

Dell EMC SCv3020 7,000 Mailbox Exchange 2016 Resiliency Storage Solution using 7.2K drives

Microsoft ESRP 4.0

[Abstract](#)

This document describes the Dell EMC™ SCv3020 storage solution for Microsoft® Exchange Server, based on the Microsoft Exchange Solution Reviewed Program (ESRP) – Storage program, with 7,000 mailboxes in two SCv3020 arrays containing 7.2K drives.

October 2017

Revisions

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1 Introduction

This document provides information on the Dell EMC™ SCv3020 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 7,000 typical user mailboxes in two 3U SCv3020 arrays containing 7.2K rpm 1 TB drives. Test results show the SCv3020 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 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 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 here 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 SC Series array, or half of the solution. The number of users simulated was 7,000 across two servers, with 3,500 users per server. The mailbox size was 2 GB per user. Each server has six databases, with one local copy 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 SCv3020 array running Dell™ Storage Center OS (SCOS) 7.2 on a redundant controller pair with redundant front-end and back-end connections. The front-end connections are 10GbE iSCSI-based, over redundant fabrics, with 2 ports per server, and 4 ports per controller. The SCv3020 array is a 30-bay, 2.5-inch drive enclosure with dual controllers.

The back-end disk connectivity is 12Gb SAS using 7.2K rpm 1 TB disk drives. The spindle count is 28 disks and two 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 compatibility information regarding SCOS 7.2 with Microsoft Windows Server®: <https://www.windowsservercatalog.com/item.aspx?itemId=bb42253c-205d-da5d-e884-cbf33697346f&bCatID=1282>

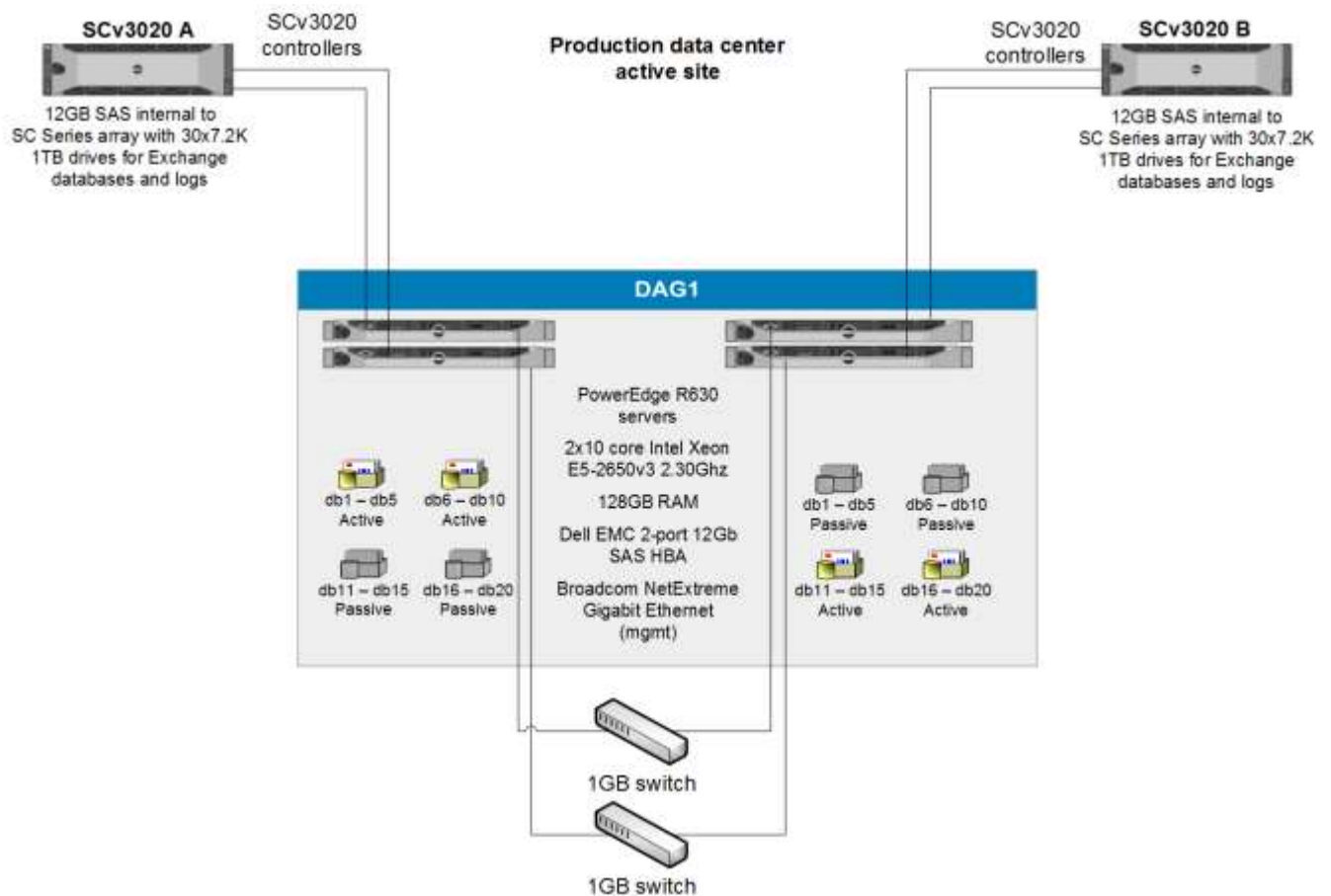


Figure 1 Highly available data center design

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.

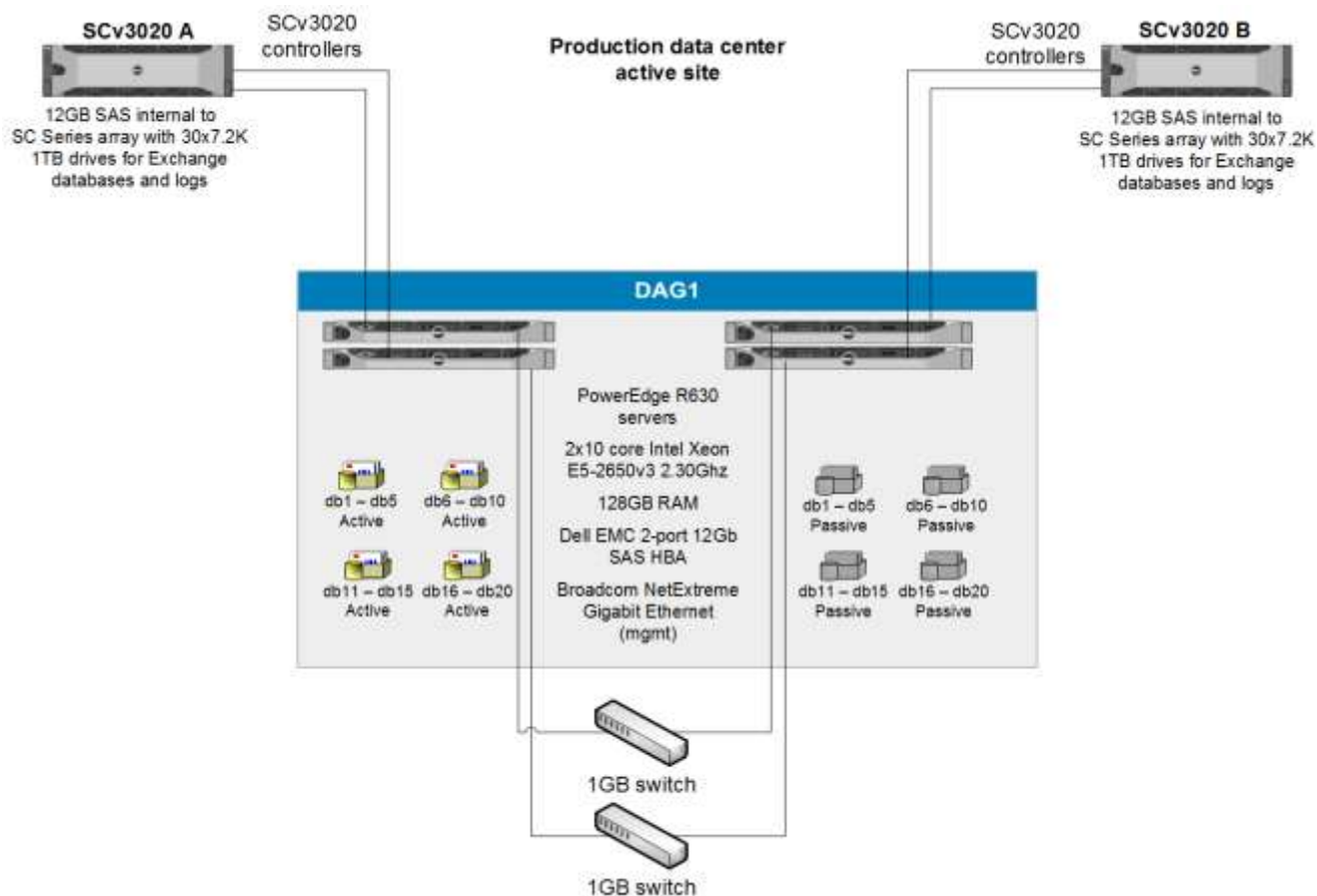


Figure 2 Tested configuration: SCv3020 A with full user load and SCv3020 B offline

The tested configuration is a single SCv3020 array (Figure 2), running with the full user load. This is to clearly show 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 SCv3020 array, while either array could handle the entire workload at any given time.

The ability to handle the entire workload on a single SCv3020 array means no I/O performance degradation will occur if an array or any volume(s) were to fail. All mailbox servers would have volumes mapped to both arrays, with one copy of each database on each array.

2 SCv3000 Series solution overview

2.1 Accelerate your workloads, automate your savings

SCv3000 Series arrays are a revolutionary upgrade to the popular SCv2000 Series, offering a full range of powerful SC Series features previously unavailable in this category.

The SCv3000 Series arrays make storage cost savings automatic with a modern architecture that optimizes the data center for economics while delivering transformational SSD, HDD, or hybrid performance. Highlights include:

- Data Progression: Achieve IOPS goals with the least-expensive mix of storage media, even as performance needs evolve.
- Intelligent 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.
- Replication: With other SC Series and PS Series arrays.
- Live Volume: Enable native business continuity and disaster recovery.
- Dell ProSupport™ services: Reduce deployment costs with remote installation options that ensure the project is successful the first time.

2.2 All-new hardware platform

Designed as the next-generation successor to the popular SCv2000 Series arrays, the SCv3000 Series offers an impressive feature set and delivers transformational HDD, hybrid, or SSD performance. With dual six-core Intel® processors, 2x more memory, and a 12Gb SAS back end, the SCv3000 Series delivers:

- Up to 50% more IOPS and capacity¹
- Up to 3x more bandwidth¹
- 2x maximum snapshots

¹Based on April 2017 internal Dell EMC testing, compared to previous-generation SCv2000. Actual performance will vary depending upon application and configuration

The SCv3000 Series has two base array options, with both models featuring a 3U all-in-one format, including dual controllers with 6-core Intel® processors, 32GB memory (16GB per controller) and flexible 10GB iSCSI, 12Gb SAS, or 16Gb FC network connections.

**SCv3000**

(16) 3.5-inch drive slots, 3U

**SCv3020**

(30) 2.5-inch drive slots, 3U

With three optional expansion enclosures, customers can mix and match in any combination with either base unit, scaling up to 222 drives, or 1 PB per array — with even larger scale-out potential in federated multi-array systems. All array and expansion enclosure models support a variety of SSD, 15K, 10K, and NL-SAS drives, including FIPS-certified self-encrypting drives (SEDs).

**SCv300**

(12) 3.5-inch drive slots, 2U

**SCv320**

(24) 2.5-inch drive slots, 2U

**SCv360**

(60) 3.5-inch drive slots, 4U

For more product information, see the SCv3000 Series [specifications sheet](#).

2.3 Targeted customer profile

This solution is targeted for a medium-sized organization. Capacity can be dynamically scaled up to 1 PB. This provides excellent growth potential with no downtime required for upgrades.

The solution was tested with the following configuration:

- User I/O profile: .084 IOPS per user, .10 tested, giving 20% headroom
- User mailbox size: 2 GB quota
- Backup strategy: 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 RAID 10, RAID 5, and RAID 6 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 will increase performance and capacity as the system grows.

The testing environment was configured for 86% storage utilization. If the storage requirement grows beyond the design specified, additional drives will 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	7,000
Database availability groups (DAGs)	1
Servers per DAG	4
Active mailboxes per server	1,750
Databases per host	6
Copies per database	2
Mailboxes per database	291 or 292
Simulated profile: I/Os per second per mailbox (IOPS, include 20% headroom)	.084 (.10 tested)
Database per log LUN size	2 TB
Total database size for performance testing	22.0 TB
% storage capacity used by Exchange database*	81%

*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.

3.2 Primary storage hardware

Table 2 Primary storage hardware

Configuration	Detail
Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	SAS 12Gb
Storage model and OS or firmware revision	Dell EMC SCv3020 with SCOS 7.2 https://www.windowsservercatalog.com/item.aspx?idItem=bb42253c-205d-da5d-e884-cbf33697346f&bCatID=1282
Storage cache	8 GB
Number of storage controllers	2
Number of storage ports	4 active ports per controller
Maximum bandwidth of storage connectivity to host	40Gb/sec (4x10GbE HBA)
Switch type, model, and firmware revision	None (direct attach)
HBA model and firmware	Dell 12Gbps SAS HBA; Avago driver version: 2.51.12.80
Number of HBAs per host	1x2-port 12Gb SAS HBA
Host server type	2x8 Intel® Xeon® Processor E5-2660 0 @ 2.30GHz, 192GB RAM
Total number of disks tested in solution	28 active for database and logs plus 2 hot spares = 30 total spindles
Maximum number of spindles that can be hosted in the storage	30 drive bays + dual controllers in a 3U chassis; Scalable up to 222 drives (30 internal, plus 192 external with modular expansion enclosures); Total of 1 PB per array

3.3 Primary storage software

Table 3 Primary storage software

Configuration	Detail
HBA driver	Intel® Ethernet 10G 4P X520/I350 rNDC; Driver version: 3.12.11.1
HBA queue depth setting	65535
Multipathing	Microsoft Windows Server 2016 R2 MPIO (in-box DSM)
Host OS	Microsoft Windows Server 2016, Datacenter Edition with desktop
ESE.dll file version	15.01.1034.026
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, and firmware revision	SAS 7.2K 1.0 TB
Raw capacity per disk (GB)	931.51 GB
Number of physical disks in test	28 + 2 hot spares = 30 drives
Total raw storage capacity (GB)	26.08 TB
RAID level	RAID 5
Total formatted capacity	24.23 TB
Storage capacity utilization	86%
Database capacity utilization	81%

4 Test results summary

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

4.1 Reliability

A number of reliability tests were run for 24 hours to verify 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 of I/O for two hours. The test is to show how long it takes for the storage to respond to an I/O under load. The following data is the sum of all of the logical disk I/Os and average of all the logical disk I/O latency in 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	416.813
Database Disks Reads/sec	308.789
Database Disks Writes/sec	108.024
Average Database Disk Read Latency (ms)	17.715
Average Database Disk Write Latency (ms)	0.575
Transaction Log I/O	Value
Log Disks Writes/sec	26.862
Average Log Disk Write Latency (ms)	0.506

Table 6 Server 2 test results

Database I/O	Value
Database Disks Transfers/sec	418.202
Database Disks Reads/sec	309.378
Database Disks Writes/sec	108.824
Average Database Disk Read Latency (ms)	17.910
Average Database Disk Write Latency (ms)	0.573
Transaction Log I/O	Value
Log Disks Writes/sec	26.854
Average Log Disk Write Latency (ms)	0.507

4.2.1 Database backup and recovery performance

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

4.2.2 Database read-only performance

The test is to measure the maximum rate at which databases could be backed up using the Volume Shadow Copy Services (VSS). The following table shows the average rate for a single database file and the total rate per server.

Performance item	Detail
MB read/sec per database	59.13
MB read/sec total per server	354.81

4.2.3 Transaction log recovery/snapshot 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 table shows the average rate for 500 log files played in a single database. Each log file is 1 MB in size.

Performance item	Detail
Average time to play one Log file (sec)	2.666

5 Conclusion

The testing shows the scalability and performance of the SCv3020 array. Improvements in I/O efficiency are seen with this newest version of SCOS and the latest Dell EMC hardware solution. These tests discovered that write I/O response times to Exchange databases improved 285% and transaction logs improved by 218% compared to the SCv2000 results.

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

This appendix shows the detailed Jetstress results of the concurrent 2 hour performance on all servers in the test study.

A.1 Server 1

A.1.1 Test results

Table 7 Test summary

Parameter	Detail
Overall Test Result	Pass
Machine Name	JS16
Test Description	3,500 Mailboxes .084 Mailbox Profile 0.10 Tested 2GB Mailboxes
Test Start Time	8/29/2017 11:41:42 AM
Test End Time	8/29/2017 3:04:18 PM
Collection Start Time	8/29/2017 11:47:26 AM
Collection End Time	8/29/2017 1:47:19 PM
Jetstress Version	15.01.1019.000
ESE Version	15.01.1034.026
Operating System	Windows Server 2016 Datacenter (6.2.9200.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2017_8_29_11_41_57.blg

Table 8 Database sizing and throughput

Performance counter	Value
Achieved Transactional I/O per Second	361.934
Target Transactional I/O per Second	350
Initial Database Size (bytes)	10741973254144
Final Database Size (bytes)	10743441260544
Database Files (Count)	6

Table 9 Jetstress system parameters

Performance counter	Value
Thread Count	11
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 10 Database configuration

Performance counter	Value
Instance2372.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance2372.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance2372.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance2372.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb
Instance2372.5	Log path: C:\DB\DB5 Database: C:\DB\DB5\Jetstress005001.edb
Instance2372.6	Log path: C:\DB\DB6 Database: C:\DB\DB6\Jetstress006001.edb

Table 11 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
Instance2372.1	18.448	0.588	42.266	17.977	33007.851	36208.397	0.000	0.507	0.000	4.437	0.000	19360.833
Instance2372.2	17.497	0.571	42.521	18.094	33046.998	36276.676	0.000	0.507	0.000	4.505	0.000	19058.813
Instance2372.3	17.522	0.572	42.453	18.131	33060.521	36176.969	0.000	0.506	0.000	4.505	0.000	19222.114
Instance2372.4	17.761	0.571	42.295	18.065	33030.822	36240.916	0.000	0.504	0.000	4.481	0.000	19406.344
Instance2372.5	17.559	0.575	42.187	17.822	33049.179	36320.971	0.000	0.506	0.000	4.448	0.000	19269.325
Instance2372.6	17.505	0.572	42.189	17.935	33063.505	36261.582	0.000	0.508	0.000	4.486	0.000	19374.520

Table 12 Background database maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2372.1	9.126	261994.057
Instance2372.2	9.151	261861.974
Instance2372.3	9.149	261942.826
Instance2372.4	9.149	261937.934
Instance2372.5	9.152	261835.252
Instance2372.6	9.151	261865.828

Table 13 Log replication I/O performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2372.1	0.366	142494.527
Instance2372.2	0.365	142123.372
Instance2372.3	0.368	143176.718
Instance2372.4	0.371	144419.398
Instance2372.5	0.365	141717.125
Instance2372.6	0.370	145303.913

Table 14 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
Instance2372.1	18.448	0.588	51.392	17.977	73669.460	36208.397	7.491	0.507	0.366	4.437	142494.527	19360.833
Instance2372.2	17.497	0.571	51.672	18.094	73571.116	36276.676	8.128	0.507	0.365	4.505	142123.372	19058.813
Instance2372.3	17.522	0.572	51.602	18.131	73640.724	36176.969	7.454	0.506	0.368	4.505	143176.718	19222.114
Instance2372.4	17.761	0.571	51.444	18.065	73740.186	36240.916	7.873	0.504	0.371	4.481	144419.398	19406.344
Instance2372.5	17.559	0.575	51.339	17.822	73834.628	36320.971	7.748	0.506	0.365	4.448	141717.125	19269.325
Instance2372.6	17.505	0.572	51.340	17.935	73845.914	36261.582	8.044	0.508	0.370	4.486	145303.913	19374.520

Table 15 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.151	0.034	13.704
Available MBytes	190983.002	190934.000	191118.000
Free System Page Table Entries	12278680.835	12278144.000	12279084.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	186687564.960	185868288.000	187854848.000
Pool Paged Bytes	150905917.996	150474752.000	156819456.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

A.1.2 Test log

8/29/2017 11:41:42 AM -- Preparing for testing ...
 8/29/2017 11:41:49 AM -- Attaching databases ...
 8/29/2017 11:41:49 AM -- Preparations for testing are complete.
 8/29/2017 11:41:49 AM -- Starting transaction dispatch ..
 8/29/2017 11:41:49 AM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)
 8/29/2017 11:41:49 AM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)
 8/29/2017 11:41:57 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 8/29/2017 11:41:57 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 8/29/2017 11:41:58 AM -- Operation mix: Sessions 11, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 8/29/2017 11:41:58 AM -- Performance logging started (interval: 15000 ms).
 8/29/2017 11:41:58 AM -- Attaining prerequisites:
 8/29/2017 11:47:26 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1453568000.0 (lower bound: 1449551000.0, upper bound: none)
 8/29/2017 1:47:27 PM -- Performance logging has ended.
 8/29/2017 3:04:01 PM -- JetInterop batch transaction stats: 17440, 17440, 17440, 17439, 17439 and 17439.
 8/29/2017 3:04:01 PM -- Dispatching transactions ends.
 8/29/2017 3:04:02 PM -- Shutting down databases ...
 8/29/2017 3:04:18 PM -- Instance2372.1 (complete), Instance2372.2 (complete), Instance2372.3 (complete), Instance2372.4 (complete), Instance2372.5 (complete) and Instance2372.6 (complete)
 8/29/2017 3:04:18 PM -- C:\Program Files\Exchange Jetstress\Performance 2017_8_29_11_41_57.blg has 500 samples.
 8/29/2017 3:04:18 PM -- Creating test report ...
 8/29/2017 3:04:20 PM -- Instance2372.1 has 18.4 for I/O Database Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.1 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.1 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.2 has 17.5 for I/O Database Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.2 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.2 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.3 has 17.5 for I/O Database Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.3 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.3 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.4 has 17.8 for I/O Database Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.4 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.4 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.5 has 17.6 for I/O Database Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.5 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.5 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.6 has 17.5 for I/O Database Reads Average Latency.
 8/29/2017 3:04:20 PM -- Instance2372.6 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 3:04:21 PM -- Instance2372.6 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 3:04:21 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 8/29/2017 3:04:21 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
 8/29/2017 3:04:21 PM -- C:\Program Files\Exchange Jetstress\Performance 2017_8_29_11_41_57.xml has 478 samples queried.

A.2 Server 2

A.2.1 Test results

Table 16 Test summary

Parameter	Detail
Overall Test Result	Pass
Machine Name	JS17
Test Description	3,500 Mailboxes .084 Profile / .10 Tested 2GB Mailbox
Test Start Time	8/29/2017 9:41:49 AM
Test End Time	8/29/2017 1:04:07 PM
Collection Start Time	8/29/2017 9:47:33 AM
Collection End Time	8/29/2017 11:47:30 AM
Jetstress Version	15.01.1019.000
ESE Version	15.01.1034.026
Operating System	Windows Server 2016 Datacenter (6.2.9200.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2017_8_29_9_42_4.blg

Table 17 Database sizing and throughput

Performance counter	Value
Achieved Transactional I/O per Second	363.751
Target Transactional I/O per Second	350
Initial Database Size (bytes)	10742459793408
Final Database Size (bytes)	10743911022592
Database Files (Count)	6

Table 18 Jetstress system parameters

Performance counter	Value
Thread Count	11
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 19 Database configuration

Performance counter	Value
Instance3892.1	Log path: C:\DB\DB7 Database: C:\DB\DB7\Jetstress001001.edb
Instance3892.2	Log path: C:\DB\DB8 Database: C:\DB\DB8\Jetstress002001.edb
Instance3892.3	Log path: C:\DB\DB9 Database: C:\DB\DB9\Jetstress003001.edb
Instance3892.4	Log path: C:\DB\DB10 Database: C:\DB\DB10\Jetstress004001.edb
Instance3892.5	Log path: C:\DB\DB11 Database: C:\DB\DB11\Jetstress005001.edb
Instance3892.6	Log path: C:\DB\DB12 Database: C:\DB\DB12\Jetstress006001.edb

Table 20 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
Instance3892.1	17.783	0.568	42.752	18.438	33026.986	36068.239	0.000	0.508	0.000	4.509	0.000	19283.406
Instance3892.2	17.591	0.571	41.935	17.761	33027.026	36271.003	0.000	0.508	0.000	4.454	0.000	19564.203
Instance3892.3	17.607	0.574	42.591	18.089	33023.805	36151.858	0.000	0.506	0.000	4.421	0.000	19287.441
Instance3892.4	17.626	0.572	42.617	18.288	33034.680	36104.741	0.000	0.504	0.000	4.534	0.000	19171.742
Instance3892.5	17.639	0.575	42.542	18.075	33045.547	36145.541	0.000	0.506	0.000	4.464	0.000	19295.543
Instance3892.6	19.211	0.578	42.491	18.173	33011.024	36103.655	0.000	0.510	0.000	4.472	0.000	19425.383

Table 21 Background database maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3892.1	9.130	261965.746
Instance3892.2	9.147	261958.874
Instance3892.3	9.149	261875.941
Instance3892.4	9.147	261984.958
Instance3892.5	9.149	261884.908
Instance3892.6	8.729	261930.808

Table 22 Log replication I/O performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3892.1	0.369	143226.982
Instance3892.2	0.369	144080.197
Instance3892.3	0.362	140313.891
Instance3892.4	0.369	143226.982
Instance3892.5	0.365	141906.780
Instance3892.6	0.369	143653.589

Table 23 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
Instance3892.1	17.783	0.568	51.881	18.438	73313.976	36068.239	7.793	0.508	0.369	4.509	143226.982	19283.406
Instance3892.2	17.591	0.571	51.082	17.761	74022.854	36271.003	7.579	0.508	0.369	4.454	144080.197	19564.203
Instance3892.3	17.607	0.574	51.739	18.089	73490.807	36151.858	7.332	0.506	0.362	4.421	140313.891	19287.441
Instance3892.4	17.626	0.572	51.764	18.288	73490.529	36104.741	7.293	0.504	0.369	4.534	143226.982	19171.742
Instance3892.5	17.639	0.575	51.692	18.075	73550.182	36145.541	7.701	0.506	0.365	4.464	141906.780	19295.543
Instance3892.6	19.211	0.578	51.220	18.173	72022.776	36103.655	7.963	0.510	0.369	4.472	143653.589	19425.383

Table 24 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.111	0.000	6.164
Available MBytes	191029.767	190999.000	191178.000
Free System Page Table Entries	12278923.113	12278293.000	12279305.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	185667584.000	185237504.000	186028032.000
Pool Paged Bytes	150273578.667	149647360.000	155676672.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

A.2.2 Test log

8/29/2017 9:41:49 AM -- Preparing for testing ...
 8/29/2017 9:41:55 AM -- Attaching databases ...
 8/29/2017 9:41:55 AM -- Preparations for testing are complete.
 8/29/2017 9:41:55 AM -- Starting transaction dispatch ..
 8/29/2017 9:41:55 AM -- Database cache settings: (minimum: 192.0 MB, maximum: 1.5 GB)
 8/29/2017 9:41:55 AM -- Database flush thresholds: (start: 15.3 MB, stop: 30.7 MB)
 8/29/2017 9:42:03 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 8/29/2017 9:42:03 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 8/29/2017 9:42:04 AM -- Operation mix: Sessions 11, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 8/29/2017 9:42:04 AM -- Performance logging started (interval: 15000 ms).
 8/29/2017 9:42:04 AM -- Attaining prerequisites:
 8/29/2017 9:47:33 AM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 1452118000.0 (lower bound: 1449551000.0, upper bound: none)
 8/29/2017 11:47:34 AM -- Performance logging has ended.
 8/29/2017 1:03:57 PM -- JetInterop batch transaction stats: 17393, 17393, 17393, 17393, 17393 and 17393.
 8/29/2017 1:03:57 PM -- Dispatching transactions ends.
 8/29/2017 1:03:58 PM -- Shutting down databases ...
 8/29/2017 1:04:07 PM -- Instance3892.1 (complete), Instance3892.2 (complete), Instance3892.3 (complete), Instance3892.4 (complete), Instance3892.5 (complete) and Instance3892.6 (complete)
 8/29/2017 1:04:07 PM -- C:\Program Files\Exchange Jetstress\Performance 2017_8_29_9_42_4.blg has 501 samples.
 8/29/2017 1:04:07 PM -- Creating test report ...
 8/29/2017 1:04:10 PM -- Instance3892.1 has 17.8 for I/O Database Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.1 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.1 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.2 has 17.6 for I/O Database Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.2 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.2 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.3 has 17.6 for I/O Database Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.3 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.3 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.4 has 17.6 for I/O Database Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.4 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.4 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.5 has 17.6 for I/O Database Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.5 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.5 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.6 has 19.2 for I/O Database Reads Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.6 has 0.5 for I/O Log Writes Average Latency.
 8/29/2017 1:04:10 PM -- Instance3892.6 has 0.5 for I/O Log Reads Average Latency.
 8/29/2017 1:04:10 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 8/29/2017 1:04:10 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
 8/29/2017 1:04:10 PM -- C:\Program Files\Exchange Jetstress\Performance 2017_8_29_9_42_4.xml has 479 samples queried.

B Technical support and resources

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[Storage Solutions Technical Documents](#) on Dell TechCenter provide expertise that helps to ensure customer success on Dell EMC storage platforms.

Related resources:

- Dell EMC SCv3000 Series specifications sheet: http://i.dell.com/sites/doccontent/shared-content/data-sheets/en/Documents/SCv3000_Series_Spec_Sheet_DellEMC.pdf
- Microsoft ESRP Program web site: <https://technet.microsoft.com/en-us/office/dn756396.aspx>
- [Dell SC Series Storage and Microsoft Exchange Server 2016 Best Practices](#)
- SC Series Exchange Server sizing and best practices: [Sizing and Best Practices for Deploying Microsoft Exchange Server 2013 with Dell SC Series Storage Arrays](#)