Dell EMC SC Series SC5020 15,000 Mailbox Exchange 2016 Resiliency Storage Solution using 10K Drives

Microsoft ESRP 4.0

Dell EMC Engineering
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Author: Mark Boeser

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1 Introduction

This document provides information on the Dell EMC™ SC5020 storage solution for Microsoft® Exchange Server, based on the Microsoft Exchange Solution Reviewed Program (ESRP) – Storage program.

This document describes the performance characteristics of a fully hardware-redundant Microsoft Exchange 2016 solution housing 15,000 typical user mailboxes in two 3U SC5020 arrays containing 10K 1.8TB drives. Test results show the SC5020 solution provided the sufficient IOPS with minimal latencies required.

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, visit https://technet.microsoft.com/en-us/office/dn756396.aspx.

1.1 Simulated environment

The solution presented in this document is designed to simulate a moderate-sized number of mailboxes hosted on highly redundant hardware. Application-level redundancy is augmented with redundant storage to create a highly available and fault-tolerant solution.

The mailbox resiliency features of Exchange Server 2016 greatly enhance the availability of Exchange Server, while also improving I/O performance. The solution presented in this paper is a mailbox resiliency solution utilizing one database availability group (DAG) and two copies of every database. The tested environment simulates all users in this DAG running on a single Dell EMC SC Series array, or half of the solution. The number of users simulated was 15,000 across four servers, with 3,750 users per server. The mailbox size was 2GB per user. Each server has six databases, with one copy local and the second copy replicated to the second server. This provides redundancy through hardware and software.

The replication mechanism is the native Exchange 2016 DAG database replication engine. This is an efficient and reliable replication mechanism and is the recommended method for providing highly-available and redundant Exchange solutions.

1.2 Solution description

Testing was performed on an SC5020 array running Dell Storage Center OS (SCOS) v7.2 with a redundant controller pair and redundant front-end and back-end connections. The front-end connections are Fibre-Channel based, over redundant fabrics, with two ports per server and four ports per controller. One 30-bay 2.5” built-in drive enclosure is utilized with each SC5020.

The back-end disk connectivity is SAS 12Gb and the disk drives used are SAS 10K 1.8TB. The spindle count is 28 disks and 2 spares for database and logs, on a dedicated disk pool on each SC Series array. Because this is a redundant solution, databases and logs are stored together on the same volumes. All volumes are RAID-5.

See the following link for information about compatibility:
https://www.windowsservercatalog.com/item.aspx?idItem=bb42253c-205d-da5d-e884-cbf33697346f&bCatID=1282

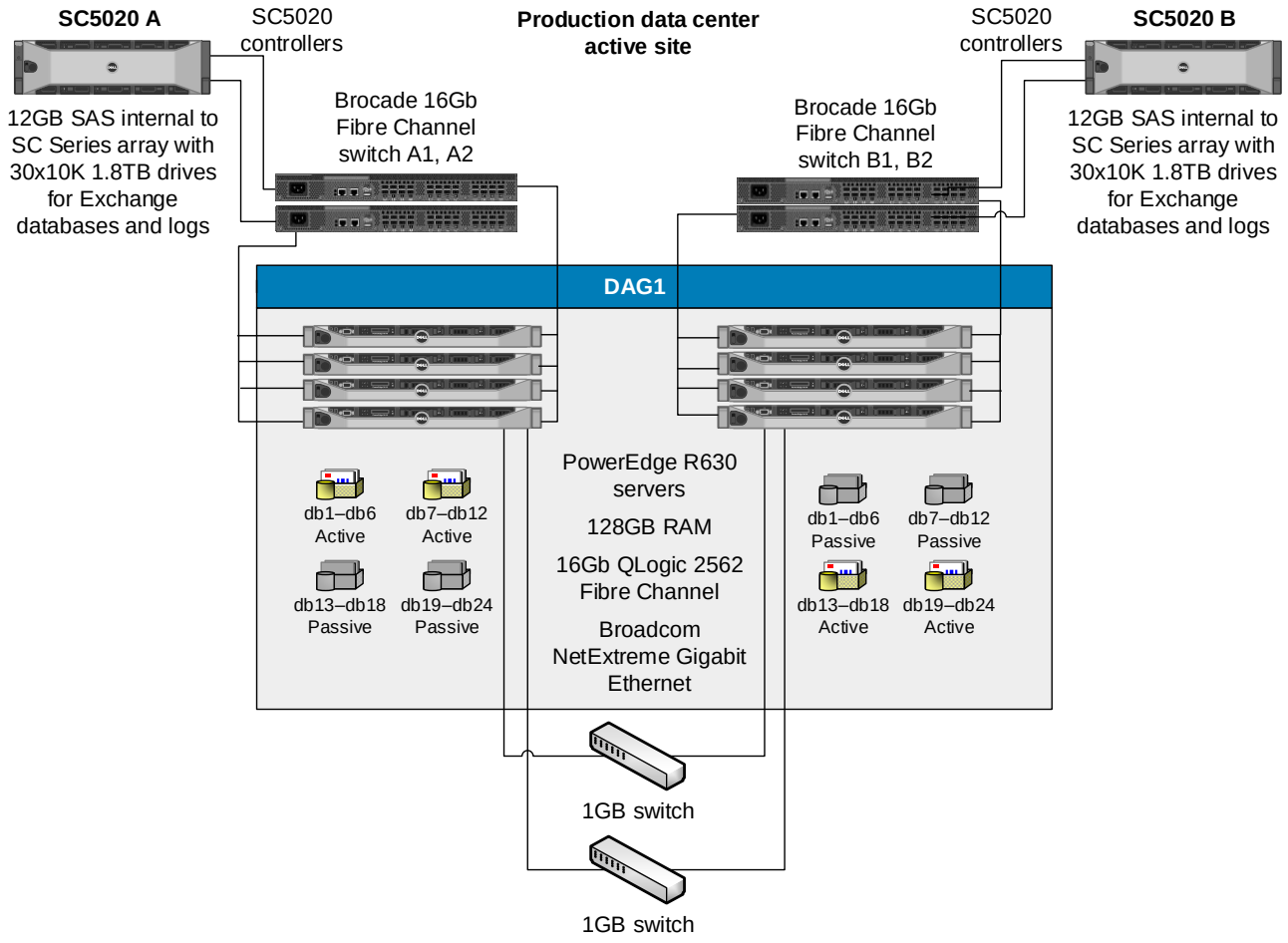

Figure 1 Highly available data center design

The solution is designed around a highly available data center model (Figure 1). There are two disk arrays for complete redundancy. The Exchange configuration is one DAG. The LAN ports are in a dedicated replication VLAN for traffic isolation. There are two networks for redundancy.

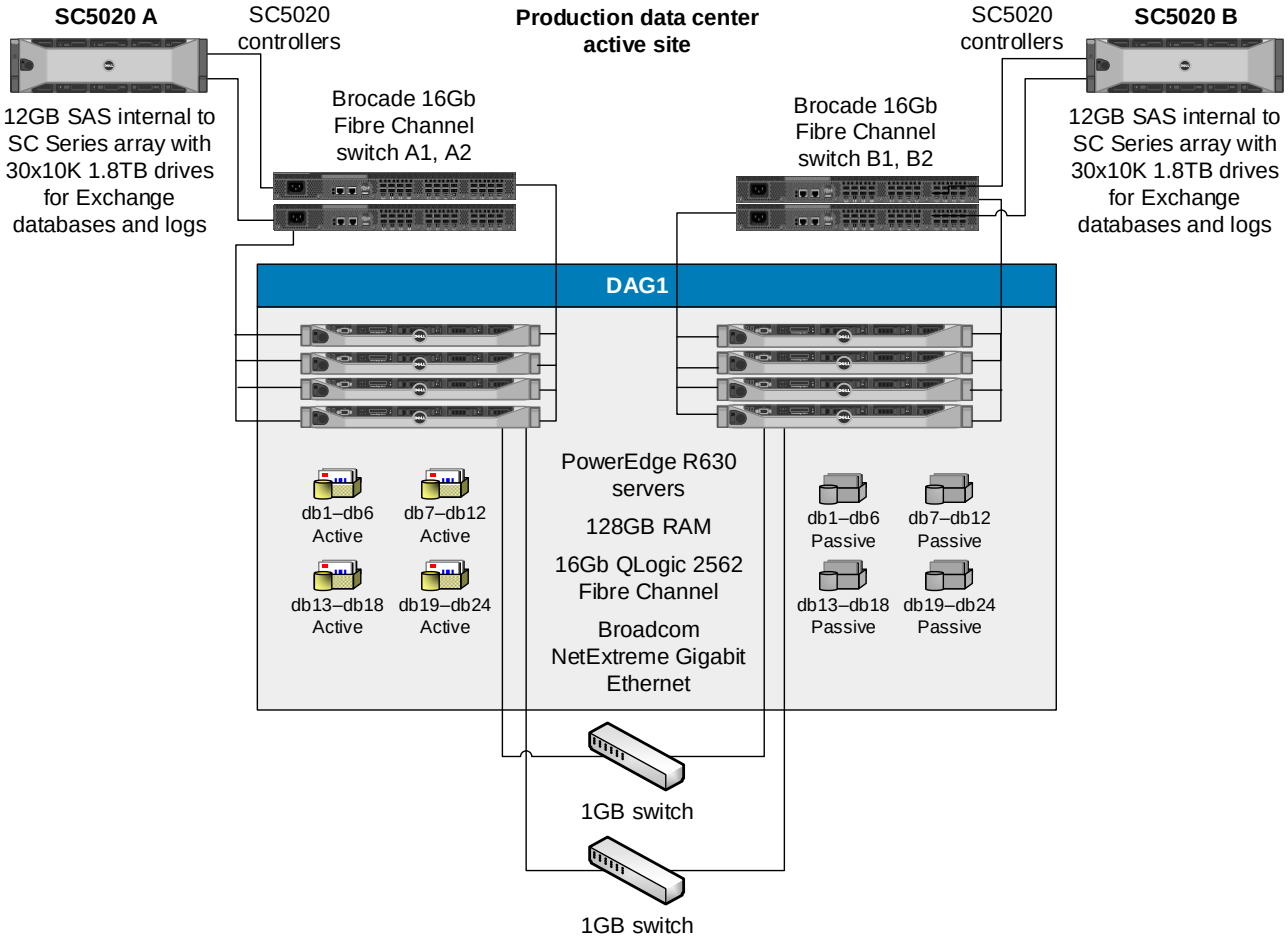

Figure 2 Tested configuration: SC5020 A with a full user load and SC5020 B offline

The tested configuration is a single SC5020 array (Figure 2), running with the full user load. This is tested to clearly show that a single array can handle the user load in an array failure scenario. Under normal operating conditions, the preferred activation scenario would be to run half of the mailbox databases active on each SC5020 array, while either array could handle the entire workload at any given time.

The ability to handle the entire workload on a single SC5020 array means no I/O performance degradation will occur if an array or any volumes were to fail. All mailbox servers would have volumes mapped to both arrays, with one copy of each database on each array.

2 SC5020 solution overview

2.1 Accelerate your workloads, automate your savings

The SC5020 array makes storage cost savings automatic with a modern architecture that optimizes the data center for economics while delivering transformational SSD, HDD, or hybrid performance.

SC Series storage provides the lowest effective cost per GB for flash and hybrid flash[1], giving organizations of any size the technology advantage needed to compete in today's fast-changing markets. Highlights include:

- Data Progression: Achieve IOPS goals with the least-expensive mix of storage media, even as performance needs evolve.
- Deduplication and compression: Dramatically reduce the raw capacity required to store data.
- RAID tiering: Eliminate manual RAID provisioning, and increase efficiency and utilization.
- Federation: Simplify multi-array environments with quick and seamless data movement, plus proactive load balancing assistance using Live Migrate and Volume Advisor.
- Dell ProSupport™ services: Reduce deployment costs with remote installation options that ensure the project is successful the first time.
- Persistent software licensing: Future-proof the investment, and minimize the cost of upgrades and expansions.

2.2 All-new hardware platform

Designed as the next-generation successor to the popular SC4020 array, the SC5020 array is a performance powerhouse. With dual 8-core Intel® processors, 4x more memory, and a 12Gb SAS back end, the SC5020 delivers:

- Up to 45% more IOPs[2]
- Up to 3x more bandwidth[2]
- 2x greater maximum capacity

The new 3U all-in-one chassis includes 30 drive bays plus dual hot-swappable controllers, providing up to 460TB raw capacity in a single compact unit. A variety of expansion enclosures enables scaling up to 2 petabytes (2PB) per array — with even larger scale-out potential in federated multi-array systems. In addition to fast hardware, the SC5020 includes all of the SCOS features to be expected from SC Series storage.

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[1] Net usable capacity of Dell array with 5 years of support, after 4:1 data reduction, vs. major competitors net of data reduction. Street price analysis is based on a variety of sources including analyst data, price sheets when available, and public information as of January 2017.
[2] Based on April 2017 internal Dell EMC testing, compared to previous-generation SC4020. Actual performance will vary depending upon application and configuration.

2.3 Targeted customer profile

This solution is targeted for a medium-sized organization, but it can be sized to meet the needs of any size of organization. Capacity can be dynamically scaled up to 2 petabytes. This provides excellent growth potential with no downtime required for upgrades. The solution was tested with the following configuration:

- User IO profile: .083 IOPS per user, .10 tested, giving 20% headroom
- User mailbox size: 2GB quota
- Backup: VSS backup using SAN-based snapshots, and mailbox resiliency as the primary data-protection mechanism
- Restore: SAN-based snapshots and boot from SAN enable a complete server restore in minutes
- RAID type: RAID 5 for database volumes and log volumes; a mix of RAID10, RAID5, and RAID6 can be blended, with fully automated tiered storage providing the most efficient and best performing storage where needed

2.4 Volume sizing

The volume size tested was just large enough to support the database size. Volumes on SC Series storage can be grown dynamically, without affecting service. As database sizes approach volume sizes, any volume can be automatically increased on demand. This simplifies sizing because capacity can be added as needed.

Using SC Series dynamic capacity and hot upgrades, additional disk capacity can be added as needed. If more spindles are required to accommodate growth, they can simply be cabled and added to the disk pool to grow volume space. Since volumes are not tied to spindle boundaries, adding spindles can increase performance and capacity as the system grows.

The testing environment was configured for 72% storage utilization. If the storage requirement grows beyond the design specified, additional drives provide additional capacity for any volume to be expanded.

3 Tested deployment

The following tables summarize the testing environment.

3.1 Simulated Exchange configuration

Table 1 Simulated Exchange configuration

Configuration	Detail
Exchange mailboxes simulated	15,000
Database availability groups (DAGs)	1
Servers per DAG	8
Active mailboxes per server	1,875
Databases per host	6
Copies per database	2
Mailboxes per database	312 or 313
Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)	.083 (.10 tested)
Database per log LUN size	2 TB
Total database size for performance testing	33.1 TB
Storage capacity used by Exchange database*	72%

*Note: Database size and capacity utilized may not match on a thin-provisioned system because only used pages will consume space. Pages that are allocated, but contain blank data, may not use disk space.

3.2 Primary storage hardware

Table 2 Primary storage hardware

Configuration	Detail
Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	Fibre Channel
Storage model and OS or firmware revision	Storage Center OS (SC5020) v7.2 https://www.windowsservercatalog.com/item.aspx?idItem=bb42253c-205d-da5d-e884-cbf33697346f&bCatID=1282
Storage cache	8GB
Storage controllers	2
Storage ports	4 active ports per controller
Maximum bandwidth of storage connectivity to host	48Gb/sec (4x12Gb HBA)
Switch type, model, and firmware revision	Brocade® model 6505 24-port 16Gb Fibre Channel switch firmware version 7.4.1b
HBA model and firmware	QLogic® QLE2694 16G Fibre Channel adapter (driver FW 08.04.02)
HBAs per host	1 dual-port QLogic 2562 16Gb HBA
Host server type	2x8 Intel® Xeon® Processor E5-2660 0 @ 2.20GHz, 128GB RAM
Total disks tested in solution	28 active for DB and logs + 2 hot spares = 30 total spindles
Maximum spindles hosted in the storage	30 drive bay + dual controllers in a 2U chassis; Scalable to 222 drives (30 internal + 192 external with modular expansion enclosures); total of 2PB per array

3.3 Primary storage software

Table 3 Primary storage software

Configuration	Detail
HBA driver	QLogic StorPort FC HBA driver 9.1.15.1
HBA queue depth setting	65535
Multipathing	Microsoft Windows Server® 2016 R2 MPIO Round Robin (in-box DSM)
Host OS	Microsoft Windows Server 2016
ESE.dll file version	15.1.669.32
Replication solution name and version	Microsoft Exchange Server 2016 DAG replication

3.4 Primary storage disk configuration (mailbox store/log disks)

Table 4 Primary storage disk configuration

Configuration	Detail
Disk type, speed	SAS 10K 1.8TB
Raw capacity per disk (GB)	1.64TB
Physical disks in test	28
Total raw storage capacity (GB)	45.92TB
RAID level	RAID 5
Total formatted capacity	24.00TB
Storage capacity utilization	72.19%
Database capacity utilization	80%

4 Test results summary

This section provides a high-level summary of the test data from ESRP. The detailed HTML reports generated by the ESRP testing framework are shown in the appendices of this paper.

4.1 Reliability

A number of reliability tests were run for 24 hours and verified the storage can handle high I/O load for a long period of time. Both log and database files were analyzed for integrity after the stress test to ensure no database or log corruption.

The following list provides an overview of the test results:

- No errors were reported in either the application or system log.
- No errors were reported during the database and log checksum process.
- No errors were reported during either the backup or restore process.

4.2 Storage performance results

The primary storage performance testing is designed to exercise the storage with the maximum sustainable Exchange-type I/O for two hours. The test shows how long it takes for the storage to respond to an I/O under load. The data in the following tables is the sum of all of the logical disk I/Os and average of all the I/O latency of the logical disks during the two-hour test duration. Each server is listed separately and the aggregate numbers across all servers is listed as well.

Table 5 Server 1 test results

Database I/O	**Value**
Database Disks Transfers/sec	426.892
Database Disks Reads/sec	312.71
Database Disks Writes/sec	114.182
Average Database Disk Read Latency (ms)	14.287
Average Database Disk Write Latency (ms)	0.595
Transaction Log I/O	
Log Disks Writes/sec	29.35
Average Log Disk Write Latency (ms)	0.525

Table 6 Server 2 test results

Database I/O	Value
Database Disks Transfers/sec	437.404
Database Disks Reads/sec	319.375
Database Disks Writes/sec	118.029
Average Database Disk Read Latency (ms)	14.342
Average Database Disk Write Latency (ms)	0.750
Transaction Log I/O	
Log Disks Writes/sec	30.346
Average Log Disk Write Latency (ms)	0.693

Table 7 Server 3 test results

Database I/O	Value
Database Disks Transfers/sec	445.817
Database Disks Reads/sec	325.586
Database Disks Writes/sec	120.231
Average Database Disk Read Latency (ms)	15.109
Average Database Disk Write Latency (ms)	0.756
Transaction Log I/O	
Log Disks Writes/sec	31.066
Average Log Disk Write Latency (ms)	0.701

Table 8 Server 4 test results

Database I/O	Value
Database Disks Transfers/sec	446.427
Database Disks Reads/sec	325.786
Database Disks Writes/sec	120.641
Average Database Disk Read Latency (ms)	15.268
Average Database Disk Write Latency (ms)	0.768
Transaction Log I/O	
Log Disks Writes/sec	31.061
Average Log Disk Write Latency (ms)	0.714

4.3 Database backup/recovery performance

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

4.3.1 Database read-only performance

The test measures the maximum rate at which databases could be backed up through VSS. The following results show the average rate for a single database file.

MB read/sec per database: 51.95

MB read/sec total per server: 311.71

4.3.2 Transaction log recovery/replay performance

The purpose of this test is to measure the maximum rate at which the log files can be played against the databases. The following result shows the average rate for 500 log files played in a single database. Each log file is 1MB in size.

Average time to play one log file (sec): 2.596

5 Conclusion

The testing described in this paper shows the scalability and performance of the SC5020 array. Improvements in I/O efficiency are seen with the newest version of SCOS and the latest Dell EMC hardware solution. These tests discovered that write I/O response times to Exchange databases improved 266% and transaction logs improved by 169%.

This document is developed by storage solution providers and reviewed by the Microsoft Exchange Product team. The test results and data presented in this document are based on the tests introduced in the ESRP v4.0 test framework. Customers should not quote the data directly for pre-deployment verification. It is still necessary to go through the prescribed exercises to validate the storage design for a specific customer environment.

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

A Performance testing

A.1 Server 1

A.1.1 Test results

Table 9 Test summary

Parameter	Detail
Overall test result	**Pass**
Machine Name	JS8
Test Description	3750 users/server 4 servers 2GB mailboxes .083 IOPS/user .10 IOPS tested 6 dbs per server 2TB db/log combined volumes 2 copies 9 threads/db
Test Start Time	4/20/2017 11:43
Test End Time	4/20/2017 14:33
Collection Start Time	4/20/2017 11:48
Collection End Time	4/20/2017 13:48
Jetstress Version	15.01.0466.031
ESE Version	15.01.0669.032
Operating System	Windows Server 2012 R2 Datacenter (6.2.9200.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_31.blg

Table 10 Database sizing and throughput

Performance counter	Value
Achieved Transactional I/O per Second	372.037
Target Transactional I/O per Second	375
Initial Database Size (bytes)	8054414245888
Final Database Size (bytes)	8055773200384
Database Files (Count)	6

Table 11 Jetstress system parameters

Performance counter	Value
Thread Count	9
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

Table 12 Database configuration

Performance counter	Value
Instance2300.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance2300.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance2300.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance2300.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb
Instance2300.5	Log path: C:\DB\DB5 Database: C:\DB\DB5\Jetstress005001.edb
Instance2300.6	Log path: C:\DB\DB6 Database: C:\DB\DB6\Jetstress006001.edb

Table 13 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
Instance2300.1	14.522	0.593	43.079	19.106	33074.289	36881.058	0.000	0.523	0.000	4.897	0.000	19255.050
Instance2300.2	15.702	0.600	43.070	19.315	33036.201	36890.393	0.000	0.525	0.000	4.964	0.000	19307.106
Instance2300.3	15.469	0.594	42.899	18.784	33025.519	36934.883	0.000	0.524	0.000	4.837	0.000	19354.115
Instance2300.4	14.084	0.593	42.842	18.960	33053.000	36923.441	0.000	0.526	0.000	4.873	0.000	19527.272
Instance2300.5	12.903	0.595	42.843	18.921	33065.627	36922.862	0.000	0.527	0.000	4.867	0.000	19637.726
Instance2300.6	13.040	0.595	43.120	19.096	33047.729	36865.103	0.000	0.524	0.000	4.912	0.000	19196.798

Table 14 Background database maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance I/O Reads Average Bytes
Instance2300.1	9.153	261778.976
Instance2300.2	9.132	261730.764
Instance2300.3	9.151	261858.730
Instance2300.4	9.150	261858.525
Instance2300.5	9.149	261841.606
Instance2300.6	9.119	261879.470

Table 15 Log replication I/O performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2300.1	0.402	156884.259
Instance2300.2	0.408	158748.884
Instance2300.3	0.399	156114.112
Instance2300.4	0.404	157289.074
Instance2300.5	0.407	158689.976
Instance2300.6	0.402	156614.212

Table 16 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
Instance2300.1	14.522	0.593	52.232	19.106	73150.415	36881.058	8.744	0.523	0.402	4.897	156884.259	19255.050
Instance2300.2	15.702	0.600	52.202	19.315	73041.428	36890.393	8.178	0.525	0.408	4.964	158748.884	19307.106
Instance2300.3	15.469	0.594	52.050	18.784	73255.181	36934.883	8.438	0.524	0.399	4.837	156114.112	19354.115
Instance2300.4	14.084	0.593	51.993	18.960	73321.409	36923.441	8.645	0.526	0.404	4.873	157289.074	19527.272
Instance2300.5	12.903	0.595	51.993	18.921	73324.069	36922.862	8.163	0.527	0.407	4.867	158689.976	19637.726
Instance2300.6	13.040	0.595	52.240	19.096	72993.474	36865.103	8.002	0.524	0.402	4.912	156614.212	19196.798

Table 17 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.086	0.000	0.159
Available MBytes	62258.963	62221.000	62323.000
Free System Page Table Entries	16479740.938	16479410.000	16480005.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	94948659.200	94740480.000	95059968.000
Pool Paged Bytes	136745582.933	136654848.000	136802304.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

A.1.2 Test log

4/20/2017 11:43:16 AM -- Preparing for testing ...
4/20/2017 11:43:23 AM -- Attaching databases ...
4/20/2017 11:43:23 AM -- Preparations for testing are complete.
4/20/2017 11:43:23 AM -- Starting transaction dispatch ..
4/20/2017 11:43:23 AM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)
4/20/2017 11:43:23 AM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)
4/20/2017 11:43:31 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/20/2017 11:43:31 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/20/2017 11:43:32 AM -- Operation mix: Sessions 9, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/20/2017 11:43:32 AM -- Performance logging started (interval: 15000 ms).
4/20/2017 11:43:32 AM -- Attaining prerequisites:
4/20/2017 11:48:42 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1455653000.0 (lower bound: 1449551000.0, upper bound: none)
4/20/2017 1:48:42 PM -- Performance logging has ended.
4/20/2017 2:33:44 PM -- JetInterop batch transaction stats: 16372, 16372, 16372, 16372, 16372 and 16371.
4/20/2017 2:33:44 PM -- Dispatching transactions ends.
4/20/2017 2:33:45 PM -- Shutting down databases ...
4/20/2017 2:33:47 PM -- Instance2300.1 (complete), Instance2300.2 (complete), Instance2300.3 (complete), Instance2300.4 (complete), Instance2300.5 (complete) and Instance2300.6 (complete)
4/20/2017 2:33:47 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_31.blg has 500 samples.
4/20/2017 2:33:47 PM -- Creating test report ...
4/20/2017 2:33:50 PM -- Instance2300.1 has 14.5 for I/O Database Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.1 has 0.5 for I/O Log Writes Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.1 has 0.5 for I/O Log Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.2 has 15.7 for I/O Database Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.2 has 0.5 for I/O Log Writes Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.2 has 0.5 for I/O Log Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.3 has 15.5 for I/O Database Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.3 has 0.5 for I/O Log Writes Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.3 has 0.5 for I/O Log Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.4 has 14.1 for I/O Database Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.4 has 0.5 for I/O Log Writes Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.4 has 0.5 for I/O Log Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.5 has 12.9 for I/O Database Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.5 has 0.5 for I/O Log Writes Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.5 has 0.5 for I/O Log Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.6 has 13.0 for I/O Database Reads Average Latency.
4/20/2017 2:33:50 PM -- Instance2300.6 has 0.5 for I/O Log Writes Average Latency.
4/20/2017 2:33:51 PM -- Instance2300.6 has 0.5 for I/O Log Reads Average Latency.
4/20/2017 2:33:51 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/20/2017 2:33:51 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/20/2017 2:33:51 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_31.xml has 479 samples queried.

A.2 Server 2

A.2.1 Test results

Table 18 Test summary

Parameter	Detail
Overall test result	**Pass**
Machine Name	JS9
Test Description	3750 users/server 4 servers 2GB mailboxes .083 IOPS/user .10 IOPS tested 6 dbs per server 2TB db/log combined volumes 2 copies 9 threads/db
Test Start Time	4/20/2017 11:43:19 AM
Test End Time	4/20/2017 2:33:44 PM
Collection Start Time	4/20/2017 11:48:44 AM
Collection End Time	4/20/2017 1:48:29 PM
Jetstress Version	15.01.0466.031
ESE Version	15.01.0669.032
Operating System	Windows Server 2012 R2 Datacenter (6.2.9200.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_34.blg

Table 19 Database sizing and throughput

Performance counter	Value
Achieved Transactional I/O per Second	383.485
Target Transactional I/O per Second	375
Initial Database Size (bytes)	8054506520576
Final Database Size (bytes)	8055915806720
Database Files (Count)	6

Table 20 Jetstress system parameters

Performance counter	Value
Thread Count	9
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

Table 21 Database configuration

Performance counter	Value
Instance3456.1	Log path: C:\DB\DB7 Database: C:\DB\DB7\Jetstress001001.edb
Instance3456.2	Log path: C:\DB\DB8 Database: C:\DB\DB8\Jetstress002001.edb
Instance3456.3	Log path: C:\DB\DB9 Database: C:\DB\DB9\Jetstress003001.edb
Instance3456.4	Log path: C:\DB\DB10 Database: C:\DB\DB10\Jetstress004001.edb
Instance3456.5	Log path: C:\DB\DB11 Database: C:\DB\DB11\Jetstress005001.edb
Instance3456.6	Log path: C:\DB\DB12 Database: C:\DB\DB12\Jetstress006001.edb

Table 22 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
Instance3456.1	14.530	0.741	44.390	19.858	33015.502	36863.596	0.000	0.692	0.000	5.074	0.000	19272.064
Instance3456.2	14.640	0.741	44.264	19.776	33074.864	36888.968	0.000	0.694	0.000	5.059	0.000	19429.480
Instance3456.3	13.185	0.746	44.111	19.437	33043.563	36956.935	0.000	0.694	0.000	5.017	0.000	19449.110
Instance3456.4	13.218	0.752	44.396	19.710	33059.198	36856.758	0.000	0.691	0.000	5.092	0.000	19228.352
Instance3456.5	13.475	0.759	44.247	19.791	33065.006	36873.180	0.000	0.693	0.000	5.097	0.000	19348.968
Instance3456.6	17.003	0.763	44.047	19.457	33044.916	36966.589	0.000	0.694	0.000	5.007	0.000	19514.915

Table 23 Background database maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance I/O Reads/sec	Database Maintenance I/O Reads Average Bytes
Instance3456.1	9.150	261868.463
Instance3456.2	9.151	261823.076
Instance3456.3	9.152	261820.046
Instance3456.4	9.153	261790.391
Instance3456.5	9.133	261770.284
Instance3456.6	8.181	261753.421

Table 24 Log replication I/O performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3456.1	0.418	163100.189
Instance3456.2	0.418	164698.414
Instance3456.3	0.415	161379.347
Instance3456.4	0.415	161379.347
Instance3456.5	0.419	162815.809
Instance3456.6	0.415	162746.295

Table 25 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
Instance3456.1	14.530	0.741	53.540	19.858	72126.059	36863.596	8.641	0.692	0.418	5.074	163100.189	19272.064
Instance3456.2	14.640	0.741	53.416	19.776	72264.499	36888.968	8.674	0.694	0.418	5.059	164698.414	19429.480
Instance3456.3	13.185	0.746	53.263	19.437	72353.916	36956.935	8.939	0.694	0.415	5.017	161379.347	19449.110
Instance3456.4	13.218	0.752	53.548	19.710	72154.242	36856.758	8.552	0.691	0.415	5.092	161379.347	19228.352
Instance3456.5	13.475	0.759	53.380	19.791	72194.107	36873.180	8.638	0.693	0.419	5.097	162815.809	19348.968
Instance3456.6	17.003	0.763	52.228	19.457	68870.826	36966.589	8.689	0.694	0.415	5.007	162746.295	19514.915

Table 26 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.325	0.145	2.411
Available MBytes	62242.100	62112.000	62321.000
Free System Page Table Entries	16474832.824	16474118.000	16475049.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	90374735.264	89350144.000	90849280.000
Pool Paged Bytes	132058827.515	130924544.000	136196096.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

A.2.2 Test log

4/20/2017 11:43:19 AM -- Preparing for testing ...
4/20/2017 11:43:26 AM -- Attaching databases ...
4/20/2017 11:43:26 AM -- Preparations for testing are complete.
4/20/2017 11:43:26 AM -- Starting transaction dispatch ..
4/20/2017 11:43:26 AM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)
4/20/2017 11:43:26 AM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)
4/20/2017 11:43:34 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/20/2017 11:43:34 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/20/2017 11:43:35 AM -- Operation mix: Sessions 9, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/20/2017 11:43:35 AM -- Performance logging started (interval: 15000 ms).
4/20/2017 11:43:35 AM -- Attaining prerequisites:
4/20/2017 11:48:44 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1458119000.0 (lower bound: 1449551000.0, upper bound: none)
4/20/2017 1:48:44 PM -- Performance logging has ended.
4/20/2017 2:33:41 PM -- JetInterop batch transaction stats: 16831, 16831, 16831, 16831, 16830 and 16830.
4/20/2017 2:33:41 PM -- Dispatching transactions ends.
4/20/2017 2:33:42 PM -- Shutting down databases ...
4/20/2017 2:33:44 PM -- Instance3456.1 (complete), Instance3456.2 (complete), Instance3456.3 (complete), Instance3456.4 (complete), Instance3456.5 (complete) and Instance3456.6 (complete)
4/20/2017 2:33:44 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_34.blg has 498 samples.
4/20/2017 2:33:44 PM -- Creating test report ...
4/20/2017 2:33:49 PM -- Instance3456.1 has 14.5 for I/O Database Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.1 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.1 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.2 has 14.6 for I/O Database Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.2 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.2 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.3 has 13.2 for I/O Database Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.3 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.3 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.4 has 13.2 for I/O Database Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.4 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.4 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.5 has 13.5 for I/O Database Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.5 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.5 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.6 has 17.0 for I/O Database Reads Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.6 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:49 PM -- Instance3456.6 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:49 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/20/2017 2:33:49 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/20/2017 2:33:49 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_34.xml has 477 samples queried.

A.3 Server 3

A.3.1 Test results

Table 27 Test summary

Parameter	Detail
Overall test result	**Pass**
Machine Name	EX1
Test Description	3750 users/server 4 servers 2GB mailboxes .083 IOPS/user .10 IOPS tested 6 dbs per server 2TB db/log combined volumes 2 copies 10 threads/db
Test Start Time	4/20/2017 11:43:22 AM
Test End Time	4/20/2017 2:33:42 PM
Collection Start Time	4/20/2017 11:48:36 AM
Collection End Time	4/20/2017 1:48:33 PM
Jetstress Version	15.01.0466.031
ESE Version	15.01.0669.032
Operating System	Windows Server 2016 Datacenter (6.2.9200.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_37.blg

Table 28 Database sizing and throughput

Performance counter	Value
Achieved Transactional I/O per Second	391.022
Target Transactional I/O per Second	375
Initial Database Size (bytes)	8054431023104
Final Database Size (bytes)	8055882252288
Database Files (Count)	6

Table 29 Jetstress system parameters

Performance counter	Value
Thread Count	10
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

Table 30 Database configuration

Performance counter	Value
Instance5492.1	Log path: C:\DB\DB13 Database: C:\DB\DB13\Jetstress001001.edb
Instance5492.2	Log path: C:\DB\DB14 Database: C:\DB\DB14\Jetstress002001.edb
Instance5492.3	Log path: C:\DB\DB15 Database: C:\DB\DB15\Jetstress003001.edb
Instance5492.4	Log path: C:\DB\DB16 Database: C:\DB\DB16\Jetstress004001.edb
Instance5492.5	Log path: C:\DB\DB17 Database: C:\DB\DB17\Jetstress005001.edb
Instance5492.6	Log path: C:\DB\DB18 Database: C:\DB\DB18\Jetstress006001.edb

Table 31 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
Instance5492.1	14.099	0.745	45.103	20.049	33025.911	36913.821	0.000	0.699	0.000	5.182	0.000	19219.380
Instance5492.2	15.276	0.748	45.212	20.004	33040.100	36842.657	0.000	0.700	0.000	5.167	0.000	19176.439
Instance5492.3	15.265	0.754	45.207	20.072	33015.927	36943.086	0.000	0.700	0.000	5.188	0.000	19232.236
Instance5492.4	15.253	0.759	45.231	20.215	33053.545	36837.918	0.000	0.702	0.000	5.183	0.000	19270.717
Instance5492.5	15.238	0.760	44.933	19.807	33036.382	36929.314	0.000	0.702	0.000	5.148	0.000	19252.932
Instance5492.6	15.523	0.769	45.106	20.084	33037.996	36917.084	0.000	0.703	0.000	5.198	0.000	19348.283

Table 32 Background database maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance5492.1	9.148	261792.794
Instance5492.2	9.152	261807.443
Instance5492.3	9.142	261769.988
Instance5492.4	9.152	261827.102
Instance5492.5	9.153	261765.048
Instance5492.6	9.047	261805.327

Table 33 Log replication I/O performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance5492.1	0.424	166777.228
Instance5492.2	0.423	164447.450
Instance5492.3	0.424	165805.098
Instance5492.4	0.425	166029.056
Instance5492.5	0.423	163458.876
Instance5492.6	0.427	167188.807

Table 34 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
Instance5492.1	14.099	0.745	45.103	20.049	33025.911	36913.821	0.000	0.699	0.000	5.182	0.000	19219.380
Instance5492.2	15.276	0.748	45.212	20.004	33040.100	36842.657	0.000	0.700	0.000	5.167	0.000	19176.439
Instance5492.3	15.265	0.754	45.207	20.072	33015.927	36943.086	0.000	0.700	0.000	5.188	0.000	19232.236
Instance5492.4	15.253	0.759	45.231	20.215	33053.545	36837.918	0.000	0.702	0.000	5.183	0.000	19270.717
Instance5492.5	15.238	0.760	44.933	19.807	33036.382	36929.314	0.000	0.702	0.000	5.148	0.000	19252.932
Instance5492.6	15.523	0.769	45.106	20.084	33037.996	36917.084	0.000	0.703	0.000	5.198	0.000	19348.283

Table 35 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.322	0.084	0.548
Available MBytes	126170.735	126124.000	126235.000
Free System Page Table Entries	12298039.219	12297432.000	12298439.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	126238660.142	125886464.000	126472192.000
Pool Paged Bytes	284596997.879	284557312.000	284696576.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

A.3.2 Test log

4/20/2017 11:43:22 AM -- Preparing for testing ...
4/20/2017 11:43:28 AM -- Attaching databases ...
4/20/2017 11:43:28 AM -- Preparations for testing are complete.
4/20/2017 11:43:28 AM -- Starting transaction dispatch ..
4/20/2017 11:43:29 AM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)
4/20/2017 11:43:29 AM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)
4/20/2017 11:43:37 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/20/2017 11:43:37 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/20/2017 11:43:39 AM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/20/2017 11:43:39 AM -- Performance logging started (interval: 15000 ms).
4/20/2017 11:43:39 AM -- Attaining prerequisites:
4/20/2017 11:48:36 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1453171000.0 (lower bound: 1449551000.0, upper bound: none)
4/20/2017 1:48:36 PM -- Performance logging has ended.
4/20/2017 2:33:38 PM -- JetInterop batch transaction stats: 17231, 17231, 17230, 17230, 17230 and 17230.
4/20/2017 2:33:38 PM -- Dispatching transactions ends.
4/20/2017 2:33:39 PM -- Shutting down databases ...
4/20/2017 2:33:42 PM -- Instance5492.1 (complete), Instance5492.2 (complete), Instance5492.3 (complete), Instance5492.4 (complete), Instance5492.5 (complete) and Instance5492.6 (complete)
4/20/2017 2:33:42 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_37.blg has 498 samples.
4/20/2017 2:33:42 PM -- Creating test report ...
4/20/2017 2:35:13 PM -- Instance5492.1 has 14.1 for I/O Database Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.1 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.1 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.2 has 15.3 for I/O Database Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.2 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.2 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.3 has 15.3 for I/O Database Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.3 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.3 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.4 has 15.3 for I/O Database Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.4 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.4 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.5 has 15.2 for I/O Database Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.5 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.5 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.6 has 15.5 for I/O Database Reads Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.6 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:35:13 PM -- Instance5492.6 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:35:13 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/20/2017 2:35:13 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/20/2017 2:35:13 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_37.xml has 478 samples queried.

A.4 Server 4

A.4.1 Test results

Table 36 Test summary

Paremeter	Detail
Overall test result	**Pass**
Machine Name	EX2
Test Description	3750 users/server 4 servers 2GB mailboxes .083 IOPS/user .10 IOPS tested 6 dbs per server 2TB db/log combined volumes 2 copies 10 threads/db
Test Start Time	4/20/2017 11:43:25 AM
Test End Time	4/20/2017 2:33:41 PM
Collection Start Time	4/20/2017 11:48:41 AM
Collection End Time	4/20/2017 1:48:36 PM
Jetstress Version	15.01.0466.031
ESE Version	15.01.0669.032
Operating System	Windows Server 2016 Datacenter (6.2.9200.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_40.blg

Table 37 Database sizing and throughput

Performance counter	Value
Achieved Transactional I/O per Second	391.951
Target Transactional I/O per Second	375
Initial Database Size (bytes)	8054498131968
Final Database Size (bytes)	8055932583936
Database Files (Count)	6

Table 38 Jetstress system parameters

Performance counter	Value
Thread Count	10
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

Table 39 Database configuration

Performance counter	Value
Instance6152.1	Log path: C:\DB\DB19 Database: C:\DB\DB19\Jetstress001001.edb
Instance6152.2	Log path: C:\DB\DB20 Database: C:\DB\DB20\Jetstress002001.edb
Instance6152.3	Log path: C:\DB\DB21 Database: C:\DB\DB21\Jetstress003001.edb
Instance6152.4	Log path: C:\DB\DB22 Database: C:\DB\DB22\Jetstress004001.edb
Instance6152.5	Log path: C:\DB\DB23 Database: C:\DB\DB23\Jetstress005001.edb
Instance6152.6	Log path: C:\DB\DB24 Database: C:\DB\DB24\Jetstress006001.edb

Table 40 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
Instance6152.1	14.261	0.757	45.079	19.838	33029.831	36928.269	0.000	0.714	0.000	5.141	0.000	19215.162
Instance6152.2	15.286	0.760	45.324	20.323	33042.280	36895.956	0.000	0.714	0.000	5.252	0.000	19209.553
Instance6152.3	15.163	0.764	44.923	19.735	33022.732	36972.737	0.000	0.715	0.000	5.118	0.000	19377.536
Instance6152.4	15.206	0.772	45.436	20.384	33063.066	36768.182	0.000	0.715	0.000	5.200	0.000	19076.072
Instance6152.5	15.174	0.773	45.473	20.262	33012.114	36807.675	0.000	0.713	0.000	5.169	0.000	19010.836
Instance6152.6	16.520	0.783	45.073	20.099	33007.347	36951.392	0.000	0.715	0.000	5.181	0.000	19440.390

Table 41 Background database maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance6152.1	9.134	261850.291
Instance6152.2	9.148	261953.949
Instance6152.3	9.156	261716.408
Instance6152.4	9.148	261826.480
Instance6152.5	9.154	261776.798
Instance6152.6	8.737	261813.646

Table 42 Log replication I/O performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance6152.1	0.420	164373.803
Instance6152.2	0.428	169441.070
Instance6152.3	0.420	164373.803
Instance6152.4	0.422	165604.514
Instance6152.5	0.418	162151.424
Instance6152.6	0.428	166865.489

Table 43 Table 1 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
Instance6152.1	14.261	0.757	54.214	19.838	71583.117	36928.269	7.591	0.714	0.420	5.141	164373.803	19215.162
Instance6152.2	15.286	0.760	54.472	20.323	71486.552	36895.956	7.772	0.714	0.428	5.252	169441.070	19209.553
Instance6152.3	15.163	0.764	54.079	19.735	71741.599	36972.737	7.554	0.715	0.420	5.118	164373.803	19377.536
Instance6152.4	15.206	0.772	54.584	20.384	71401.926	36768.182	7.841	0.715	0.422	5.200	165604.514	19076.072
Instance6152.5	15.174	0.773	54.627	20.262	71346.743	36807.675	7.353	0.713	0.418	5.169	162151.424	19010.836
Instance6152.6	16.520	0.783	53.810	20.099	70159.281	36951.392	7.503	0.715	0.428	5.181	166865.489	19440.390

Table 44 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.330	0.206	0.534
Available MBytes	126306.378	126253.000	126370.000
Free System Page Table Entries	12297827.635	12297221.000	12298217.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	105948760.718	104677376.000	106868736.000
Pool Paged Bytes	226725494.647	226222080.000	227127296.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

A.4.2 Test log

4/20/2017 11:43:25 AM -- Preparing for testing ...
4/20/2017 11:43:31 AM -- Attaching databases ...
4/20/2017 11:43:31 AM -- Preparations for testing are complete.
4/20/2017 11:43:31 AM -- Starting transaction dispatch ..
4/20/2017 11:43:32 AM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)
4/20/2017 11:43:32 AM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)
4/20/2017 11:43:40 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
4/20/2017 11:43:40 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
4/20/2017 11:43:42 AM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
4/20/2017 11:43:42 AM -- Performance logging started (interval: 15000 ms).
4/20/2017 11:43:42 AM -- Attaining prerequisites:
4/20/2017 11:48:41 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1449718000.0 (lower bound: 1449551000.0, upper bound: none)
4/20/2017 1:48:43 PM -- Performance logging has ended.
4/20/2017 2:33:35 PM -- JetInterop batch transaction stats: 17157, 17157, 17156, 17156, 17156 and 17156.
4/20/2017 2:33:35 PM -- Dispatching transactions ends.
4/20/2017 2:33:35 PM -- Shutting down databases ...
4/20/2017 2:33:41 PM -- Instance6152.1 (complete), Instance6152.2 (complete), Instance6152.3 (complete), Instance6152.4 (complete), Instance6152.5 (complete) and Instance6152.6 (complete)
4/20/2017 2:33:41 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_40.blg has 498 samples.
4/20/2017 2:33:42 PM -- Creating test report ...
4/20/2017 2:33:46 PM -- Instance6152.1 has 14.3 for I/O Database Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.1 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.1 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.2 has 15.3 for I/O Database Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.2 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.2 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.3 has 15.2 for I/O Database Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.3 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.3 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.4 has 15.2 for I/O Database Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.4 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.4 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.5 has 15.2 for I/O Database Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.5 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.5 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.6 has 16.5 for I/O Database Reads Average Latency.
4/20/2017 2:33:46 PM -- Instance6152.6 has 0.7 for I/O Log Writes Average Latency.
4/20/2017 2:33:47 PM -- Instance6152.6 has 0.7 for I/O Log Reads Average Latency.
4/20/2017 2:33:47 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
4/20/2017 2:33:47 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
4/20/2017 2:33:47 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_4_20_11_43_40.xml has 478 samples queried.

B Technical support and resources

Dell.com/support is focused on meeting customer needs with proven services and support.

Dell TechCenter is an online technical community where IT professionals have access to numerous resources for Dell EMC software, hardware, and services.

Storage Solutions Technical Documents on Dell TechCenter provide expertise that helps to ensure customer success on Dell EMC storage platforms.

Related resources:

- Dell EMC SC Series SC5020 Storage Array specifications sheet
- Microsoft ESRP Program web site
- *Sizing and Best Practices for Deploying Microsoft Exchange Server 2013 with Dell SC Series Storage Arrays*