\DatabaseBackup_2017_4_24_0_55_25.blg has 315 samples.
4/24/2017 3:33:10 AM -- Creating test report ...

Appendix D: Soft Recovery Test

Microsoft Exchange Jetstress 2013

SoftRecovery Test Result Report

Soft-Recovery Statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance2220.1	506	320.5787885
Instance2220.2	501	308.3912422
Avg	503	314.485
Sum	1007	628.9700307

Database Configuration

Instance2220.1 Log path: G:\
Database: E:\Jetstress001001.edb

Instance2220.2 Log path: H:\
Database: F:\Jetstress002001.edb

Transactional I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2220.1	6.878	1.319	1372.788	6.217	40339.292	32768.000	3.105	0.000	7.787	0.000	209696.987	0.000
Instance2220.2	6.595	1.356	1428.623	6.384	40335.839	32768.000	2.974	0.010	8.009	0.007	209775.814	26.947

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2220.1	9.014	261729.215
Instance2220.2	9.021	261842.757

Total I/O Performance

MSExchange Database ==> Instances	I/O Database Reads Average Latency (msec)	I/O Database Writes Average Latency (msec)	I/O Database Reads/sec	I/O Database Writes/sec	I/O Database Reads Average Bytes	I/O Database Writes Average Bytes	I/O Log Reads Average Latency (msec)	I/O Log Writes Average Latency (msec)	I/O Log Reads/sec	I/O Log Writes/sec	I/O Log Reads Average Bytes	I/O Log Writes Average Bytes
Instance2220.1	6.878	1.319	1381.802	6.217	41783.526	32768.000	3.105	0.000	7.787	0.000	209696.987	0.000
Instance2220.2	6.595	1.356	1437.643	6.384	41725.716	32768.000	2.974	0.010	8.009	0.007	209775.814	26.947

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	39.918	20.154	63.566
Available MBytes	1664.799	719.000	3259.000
Free System Page Table Entries	16630685.063	16630546.000	16630742.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	94786952.855	91811840.000	98471936.000
Pool Paged Bytes	91415378.113	91381760.000	91537408.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```
4/24/2017 10:10:08 AM -- Preparing for testing ...
4/24/2017 10:10:12 AM -- Attaching databases ...
4/24/2017 10:10:12 AM -- Preparations for testing are complete.
4/24/2017 10:10:12 AM -- Starting transaction dispatch ..
4/24/2017 10:10:12 AM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
4/24/2017 10:10:12 AM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
4/24/2017 10:10:14 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/24/2017 10:10:14 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/24/2017 10:10:14 AM -- Operation mix: Sessions 8, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/24/2017 10:10:14 AM -- Performance logging started (interval: 15000 ms).
4/24/2017 10:10:14 AM -- Generating log files ...
4/24/2017 10:33:56 AM -- G:\ (101.2% generated) and H:\ (100.2% generated)
4/24/2017 10:33:56 AM -- Performance logging has ended.
4/24/2017 10:33:56 AM -- JetInterop batch transaction stats: 21694 and 21693.
4/24/2017 10:33:56 AM -- Dispatching transactions ends.
4/24/2017 10:33:57 AM -- Shutting down databases ...
```