



# Infotrend EonStor DS 3016G iSCSI 1G 3,000 mailbox resiliency Exchange Server 2013 storage solution

Technical white paper

## **Abstract:**

**EonStor DS 3016G RAID subsystems offer high performance entry-level storage solutions with the reliability and scalability enterprises demand in Microsoft Exchange-based email servers. This technical white paper covers in detail the testing done to Microsoft ESRP standards in establishing the email server capabilities of the EonStor DS 3016G. Extensive test result data is provided to help customers make an informed decision when choosing a new email server and storage solution that is able to handle the needs of thousands of users.**

**Tested with: ESRP – Storage Version 4.0**

**Tested Date: 2013/09/24**

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# Overview

This document provides information on Infortrend storage solutions for Microsoft Exchange Server, based the Microsoft Exchange Solution Reviewed Program (ESRP)\*. For any questions or comments regarding the contents of this document, see [Contact for Additional Information](#).

\*The ESRP program was developed by Microsoft and provides a common storage testing framework for vendors to publish information on storage solutions for Microsoft Exchange Server software. For more details on this program, please visit <http://technet.microsoft.com/en-us/exchange/ff182054>

# Disclaimer

This document has been produced independently of Microsoft Corporation. Microsoft Corporation expressly disclaims responsibility for, and makes no warranty, express or implied, with respect to the accuracy of the contents of this document.

The information contained in this document represents the current view of Infortrend on the issues discussed as of the date of publication. Due to changing market conditions, it should not be interpreted to be a commitment on the part of Infortrend, and Infortrend cannot guarantee the accuracy of any information presented after the date of publication.

# Features

The attractively-priced single controller EonStor DS 3016G RAID system offers a 3U 16-bay solution featuring optional 1GbE iSCSI host connectivity. With its excellent cost to performance ratio, it brings enterprises a fully-featured entry level array for SAN applications, supporting seamless networking and virtualization. Customers can scale up to 316 drives via 6Gb/s SAS enclosures, unlocking large capacities for future growth. Due to its swappable controller, fan module, and dual power supplies, the EonStor DS 3016G is easy to maintain and upgrade with minimal downtime.

## Key feature list

- **Host ports:** four 1GbE iSCSI
- **Expansion scalability:** up to 316 HDDs
- **Availability and reliability:** redundant, hot-swappable hardware modules include controller, power supply, and cooling fan, with high availability hardware design preventing single points of failure
- **Capacity efficiency:** thin provisioning ensures the most efficient allocation of pooled capacity
- **Easy deployment and management:** powerful SANWatch management software suite
- **Green design:** high efficiency power supplies and intelligent multi-level drive spin-down technology
- **Data protection:** snapshot and volume copy/mirror

For detailed product information, please check

<http://infortrend.com/global/products/models/ESDS%203016G>

# Solution description

Total HDDs deployed: 16

- 15 spindles in a RAID 5 disk group
- 6 Exchange databases per disk group
- 1 spare drive

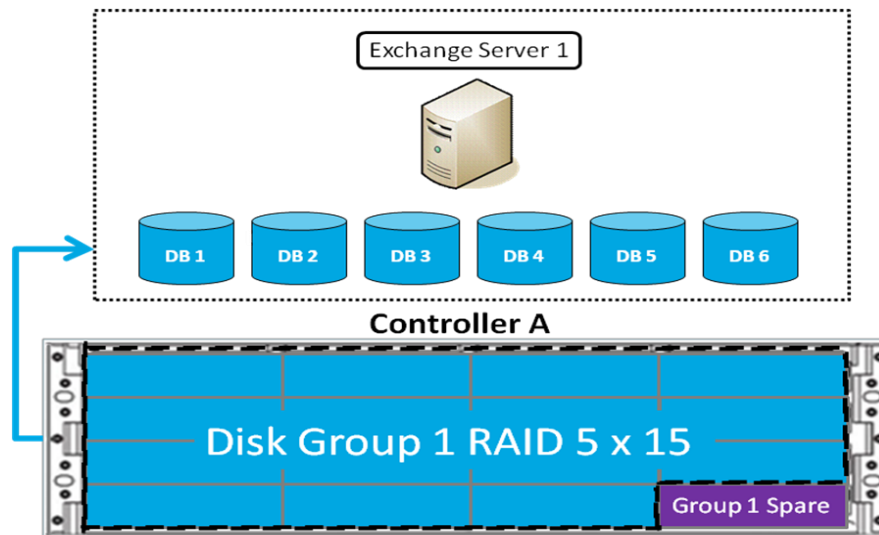


Figure 1: solution configuration

One RAID 5 disk group was created with 15 HDDs in this solution. The disk group was divided to 6 LUNs for a total of 6 databases hosted by 1 active Exchange server. Figure 1 shows the complete architecture of this solution.

A total 6 databases were tested with 1 exchange server in this solution. The server hosts 6 databases and each database has 1 active at the local site and 1 passive at the remote site. The servers were configured in the same DAG for Exchange 2013 built-in database recovery and high availability mailbox resiliency in the event of failure.

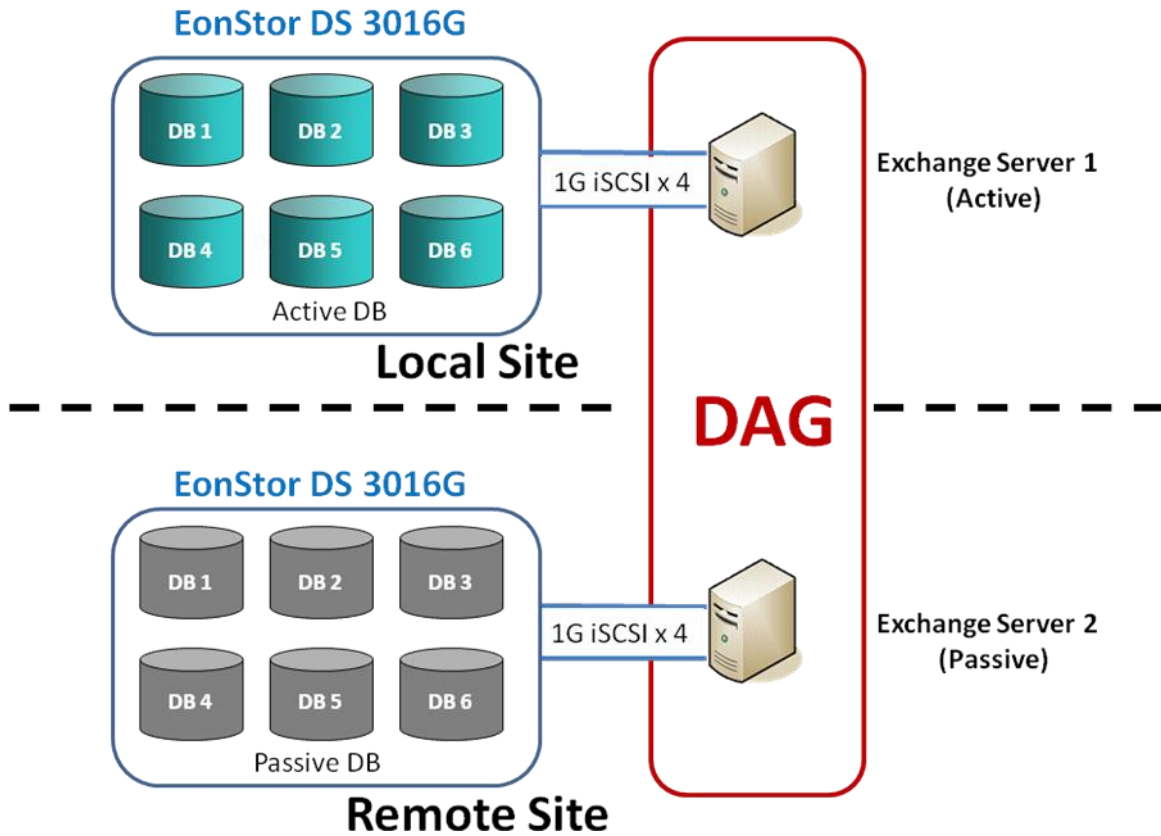


Figure 2: database architecture

One server was deployed in this solution with multipath I/O configured. Figure 3 shows the complete diagram.

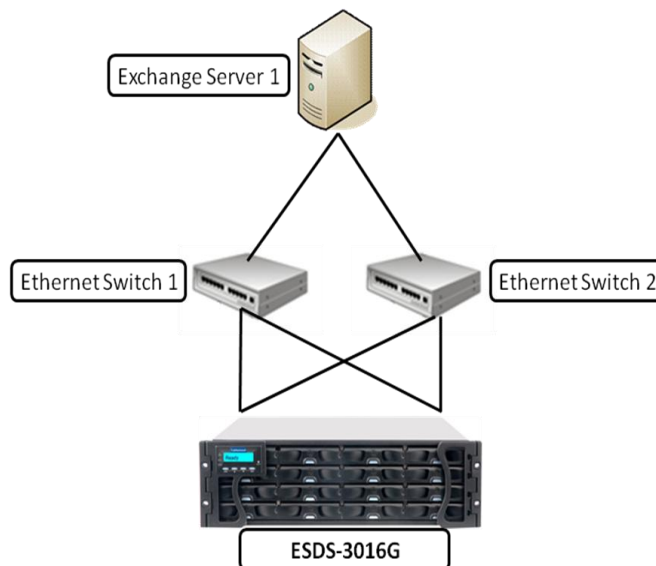


Figure 3: solution connection topology

The ESRP 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 server scalability are server processor utilization, server physical and virtual memory limitations, resource requirements for applications,

directory and network service latencies, network infrastructure limitations, replication and recovery requirements, and client usage profiles. All these factors are beyond the scope of ESRP. Therefore, the number of mailboxes hosted per server as part of the tested configuration may not necessarily be viable for some customer deployments.

For more information on identifying and addressing performance bottlenecks in an Exchange system, please refer to Troubleshooting Microsoft Exchange Server Performance, available at <http://technet.microsoft.com/en-us/library/dd335215.aspx>

# Targeted customer profile

This solution targets a 3,000-user Exchange environment, found in medium and large enterprises. The EonStor DS (iSCSI) provides an excellent price point and performance through replication, backup, and disaster recovery features. It was also designed for easy deployment and maintenance without IT professionals involved.

The solution was tested with the following parameters:

- 3,000 mailboxes
- 3GB capacity per mailbox
- 0.16 user profile (including 20% headroom)
- Tested with 1 server
- 24x7 background database maintenance enabled
- Mailbox resiliency
- 10% of capacity reserved for EonStor DS snapshot technology for data protection

# Tested deployment

The following tables summarize the test environment

## Simulated Exchange configuration

Number of Exchange mailboxes simulated	3,000
Number of database availability groups (DAGs)	1
Number of servers/DAGs	2 (1 active/1 passive)
Number of active mailboxes/server	3,000
Number of databases/host	6
Number of copies/database	2
Number of mailboxes/database	500
Simulated profile: I/O per second per mailbox (IOPS, include 20% headroom)	0.16
Database/log LUN size	2TB
Total database size for performance testing	9TB
Storage capacity used by Exchange database**	75%

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



## Storage hardware

Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	iSCSI
Storage model and OS/firmware revision	ESDS-3016G Firmware version: FA511G19
Storage cache	8GB per controller
Number of storage controllers	1
Number of storage ports	4
Maximum bandwidth of storage connectivity to host	4Gb/s (4 x 1Gb/s iSCSI )
Switch type/model/firmware revision	N/A
HBA model and firmware	Intel PRO 1000 PT Quad Port LP
Number of HBAs/host	4 x quad-port 1Gb/s Ethernet adapter
Host server type	Intel Xeon L5410 2.33GHz x 8GB RAM
Total number of disks tested in solution	16 (15 + 1 spare)
Maximum number of spindles hosted	316

## Storage software

HBA driver	Version: 9.15.17.0
HBA queue target setting	N/A
HBA queue depth setting	N/A
Multi-pathing	EonPath v1.23.2.50
Host OS	Windows Server 2008 R2 64-bit
ESE.dll file version	15.00.0516.026
Replication solution name/version	N/A

## Storage disk configuration (mailbox store disks)

Disk type, speed, and firmware revision	7.2k RPM NL-SAS HDD
Raw capacity per disk (GB)	3,000GB
Number of physical disks in test	15 + 1 spare
Total raw storage capacity (GB)	48,000GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	15 disks per 6 LUNs

RAID level	RAID 5
Total formatted capacity	12,000GB
Storage capacity utilization	25%
Database capacity utilization	18.75%

## Storage disk configuration (transactional log disks)

Disk type, speed, and firmware revision	7.2k RPM NL-SAS HDD
Raw capacity per disk (GB)	3,000GB
Number of spindles in test	15 + 1 spare
Total raw storage capacity (GB)	48,000GB
Disk slice size (GB)	N/A
Number of slices per LUN or number of disks per LUN	15 disks per 6 LUNs
RAID level	RAID 5
Total formatted capacity	12,000GB

# Best practices

Exchange Server is a disk-intensive application. Based on testing run using the ESRP framework, Infortrend recommends the following to improve storage performance:

## EonStor DS

- Capacity and performance
  - Mailbox capacity
  - Performance requirements
  - Future growth

This solution includes best practices for initial deployment of EonStor DS for Microsoft Exchange 2013, considering both mailbox capacity and performance requirements. The type and amount of hard disk drives is the key factor in this solution when thinking of future growth in data size and usage. Please refer to the official Microsoft Exchange 2013 best practices for storage design: <http://technet.microsoft.com/en-us/library/dd346703.aspx>.

- Layout
  - Number of databases
  - Database size

Since larger *and* more numerous databases may cause higher performance impact, it is recommended to follow this white paper for best practice when configuring the number of databases and database size while using EonStor DS for Exchange 2013 deployment. It has been shown that with the same total available capacity, deploying smaller but more numerous databases causes a higher impact than deploying fewer databases that are larger in individual size.

- Windows Server 2008 R2 no longer requires diskpart for partitioning and aligning sector boundaries. For Windows Server 2003, use diskpart to align sectors to 64k
- It is not recommended to share Exchange 2013 disks with other I/O-intensive applications as this may cause performance impact
- Database and log I/O no longer need to be isolated in Exchange 2013
- Format database and log LUN using 64k allocation size
- Minimize the number of databases but increase individual database size
- Minimize the number of disk groups as multiple disk groups hosted by a single server may cause lower performance than single disk groups
- Use identical drives for better performance optimization and capacity utilization
- Optimize performance by balancing the load of both controllers with even disk groups

## **Backup strategy**

This solution includes Infortrend snapshot technology for Exchange Server data protection. For database backup, deployment of capacity expansion will be required in addition to this solution.

# Contact for additional information

For more information about the EonStor DS 3016G, please visit the product page:

<http://infortrend.com/global/products/models/ESDS%203016G>

For more information about Infortrend storage solutions, we recommend you consult with Infortrend directly to assist with related product and service information. You can also visit the Infortrend website: <http://www.infortrend.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 the ESRP testing framework. Please check the [Appendix](#) for detailed information about test results.

## Reliability

A number of tests in the framework check reliability over a 24hr period. The goal is to verify whether storage can handle high I/O load for a long period of time. Both log and database files are analyzed for integrity after the stress test to ensure no database/log corruption. Please check [Appendix A: Stress Test](#) for detailed results.

The following list provides an overview (clicking on underlined words shows the post-reliability test HTML report)

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

## Storage performance results

Primary storage performance testing is designed to exercise storage with maximum sustainable Exchange-type I/O for 2 hours. The test shows how long it takes for storage to respond to an I/O under load. The data below is the sum of all of the logical disk I/Os and average of all the logical disk I/O latency in the 2 hour test duration. Each server is listed separately, and the aggregate numbers across all servers are listed as well. Please check [Appendix B: Performance Test](#) for detailed results.

### Individual server metrics:

The sum of I/Os across storage groups and the average latency across all storage groups on a per server basis

#### Server 1

Database I/O	
Database disk transfers/sec	575.44
Database disk reads/sec	401.197
Database disk writes/sec	172.244
Average database disk read latency (ms)	16.779
Average database disk write latency (ms)	2.6205

<b>Transaction log I/O</b>	
Log disk writes/sec	122.456
Average log disk write latency (ms)	1.3705

**Aggregate performance across all server metrics:**

The sum of I/Os and average latency across all servers in the solution

<b>Database I/O</b>	
Database disk transfers/sec	575.44
Database disk reads/sec	401.197
Database disk writes/sec	172.244
Average database disk read latency (ms)	16.779
Average database disk write latency (ms)	2.6205
<b>Transaction log I/O</b>	
Log disk writes/sec	122.456
Average log disk write latency (ms)	1.3705

## Database backup/recovery performance

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

### Database read-only performance

The test measures the maximum rate at which databases can be backed up via VSS. The following table shows the average rate for a single database file. Please check [Appendix C: Database Backup Test](#) for detailed results.

MB read/sec per database	38.33
MB read/sec total per server	229.95

### Transaction log recovery/replay performance

The test measures the maximum rate at which log files can be played against databases. The following table shows the average rate for 500 log files played in a single storage group. Each log file is 1MB. Please check [Appendix D: Soft Recovery Test](#) for detailed results.

Average time to play one log file (sec)	2.3155
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# Conclusions

The information discussed in this report describes the best practices and test reports for EonStor DS 3016G supporting 3,000 users. Tests were conducted under the environment listed in the [Tested Deployment](#) section. Test results show that the EonStor DS 3016G is capable of handling the specified number of users without using up its performance resources.

This document developed by storage solution providers and reviewed by the Microsoft Exchange Product team. Test results/data presented in this document based on tests introduced in the ESRP test framework. Customers should not quote data directly for their pre-deployment verification. It is still necessary to validate storage design for every specific customer environment.

ESRP is not designed to be a benchmark. Tests are not designed to get maximum throughput for a given solution. Rather, it is focused on producing recommendations from vendors for Exchange applications. Data presented in this document should not be used for direct comparisons among solutions.

# Appendix: test reports

This appendix contains Microsoft Exchange Jetstress 2013 test results for one of the servers used in testing the storage solution. Results are representative of those obtained for all servers tested.

## Appendix A: stress test

### Microsoft Exchange Jetstress 2013

### 24hr stress test (server 1)

#### Test summary

Overall test result	Pass
Machine name	WIN-2IPTC89B5DU
Test description	
Test start time	9/25/2013 9:34:10 AM
Test end time	9/26/2013 1:17:35 PM
Collection start time	9/25/2013 9:37:03 AM
Collection end time	9/26/2013 9:36:59 AM
Jetstress version	15.00.0658.004
ESE version	15.00.0516.026
Operating system	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance log	<a href="C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress_2013_9_25_9_34_24.blg">C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress_2013_9_25_9_34_24.blg</a>

#### Database sizing and throughput

Achieved transactional I/O per second	574.397
Target transactional I/O per second	480
Initial database size (bytes)	9460775256064
Final database size (bytes)	9479414743040
Database files (count)	6

#### Jetstress system parameters

Thread count	12
Minimum database cache	192.0 MB
Maximum database cache	1536.0 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

<b>Instance2716.1</b>	Log path: J:\log1 Database: J:\db1\Jetstress001001.edb
<b>Instance2716.2</b>	Log path: I:\log2 Database: I:\db2\Jetstress002001.edb
<b>Instance2716.3</b>	Log path: K:\log3 Database: K:\db3\Jetstress003001.edb
<b>Instance2716.4</b>	Log path: G:\log4 Database: G:\db4\Jetstress004001.edb
<b>Instance2716.5</b>	Log path: F:\log5 Database: F:\db5\Jetstress005001.edb
<b>Instance2716.6</b>	Log path: H:\log6 Database: H:\db6\Jetstress006001.edb

### Transactional I/O performance

MS Exchange database ==> instances	I/O reads average latency (msec)	I/O 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 (msec)	I/O log writes average (msec)	I/O log reads/sec	I/O log writes/sec	I/O log reads average bytes	I/O log writes average bytes
<b>Instance2716.1</b>	18.228	3.390	66.662	29.031	32953.752	35432.333	0.000	1.387	0.000	20.230	0.000	7906.661
<b>Instance2716.2</b>	16.642	2.953	66.684	29.092	32955.760	35416.832	0.000	1.376	0.000	20.267	0.000	7922.953
<b>Instance2716.3</b>	16.354	2.577	66.621	28.980	32968.962	35423.071	0.000	1.373	0.000	20.309	0.000	7896.043
<b>Instance2716.4</b>	16.319	2.245	66.663	29.105	32964.371	35396.862	0.000	1.375	0.000	20.313	0.000	7913.828
<b>Instance2716.5</b>	16.648	2.060	66.670	29.068	32966.137	35424.026	0.000	1.374	0.000	20.245	0.000	7920.623
<b>Instance2716.6</b>	17.468	2.103	66.697	29.126	32963.050	35402.428	0.000	1.388	0.000	20.348	0.000	7896.057

### Background database maintenance I/O performance

MS Exchange database ==> instances	Database maintenance I/O reads/sec	Database maintenance I/O reads average bytes
<b>Instance2716.1</b>	8.594	261872.594
<b>Instance2716.2</b>	8.604	261877.023

<b>Instance2716.3</b>	8.619	261859.796
<b>Instance2716.4</b>	8.627	261882.952
<b>Instance2716.5</b>	8.624	261877.654
<b>Instance2716.6</b>	8.609	261862.753

### Log replication I/O performance

<b>MS Exchange database ==&gt; instances</b>	<b>I/O log reads/sec</b>	<b>I/O log reads average bytes</b>
<b>Instance2716.1</b>	0.465	179724.565
<b>Instance2716.2</b>	0.466	179757.381
<b>Instance2716.3</b>	0.465	179251.195
<b>Instance2716.4</b>	0.467	180156.101
<b>Instance2716.5</b>	0.466	179428.015
<b>Instance2716.6</b>	0.466	179769.346

### Total I/O performance

<b>MS Exchange database ==&gt; instances</b>	<b>I/O database reads average latency (msec)</b>	<b>I/O database writes average latency (msec)</b>	<b>I/O Database reads/sec</b>	<b>I/O Database writes/sec</b>	<b>I/O database reads average bytes</b>	<b>I/O Database writes average bytes</b>	<b>I/O log reads average latency (msec)</b>	<b>I/O log writes average latency (msec)</b>	<b>I/O log reads/sec</b>	<b>I/O log writes/sec</b>	<b>I/O log reads average bytes</b>	<b>I/O log writes average bytes</b>
<b>Instance2716.1</b>	18.228	3.390	75.256	29.031	59096.345	35432.333	2.766	1.387	0.465	20.230	179724.565	7906.665
<b>Instance2716.2</b>	16.642	2.953	75.288	29.092	59116.479	35416.832	2.827	1.376	0.466	20.267	179757.381	7922.981
<b>Instance2716.3</b>	16.354	2.577	75.240	28.980	59190.635	35423.071	2.812	1.373	0.465	20.309	179251.195	7896.095
<b>Instance2716.4</b>	16.319	2.245	75.290	29.105	59195.735	35396.862	2.838	1.375	0.467	20.313	180156.101	7913.801
<b>Instance2716.5</b>	16.648	2.060	75.294	29.068	59185.639	35424.026	2.762	1.374	0.466	20.245	179428.015	7920.615
<b>Instance2716.6</b>	17.468	2.103	75.306	29.126	59131.681	35402.428	2.771	1.388	0.466	20.348	179769.346	7896.046

### Host system performance

<b>Counter</b>	<b>Average</b>	<b>Minimum</b>	<b>Maximum</b>
<b>% processor time</b>	0.602	0.000	1.869
<b>Available MB</b>	44599.429	44563.000	44809.000
<b>Free system page table entries</b>	33555941.921	33555354.000	33557072.000

<b>Transition pages repurposed/sec</b>	0.000	0.000	0.000
<b>Pool non-paged bytes</b>	53688891.816	53276672.000	55304192.000
<b>Pool paged bytes</b>	162674912.312	162037760.000	163090432.000
<b>Database page fault stalls/sec</b>	0.000	0.000	0.000

## Test log

9/25/2013 9:34:10 AM -- Preparing for testing ...

9/25/2013 9:34:17 AM -- Attaching databases ...

9/25/2013 9:34:17 AM -- Preparations for testing are complete.

9/25/2013 9:34:17 AM -- Starting transaction dispatch ..

9/25/2013 9:34:17 AM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)

9/25/2013 9:34:17 AM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)

9/25/2013 9:34:24 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).

9/25/2013 9:34:24 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).

9/25/2013 9:34:33 AM -- Operation mix: Sessions 12, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

9/25/2013 9:34:33 AM -- Performance logging started (interval: 15000 ms).

9/25/2013 9:34:33 AM -- Attaining prerequisites:

9/25/2013 9:37:03 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1451893000.0 (lower bound: 1449551000.0, upper bound: none)

9/26/2013 9:37:03 AM -- Performance logging has ended.

9/26/2013 1:17:30 PM -- JetInterop batch transaction stats: 221598, 221598, 221597, 221597, 221597 and 221597.

9/26/2013 1:17:30 PM -- Dispatching transactions ends.

9/26/2013 1:17:30 PM -- Shutting down databases ...

9/26/2013 1:17:35 PM -- Instance2716.1 (complete), Instance2716.2 (complete), Instance2716.3 (complete), Instance2716.4 (complete), Instance2716.5 (complete) and Instance2716.6 (complete)

9/26/2013 1:17:35 PM -- <C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress 2013 9 25 9 34 24.blg> has 5761 samples.

9/26/2013 1:17:35 PM -- Creating test report ...

9/26/2013 1:18:22 PM -- Instance2716.1 has 18.2 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.1 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.1 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.2 has 16.6 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.2 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.2 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.3 has 16.4 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.3 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.3 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.4 has 16.3 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.4 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.4 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.5 has 16.6 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.5 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.5 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.6 has 17.5 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.6 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.6 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

9/26/2013 1:18:22 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.

9/26/2013 1:18:22 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress\\_2013\\_9\\_25\\_9\\_34\\_24.xml](C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress_2013_9_25_9_34_24.xml) has 5751 samples queried.

## Stress test database checksum (server 1)

### Checksum statistics - all

Database	Seen pages	Bad pages	Correctable pages	Wrong page number pages	File length/seconds taken
J:\db1\Jetstress001001.edb	48214370	0	0	0	1506699 MB/19629 sec
I:\db2\Jetstress002001.edb	48214370	0	0	0	1506699 MB/19603 sec
K:\db3\Jetstress003001.edb	48214882	0	0	0	1506715 MB/19598 sec
G:\db4\Jetstress004001.edb	48215394	0	0	0	1506731 MB/19596 sec
F:\db5\Jetstress005001.edb	48214882	0	0	0	1506715 MB/19595 sec
H:\db6\Jetstress006001.edb	48214882	0	0	0	1506715 MB/19603 sec
(Sum)	289288780	0	0	0	9040274 MB/19629 sec

### Disk subsystem performance (checksum)

Logical disk	Avg. disk sec/read	Avg. disk sec/write	Disk reads/sec	Disk writes/sec	Avg. disk bytes/read
J:	0.035	0.000	1228.114	0.000	65535.997
I:	0.036	0.000	1229.473	0.000	65536.000
K:	0.036	0.000	1229.961	0.000	65536.000
G:	0.037	0.000	1230.222	0.000	65536.000
F:	0.036	0.000	1230.240	0.000	65536.000
H:	0.035	0.000	1229.526	0.000	65536.000

### Memory system performance (checksum)

Counter	Average	Minimum	Maximum
% processor time	6.471	5.769	7.991
Available MB	46321.511	46229.000	46386.000
Free system page table entries	33555976.237	33555472.000	33557014.000
Transition pages repurposed/sec	0.000	0.000	0.000
Pool non-paged bytes	56409805.113	54091776.000	59461632.000
Pool paged bytes	155341733.187	148488192.000	185237504.000

## Test log

9/25/2013 9:34:10 AM -- Preparing for testing ...

9/25/2013 9:34:17 AM -- Attaching databases ...

9/25/2013 9:34:17 AM -- Preparations for testing are complete.

9/25/2013 9:34:17 AM -- Starting transaction dispatch ..

9/25/2013 9:34:17 AM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)

9/25/2013 9:34:17 AM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)

9/25/2013 9:34:24 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).

9/25/2013 9:34:24 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).

9/25/2013 9:34:33 AM -- Operation mix: Sessions 12, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

9/25/2013 9:34:33 AM -- Performance logging started (interval: 15000 ms).

9/25/2013 9:34:33 AM -- Attaining prerequisites:

9/25/2013 9:37:03 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1451893000.0 (lower bound: 1449551000.0, upper bound: none)

9/26/2013 9:37:03 AM -- Performance logging has ended.

9/26/2013 1:17:30 PM -- JetInterop batch transaction stats: 221598, 221598, 221597, 221597, 221597 and 221597.

9/26/2013 1:17:30 PM -- Dispatching transactions ends.

9/26/2013 1:17:30 PM -- Shutting down databases ...

9/26/2013 1:17:35 PM -- Instance2716.1 (complete), Instance2716.2 (complete), Instance2716.3 (complete), Instance2716.4 (complete), Instance2716.5 (complete) and Instance2716.6 (complete)

9/26/2013 1:17:35 PM -- <C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress 2013 9 25 9 34 24.blg> has 5761 samples.

9/26/2013 1:17:35 PM -- Creating test report ...

9/26/2013 1:18:22 PM -- Instance2716.1 has 18.2 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.1 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.1 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.2 has 16.6 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.2 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.2 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.3 has 16.4 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.3 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.3 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.4 has 16.3 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.4 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.4 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.5 has 16.6 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.5 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.5 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.6 has 17.5 for I/O Database Reads Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.6 has 1.4 for I/O Log Writes Average Latency.

9/26/2013 1:18:22 PM -- Instance2716.6 has 1.4 for I/O Log Reads Average Latency.

9/26/2013 1:18:22 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

9/26/2013 1:18:22 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.

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9/26/2013 1:18:22 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress\\_2013\\_9\\_25\\_9\\_34\\_24.xml](C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress_2013_9_25_9_34_24.xml) has 5751 samples queried.

9/26/2013 1:18:22 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress\\_2013\\_9\\_25\\_9\\_34\\_24.html](C:\Users\Administrator\Desktop\3016G 1G\Stress\Stress_2013_9_25_9_34_24.html) was saved.

9/26/2013 1:18:23 PM -- Performance logging started (interval: 30000 ms).

9/26/2013 1:18:23 PM -- Verifying database checksums ...

9/26/2013 6:45:33 PM -- J: (100% processed), I: (100% processed), K: (100% processed), G: (100% processed), F: (100% processed) and H: (100% processed)

9/26/2013 6:45:33 PM -- Performance logging has ended.

9/26/2013 6:45:33 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Stress\DBChecksum\\_2013\\_9\\_26\\_13\\_18\\_22.blg](C:\Users\Administrator\Desktop\3016G 1G\Stress\DBChecksum_2013_9_26_13_18_22.blg) has 654 samples.



# Appendix B: performance test

## Microsoft Exchange Jetstress 2013

### 2hr performance test (server 1)

#### Test summary

Overall test result	Pass
Machine name	WIN-2IPTC89B5DU
Test description	
Test start time	9/24/2013 3:26:30 PM
Test end time	9/24/2013 5:59:18 PM
Collection start time	9/24/2013 3:29:29 PM
Collection end time	9/24/2013 5:29:20 PM
Jetstress version	15.00.0658.004
ESE version	15.00.0516.026
Operating system	Windows Server 2008 R2 Enterprise (6.1.7600.0)
Performance log	<a href="C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance_2013_9_24_15_26_44.blg">C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance_2013_9_24_15_26_44.blg</a>

#### Database sizing and throughput

Achieved transactional I/O per second	575.44
Target transactional I/O per second	480
Initial database size (bytes)	9459055591424
Final database size (bytes)	9460775256064
Database files (count)	6

#### Jetstress system parameters

Thread count	12
Minimum database cache	192.0 MB
Maximum database cache	1536.0 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

Instance2716.1	Log path: J:\log1
----------------	-------------------

	Database: J:\db1\Jetstress001001.edb
<b>Instance2716.2</b>	Log path: I:\log2 Database: I:\db2\Jetstress002001.edb
<b>Instance2716.3</b>	Log path: K:\log3 Database: K:\db3\Jetstress003001.edb
<b>Instance2716.4</b>	Log path: G:\log4 Database: G:\db4\Jetstress004001.edb
<b>Instance2716.5</b>	Log path: F:\log5 Database: F:\db5\Jetstress005001.edb
<b>Instance2716.6</b>	Log path: H:\log6 Database: H:\db6\Jetstress006001.edb

### Transactional I/O performance

<b>MS Exchange Database ==&gt; Instances</b>	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
<b>Instance2716.1</b>	18.083	3.504	66.564	28.739	32968.968	35616.550	0.000	1.403	0.000	20.217	0.000	7908.052
<b>Instance2716.2</b>	16.464	2.975	66.791	29.042	32965.644	35617.073	0.000	1.380	0.000	20.341	0.000	7911.208
<b>Instance2716.3</b>	16.190	2.595	66.937	29.053	32962.396	35587.054	0.000	1.368	0.000	20.391	0.000	7909.594
<b>Instance2716.4</b>	16.131	2.317	66.670	29.046	32979.391	35606.714	0.000	1.364	0.000	20.573	0.000	7924.380
<b>Instance2716.5</b>	16.499	2.149	66.902	28.993	32989.462	35531.136	0.000	1.347	0.000	20.412	0.000	7899.755
<b>Instance2716.6</b>	17.309	2.183	67.333	29.371	32966.946	35534.382	0.000	1.361	0.000	20.522	0.000	7803.663

### Background database maintenance I/O performance

<b>MS Exchange database ==&gt; instances</b>	Database maintenance I/O reads/sec	Database maintenance I/O reads average bytes
<b>Instance2716.1</b>	8.612	261826.238
<b>Instance2716.2</b>	8.628	261810.020
<b>Instance2716.3</b>	8.646	261898.274
<b>Instance2716.4</b>	8.656	261905.652
<b>Instance2716.5</b>	8.644	261821.217
<b>Instance2716.6</b>	8.631	261850.008

### Log replication I/O performance

MS Exchange database ==> instances	I/O log reads/sec	I/O log reads average bytes
Instance2716.1	0.464	179515.293
Instance2716.2	0.467	180502.970
Instance2716.3	0.466	180571.284
Instance2716.4	0.474	182449.093
Instance2716.5	0.469	181813.965
Instance2716.6	0.462	178554.180

## Total I/O performance

MS Exchange database ==> instances	I/O database reads average latency (msec)	I/O database writes average latency (msec)	I/O database reads/sec	I/O database writes/sec	I/O database reads average bytes	I/O database writes average bytes	I/O log reads average latency (msec)	I/O log writes average latency (msec)	I/O log reads/sec	I/O log writes/sec	I/O log reads average bytes	I/O log writes average bytes
Instance2716.1	18.083	3.504	75.176	28.739	59187.312	35616.550	2.739	1.403	0.464	20.217	179515.293	7908.052
Instance2716.2	16.464	2.975	75.419	29.042	59146.928	35617.073	2.770	1.380	0.467	20.341	180502.970	7911.208
Instance2716.3	16.190	2.595	75.583	29.053	59149.411	35587.054	3.085	1.368	0.466	20.391	180571.284	7909.594
Instance2716.4	16.131	2.317	75.326	29.046	59285.895	35606.714	2.927	1.364	0.474	20.573	182449.093	7924.380
Instance2716.5	16.499	2.149	75.546	28.993	59173.092	35531.136	2.774	1.347	0.469	20.412	181813.965	7899.755
Instance2716.6	17.309	2.183	75.963	29.371	58971.478	35534.382	2.670	1.361	0.462	20.522	178554.180	7803.663

## Host system performance

Counter	Average	Minimum	Maximum
% processor time	0.596	0.000	1.713
Available MB	44715.998	44699.000	44793.000
Free system page table entries	33556041.687	33555984.000	33556048.000
Transition pages repurposed/sec	0.000	0.000	0.000
Pool non-paged Bytes	53733525.645	53444608.000	54030336.000
Pool paged bytes	160266894.163	160247808.000	160399360.000
Database page fault stalls/sec	0.000	0.000	0.000

## Test log

9/24/2013 3:26:30 PM -- Preparing for testing ...

9/24/2013 3:26:37 PM -- Attaching databases ...

9/24/2013 3:26:37 PM -- Preparations for testing are complete.

9/24/2013 3:26:37 PM -- Starting transaction dispatch ..

9/24/2013 3:26:37 PM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)

9/24/2013 3:26:37 PM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)

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9/24/2013 3:26:44 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

9/24/2013 3:26:44 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

9/24/2013 3:26:54 PM -- Operation mix: Sessions 12, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

9/24/2013 3:26:54 PM -- Performance logging started (interval: 15000 ms).

9/24/2013 3:26:54 PM -- Attaining prerequisites:

9/24/2013 3:29:29 PM -- \\MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1455108000.0 (lower bound: 1449551000.0, upper bound: none)

9/24/2013 5:29:30 PM -- Performance logging has ended.

9/24/2013 5:59:10 PM -- JetInterop batch transaction stats: 20549, 20549, 20549, 20549, 20549 and 20549.

9/24/2013 5:59:10 PM -- Dispatching transactions ends.

9/24/2013 5:59:10 PM -- Shutting down databases ...

9/24/2013 5:59:18 PM -- Instance2716.1 (complete), Instance2716.2 (complete), Instance2716.3 (complete), Instance2716.4 (complete), Instance2716.5 (complete) and Instance2716.6 (complete)

9/24/2013 5:59:18 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance\\_2013\\_9\\_24\\_15\\_26\\_44.blg](C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance_2013_9_24_15_26_44.blg) has 489 samples.

9/24/2013 5:59:18 PM -- Creating test report ...

9/24/2013 5:59:23 PM -- Instance2716.1 has 18.1 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.1 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.1 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.2 has 16.5 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.2 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.2 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.3 has 16.2 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.3 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.3 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.4 has 16.1 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.4 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.4 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.5 has 16.5 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.5 has 1.3 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.5 has 1.3 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.6 has 17.3 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.6 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.6 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

9/24/2013 5:59:23 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.

9/24/2013 5:59:23 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance\\_2013\\_9\\_24\\_15\\_26\\_44.xml](C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance_2013_9_24_15_26_44.xml) has 478 samples queried.

# Performance test database checksum (Server 1)

## Checksum statistics - all

Database	Seen pages	Bad pages	Correctable pages	Wrong page-number pages	File length/seconds taken
J:\db1\Jetstress001001.edb	48119650	0	0	0	1503739 MB/19590 sec
I:\db2\Jetstress002001.edb	48119650	0	0	0	1503739 MB/19562 sec
K:\db3\Jetstress003001.edb	48120162	0	0	0	1503755 MB/19558 sec
G:\db4\Jetstress004001.edb	48120418	0	0	0	1503763 MB/19548 sec
F:\db5\Jetstress005001.edb	48120162	0	0	0	1503755 MB/19541 sec
H:\db6\Jetstress006001.edb	48119906	0	0	0	1503747 MB/19554 sec
(Sum)	288719948	0	0	0	9022498 MB/19590 sec

## Disk subsystem performance (of checksum)

Logical disk	Avg. disk sec/read	Avg. disk sec/write	Disk reads/sec	Disk writes/sec	Avg. disk bytes/read
J:	0.035	0.000	1221.990	0.000	65535.997
I:	0.036	0.000	1228.851	0.000	65536.000
K:	0.036	0.000	1229.667	0.000	65536.000
G:	0.037	0.000	1230.735	0.000	65536.000
F:	0.036	0.000	1231.234	0.000	65536.000
H:	0.035	0.000	1230.161	0.000	65536.000

## Memory system performance (of checksum)

Counter	Average	Minimum	Maximum
% processor time	6.380	5.421	7.049
Available MB	46304.314	46284.000	46316.000
Free system page table entries	33555971.916	33555472.000	33556544.000
Transition pages repurposed/sec	0.000	0.000	0.000
Pool non-paged bytes	55539347.632	53473280.000	58859520.000
Pool paged bytes	161002734.724	160907264.000	162414592.000

## Test log

9/24/2013 3:26:30 PM -- Preparing for testing ...

9/24/2013 3:26:37 PM -- Attaching databases ...

9/24/2013 3:26:37 PM -- Preparations for testing are complete.

9/24/2013 3:26:37 PM -- Starting transaction dispatch ..

9/24/2013 3:26:37 PM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)

9/24/2013 3:26:37 PM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)

9/24/2013 3:26:44 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

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9/24/2013 3:26:44 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

9/24/2013 3:26:54 PM -- Operation mix: Sessions 12, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

9/24/2013 3:26:54 PM -- Performance logging started (interval: 15000 ms).

9/24/2013 3:26:54 PM -- Attaining prerequisites:

9/24/2013 3:29:29 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1455108000.0 (lower bound: 1449551000.0, upper bound: none)

9/24/2013 5:29:30 PM -- Performance logging has ended.

9/24/2013 5:59:10 PM -- JetInterop batch transaction stats: 20549, 20549, 20549, 20549, 20549 and 20549.

9/24/2013 5:59:10 PM -- Dispatching transactions ends.

9/24/2013 5:59:10 PM -- Shutting down databases ...

9/24/2013 5:59:18 PM -- Instance2716.1 (complete), Instance2716.2 (complete), Instance2716.3 (complete), Instance2716.4 (complete), Instance2716.5 (complete) and Instance2716.6 (complete)

9/24/2013 5:59:18 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance\\_2013\\_9\\_24\\_15\\_26\\_44.blg](C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance_2013_9_24_15_26_44.blg) has 489 samples.

9/24/2013 5:59:18 PM -- Creating test report ...

9/24/2013 5:59:23 PM -- Instance2716.1 has 18.1 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.1 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.1 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.2 has 16.5 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.2 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.2 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.3 has 16.2 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.3 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.3 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.4 has 16.1 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.4 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.4 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.5 has 16.5 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.5 has 1.3 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.5 has 1.3 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.6 has 17.3 for I/O Database Reads Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.6 has 1.4 for I/O Log Writes Average Latency.

9/24/2013 5:59:23 PM -- Instance2716.6 has 1.4 for I/O Log Reads Average Latency.

9/24/2013 5:59:23 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

9/24/2013 5:59:23 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.

9/24/2013 5:59:23 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance\\_2013\\_9\\_24\\_15\\_26\\_44.xml](C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance_2013_9_24_15_26_44.xml) has 478 samples queried.

9/24/2013 5:59:23 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance\\_2013\\_9\\_24\\_15\\_26\\_44.html](C:\Users\Administrator\Desktop\3016G 1G\Performance\Performance_2013_9_24_15_26_44.html) was saved.

9/24/2013 5:59:24 PM -- Performance logging started (interval: 30000 ms).

9/24/2013 5:59:24 PM -- Verifying database checksums ...

9/24/2013 11:25:55 PM -- J: (100% processed), I: (100% processed), K: (100% processed), G: (100% processed), F: (100% processed) and H: (100% processed)

9/24/2013 11:25:55 PM -- Performance logging has ended.

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9/24/2013 11:25:55 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Performance\DBChecksum\\_2013\\_9\\_24\\_17\\_59\\_23.blg](C:\Users\Administrator\Desktop\3016G 1G\Performance\DBChecksum_2013_9_24_17_59_23.blg) has 652 samples.

# Appendix C: database backup test

## Microsoft Exchange Jetstress 2013

### Database backup test (server 1)

#### Database backup statistics - all

Database instance	Database size (MB)	Elapsed backup time	MB transferred/sec
Instance2716.1	1506691.09	10:55:10	38.33
Instance2716.2	1506691.09	10:54:03	38.39
Instance2716.3	1506707.09	10:55:26	38.31
Instance2716.4	1506723.09	10:53:29	38.43
Instance2716.5	1506707.09	10:56:22	38.26
Instance2716.6	1506707.09	10:56:49	38.23
Avg.			38.33
Sum			229.95

#### Jetstress system parameters

Thread count	12
Minimum database cache	192.0 MB
Maximum database cache	1536.0 MB
Insert operations	40%
Delete operations	20%
Replace operations	5%
Read operations	35%
Lazy commits	70%

#### Database configuration

Instance2716.1	Log path: J:\log1 Database: J:\db1\Jetstress001001.edb
Instance2716.2	Log path: I:\log2 Database: I:\db2\Jetstress002001.edb
Instance2716.3	Log path: K:\log3 Database: K:\db3\Jetstress003001.edb
Instance2716.4	Log path: G:\log4 Database: G:\db4\Jetstress004001.edb
Instance2716.5	Log path: F:\log5



	Database: F:\db5\Jetstress005001.edb
<b>Instance2716.6</b>	Log path: H:\log6 Database: H:\db6\Jetstress006001.edb

### Transactional I/O performance

MS Exchange database ==> instances	I/O reads average latency (msec)	I/O 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
<b>Instance2716.1</b>	12.784	0.000	153.310	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Instance2716.2</b>	12.769	0.000	153.558	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Instance2716.3</b>	12.802	0.000	153.186	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Instance2716.4</b>	12.757	0.000	153.711	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Instance2716.5</b>	12.840	0.000	152.932	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Instance2716.6</b>	12.874	0.000	152.799	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	2.304	1.620	2.756
Available MB	46371.825	46357.000	46402.000
Free system page table entries	33555764.236	33555508.000	33556550.000
Transition pages re-purposed/sec	0.000	0.000	0.000
Pool non-paged bytes	55505095.805	55345152.000	57462784.000
Pool paged bytes	151765735.024	151646208.000	151932928.000
Database page fault stalls/sec	0.000	0.000	0.000

### Test log

9/27/2013 9:14:08 AM -- Preparing for testing ...

9/27/2013 9:14:14 AM -- Attaching databases ...

9/27/2013 9:14:14 AM -- Preparations for testing are complete.

9/27/2013 9:14:27 AM -- Performance logging started (interval: 30000 ms).

9/27/2013 9:14:27 AM -- Backing up databases ...

9/27/2013 8:11:16 PM -- Performance logging has ended.

9/27/2013 8:11:16 PM -- Instance2716.1 (100% processed), Instance2716.2 (100% processed), Instance2716.3 (100% processed), Instance2716.4 (100% processed), Instance2716.5 (100% processed) and Instance2716.6 (100% processed)

9/27/2013 8:11:16 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Database\DatabaseBackup\\_2013\\_9\\_27\\_9\\_14\\_14.blg](C:\Users\Administrator\Desktop\3016G 1G\Database\DatabaseBackup_2013_9_27_9_14_14.blg) has 1312 samples.

9/27/2013 8:11:16 PM -- Creating test report ...

# Appendix D: soft recovery test

## Microsoft Exchange Jetstress 2013

### Soft recovery test (server 1)

#### Soft recovery statistics - all

Database instance	Log files replayed	Elapsed seconds
Instance2716.1	508	1293.6946722
Instance2716.2	511	1147.3040151
Instance2716.3	506	1097.181127
Instance2716.4	508	1097.711528
Instance2716.5	507	1168.7852528
Instance2716.6	501	1285.4734578
Avg.	506	1181.692
Sum	3041	7090.1500529

#### Database configuration

Instance2716.1	Log path: J:\log1 Database: J:\db1\Jetstress001001.edb
Instance2716.2	Log path: I:\log2 Database: I:\db2\Jetstress002001.edb
Instance2716.3	Log path: K:\log3 Database: K:\db3\Jetstress003001.edb
Instance2716.4	Log path: G:\log4 Database: G:\db4\Jetstress004001.edb
Instance2716.5	Log path: F:\log5 Database: F:\db5\Jetstress005001.edb
Instance2716.6	Log path: H:\log6 Database: H:\db6\Jetstress006001.edb

#### Transactional I/O performance

MS Exchange database ==> instances	I/O reads	I/O writes	I/O reads/sec	I/O writes/sec	I/O reads	I/O writes	I/O log average	I/O log average	I/O log	I/O log	I/O log	I/O log
	database	database	database	database	database	database	reads	writes	reads/sec	Writes/sec	reads	writes
	reads	writes	reads/sec	writes/sec	reads	writes	average	average			average	average

	average latency (msec)	average latency (msec)			average bytes	average bytes	latency (msec)	latency (msec)			bytes	bytes
<b>Instance2716.1</b>	17.822	1.138	330.748	1.568	40611.949	32665.600	13.197	0.000	1.962	0.000	209010.692	0.000
<b>Instance2716.2</b>	15.263	0.942	380.829	1.780	40487.089	32652.620	11.128	0.000	2.227	0.000	209607.936	0.000
<b>Instance2716.3</b>	14.805	1.110	399.637	1.843	40589.320	32526.170	10.148	0.000	2.306	0.000	208177.395	0.000
<b>Instance2716.4</b>	14.859	0.988	395.826	1.850	40523.267	32647.085	10.017	0.000	2.315	0.000	208937.534	0.000
<b>Instance2716.5</b>	15.535	0.991	378.653	1.732	40487.076	32768.000	10.238	0.000	2.167	0.000	209746.663	0.000
<b>Instance2716.6</b>	17.138	0.979	332.120	1.553	40613.950	32664.956	12.015	0.000	1.943	0.000	209049.918	0.000

### Background database maintenance I/O performance

MS Exchange database ==> instances	Database maintenance I/O reads/sec	Database maintenance I/O reads average bytes
<b>Instance2716.1</b>	9.095	262017.234
<b>Instance2716.2</b>	9.119	261861.367
<b>Instance2716.3</b>	9.121	262000.037
<b>Instance2716.4</b>	9.122	261654.667
<b>Instance2716.5</b>	9.127	261795.466
<b>Instance2716.6</b>	9.110	262031.010

### Total I/O performance

MS Exchange database ==> instances	I/O database reads average latency (msec)	I/O database writes average latency (msec)	I/O database reads/sec	I/O database writes/sec	I/O database reads average bytes	I/O database writes average bytes	I/O log reads average latency (msec)	I/O log writes average latency (msec)	I/O log reads/sec	I/O log writes/sec	I/O log reads average bytes	I/O log writes average bytes
<b>Instance2716.1</b>	17.822	1.138	339.843	1.568	46537.217	32665.600	13.197	0.000	1.962	0.000	209010.692	0.000
<b>Instance2716.2</b>	15.263	0.942	389.947	1.780	45663.763	32652.620	11.128	0.000	2.227	0.000	209607.936	0.000
<b>Instance2716.3</b>	14.805	1.110	408.758	1.843	45530.120	32526.170	10.148	0.000	2.306	0.000	208177.395	0.000
<b>Instance2716.4</b>	14.859	0.988	404.948	1.850	45504.763	32647.085	10.017	0.000	2.315	0.000	208937.534	0.000
<b>Instance2716.5</b>	15.535	0.991	387.780	1.732	45695.934	32768.000	10.238	0.000	2.167	0.000	209746.663	0.000
<b>Instance2716.6</b>	17.138	0.979	341.230	1.553	46525.543	32664.956	12.015	0.000	1.943	0.000	209049.918	0.000

### Host system performance

Counter	Average	Minimum	Maximum
<b>% processor time</b>	2.257	0.000	7.757
<b>Available MB</b>	44680.707	44599.000	46172.000
<b>Free system page table entries</b>	3355551.576	33555492.000	33556054.000

<b>Transition pages repurposed/sec</b>	0.000	0.000	0.000
<b>Pool non-paged bytes</b>	56070526.804	55721984.000	56356864.000
<b>Pool Paged bytes</b>	153951656.274	153284608.000	154742784.000
<b>Database page fault stalls/sec</b>	0.000	0.000	0.000

## Test Log

9/27/2013 8:32:08 PM -- Preparing for testing ...

9/27/2013 8:32:15 PM -- Attaching databases ...

9/27/2013 8:32:15 PM -- Preparations for testing are complete.

9/27/2013 8:32:15 PM -- Starting transaction dispatch ..

9/27/2013 8:32:15 PM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)

9/27/2013 8:32:15 PM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)

9/27/2013 8:32:22 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

9/27/2013 8:32:22 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

9/27/2013 8:32:28 PM -- Operation mix: Sessions 12, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

9/27/2013 8:32:28 PM -- Performance logging started (interval: 15000 ms).

9/27/2013 8:32:28 PM -- Generating log files ...

9/27/2013 11:03:16 PM -- J:\log1 (101.6% generated), I:\log2 (102.2% generated), K:\log3 (101.2% generated), G:\log4 (101.6% generated), F:\log5 (101.4% generated) and H:\log6 (100.2% generated)

9/27/2013 11:03:16 PM -- Performance logging has ended.

9/27/2013 11:03:16 PM -- JetInterop batch transaction stats: 21822, 21822, 21822, 21822, 21822 and 21822.

9/27/2013 11:03:16 PM -- Dispatching transactions ends.

9/27/2013 11:03:17 PM -- Shutting down databases ...

9/27/2013 11:03:20 PM -- Instance2716.1 (complete), Instance2716.2 (complete), Instance2716.3 (complete), Instance2716.4 (complete), Instance2716.5 (complete) and Instance2716.6 (complete)

9/27/2013 11:03:20 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\Performance\\_2013\\_9\\_27\\_20\\_32\\_22.blg](C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\Performance_2013_9_27_20_32_22.blg) has 602 samples.

9/27/2013 11:03:20 PM -- Creating test report ...

9/27/2013 11:03:24 PM -- Instance2716.1 has 17.4 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.1 has 1.4 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.1 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.2 has 15.8 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.2 has 1.4 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.2 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.3 has 15.6 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.3 has 1.4 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.3 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.4 has 15.6 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.4 has 1.3 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.4 has 1.3 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.5 has 15.9 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.5 has 1.4 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.5 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.6 has 16.6 for I/O Database Reads Average Latency.  
 9/27/2013 11:03:24 PM -- Instance2716.6 has 1.4 for I/O Log Writes Average Latency.  
 9/27/2013 11:03:24 PM -- Instance2716.6 has 1.4 for I/O Log Reads Average Latency.  
 9/27/2013 11:03:24 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.  
 9/27/2013 11:03:24 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.  
 9/27/2013 11:03:24 PM -- <C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\Performance 2013 9 27 20 32 22.xml> has 601 samples queried.  
 9/27/2013 11:03:24 PM -- <C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\Performance 2013 9 27 20 32 22.html> was saved.  
 9/30/2013 9:18:30 AM -- Performance logging started (interval: 4000 ms).  
 9/30/2013 9:18:30 AM -- Recovering databases ...  
 9/30/2013 9:40:03 AM -- Performance logging has ended.  
 9/30/2013 9:40:03 AM -- Instance2716.1 (1293.6946722), Instance2716.2 (1147.3040151), Instance2716.3 (1097.181127), Instance2716.4 (1097.711528), Instance2716.5 (1168.7852528) and Instance2716.6 (1285.4734578)  
 9/30/2013 9:40:04 AM -- <C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\SoftRecovery 2013 9 30 9 18 24.blg> has 321 samples.  
 9/30/2013 9:40:04 AM -- Creating test report ...

## Soft recovery performance test (server 1)

### Test summary

<b>Overall test result</b>	<b>Pass</b>
<b>Machine name</b>	WIN-2IPTC89B5DU
<b>Test description</b>	
<b>Test start time</b>	9/27/2013 8:32:08PM
<b>Test end time</b>	9/27/2013 11:03:20PM
<b>Collection start time</b>	9/27/2013 8:32:43PM
<b>Collection end time</b>	9/27/2013 11:03:12PM
<b>Jetstress version</b>	15.00.0658.004
<b>ESE version</b>	15.00.0516.026
<b>Operating system</b>	Windows Server 2008 R2 Enterprise (6.1.7600.0)
<b>Performance log</b>	<a href="C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\Performance 2013 9 27 20 32 22.blg">C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\Performance 2013 9 27 20 32 22.blg</a>

### Database sizing and throughput

<b>Achieved transactional I/O per second</b>	626.537
<b>Target transactional I/O per second</b>	480
<b>Initial database size (bytes)</b>	9479414743040
<b>Final database size (bytes)</b>	9481235070976
<b>Database files (count)</b>	6

### Jetstress system parameters

<b>Thread count</b>	12
<b>Minimum database cache</b>	192.0MB

<b>Maximum database cache</b>	1536.0MB
<b>Insert operations</b>	40%
<b>Delete operations</b>	20%
<b>Replace operations</b>	5%
<b>Read operations</b>	35%
<b>Lazy commits</b>	70%

### Database configuration

<b>Instance2716.1</b>	Log path: J:\log1 Database: J:\db1\Jetstress001001.edb
<b>Instance2716.2</b>	Log path: I:\log2 Database: I:\db2\Jetstress002001.edb
<b>Instance2716.3</b>	Log path: K:\log3 Database: K:\db3\Jetstress003001.edb
<b>Instance2716.4</b>	Log path: G:\log4 Database: G:\db4\Jetstress004001.edb
<b>Instance2716.5</b>	Log path: F:\log5 Database: F:\db5\Jetstress005001.edb
<b>Instance2716.6</b>	Log path: H:\log6 Database: H:\db6\Jetstress006001.edb

### Transactional I/O performance

<b>MS Exchange database ==&gt; instances</b>	I/O database reads average	I/O database writes average	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 average bytes	I/O log reads average bytes	I/O log writes average bytes
<b>Instance27 16.1</b>	17.368	4.850	73.004	31.733	32768.253	35194.735	0.000	1.370	0.000	21.939	0.000	7892.16
<b>Instance27 16.2</b>	15.821	4.113	72.674	31.481	32768.000	35318.990	0.000	1.351	0.000	22.043	0.000	7908.84
<b>Instance27 16.3</b>	15.567	3.420	72.903	31.597	32768.324	35191.998	0.000	1.367	0.000	21.848	0.000	7904.22
<b>Instance27 16.4</b>	15.591	2.793	72.710	31.358	32768.000	35233.093	0.000	1.349	0.000	21.974	0.000	7897.20
<b>Instance27</b>	15.897	2.350	72.941	31.649	32768.000	35213.433	0.000	1.383	0.000	22.02	0.000	7876.91

<b>16.5</b>					0					6		
<b>Instance27</b>	16.617	2.409	72.996	31.491	32768.00	35229.864	0.000	1.382	0.000	21.82	0.000	7854.80
<b>16.6</b>					0					1		

### Host system performance

Counter	Average	Minimum	Maximum
<b>% processor time</b>	0.657	0.000	1.927
<b>Available MB</b>	44760.809	44729.000	46107.000
<b>Free system page table entries</b>	33555715.595	33555350.000	33556566.000
<b>Transition pages repurposed/sec</b>	0.000	0.000	0.000
<b>Pool non-paged bytes</b>	55616984.877	55410688.000	57577472.000
<b>Pool paged bytes</b>	152442437.741	152383488.000	152559616.000
<b>Database page fault stalls/sec</b>	0.000	0.000	0.000

### Test log

9/27/2013 8:32:08 PM -- Preparing for testing ...

9/27/2013 8:32:15 PM -- Attaching databases ...

9/27/2013 8:32:15 PM -- Preparations for testing are complete.

9/27/2013 8:32:15 PM -- Starting transaction dispatch ..

9/27/2013 8:32:15 PM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)

9/27/2013 8:32:15 PM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)

9/27/2013 8:32:22 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).

9/27/2013 8:32:22 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).

9/27/2013 8:32:28 PM -- Operation mix: Sessions 12, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.

9/27/2013 8:32:28 PM -- Performance logging started (interval: 15000 ms).

9/27/2013 8:32:28 PM -- Generating log files ...

9/27/2013 11:03:16 PM -- J:\log1 (101.6% generated), I:\log2 (102.2% generated), K:\log3 (101.2% generated), G:\log4 (101.6% generated), F:\log5 (101.4% generated) and H:\log6 (100.2% generated)

9/27/2013 11:03:16 PM -- Performance logging has ended.

9/27/2013 11:03:16 PM -- JetInterop batch transaction stats: 21822, 21822, 21822, 21822, 21822 and 21822.

9/27/2013 11:03:16 PM -- Dispatching transactions ends.

9/27/2013 11:03:17 PM -- Shutting down databases ...

9/27/2013 11:03:20 PM -- Instance2716.1 (complete), Instance2716.2 (complete), Instance2716.3 (complete), Instance2716.4 (complete), Instance2716.5 (complete) and Instance2716.6 (complete)

9/27/2013 11:03:20 PM -- [C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\Performance\\_2013\\_9\\_27\\_20\\_32\\_22.blg](C:\Users\Administrator\Desktop\3016G 1G\Software Recovery\Performance_2013_9_27_20_32_22.blg) has 602 samples.

9/27/2013 11:03:20 PM -- Creating test report ...

9/27/2013 11:03:24 PM -- Instance2716.1 has 17.4 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.1 has 1.4 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.1 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.2 has 15.8 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.2 has 1.4 for I/O Log Writes Average Latency.

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9/27/2013 11:03:24 PM -- Instance2716.2 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.3 has 15.6 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.3 has 1.4 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.3 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.4 has 15.6 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.4 has 1.3 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.4 has 1.3 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.5 has 15.9 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.5 has 1.4 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.5 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.6 has 16.6 for I/O Database Reads Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.6 has 1.4 for I/O Log Writes Average Latency.

9/27/2013 11:03:24 PM -- Instance2716.6 has 1.4 for I/O Log Reads Average Latency.

9/27/2013 11:03:24 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.

9/27/2013 11:03:24 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.

9/27/2013 11:03:24 PM -- [C:\Users\Administrator\Desktop\3016G\\_1G\Software Recovery\Performance\\_2013\\_9\\_27\\_20\\_32\\_22.xml](C:\Users\Administrator\Desktop\3016G_1G\Software_Recovery\Performance_2013_9_27_20_32_22.xml) has 601 samples queried.