# Dell EMC SCv3020 14,000 Mailbox Exchange 2016 Resiliency Storage Solution using 10K 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 14,000 mailboxes in two SCv3020 arrays containing 10K drives.



October 2017

# Revisions

| Date | Description |
|---|---|
| October 2017 | Initial release |

# Acknowledgements

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# 1 Introduction

This document provides information on the Dell EMC™ SC Series 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 14,000 typical user mailboxes in two 3U SCv3020 arrays containing 10K rpm 1.8 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, please click 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 14,000 across four servers, with 3,750 users per server. The mailbox size was 2 GB per user. Each server has five 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 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 two ports per server, and four 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 10K rpm 1.8 TB disk drives. The spindle count is 28 disks plus two spares for databases 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?idItem=bb42253c-205d-da5d-e884-cbf33697346f&bCatID=1282

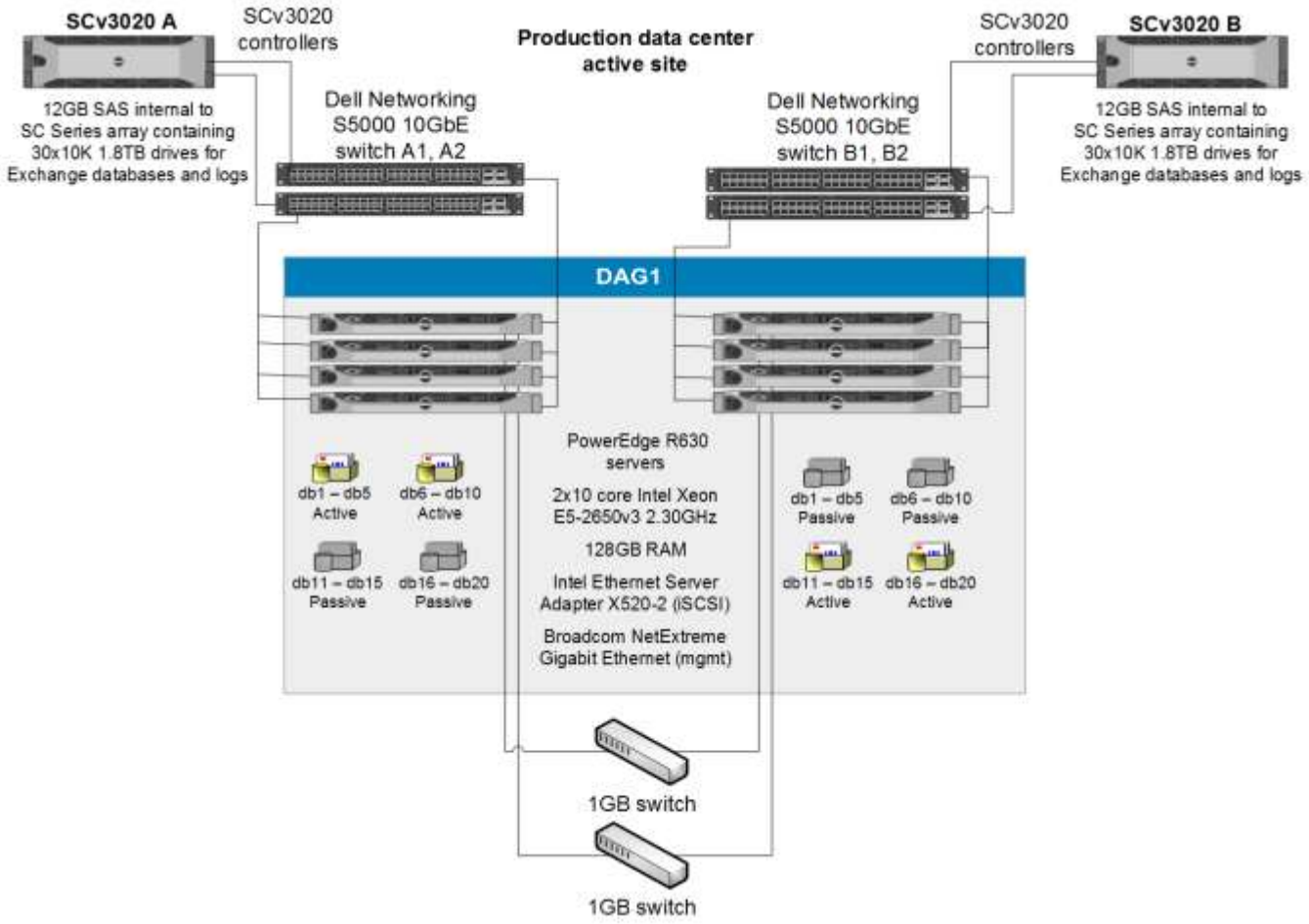


Figure 1 Highly available data center design

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.

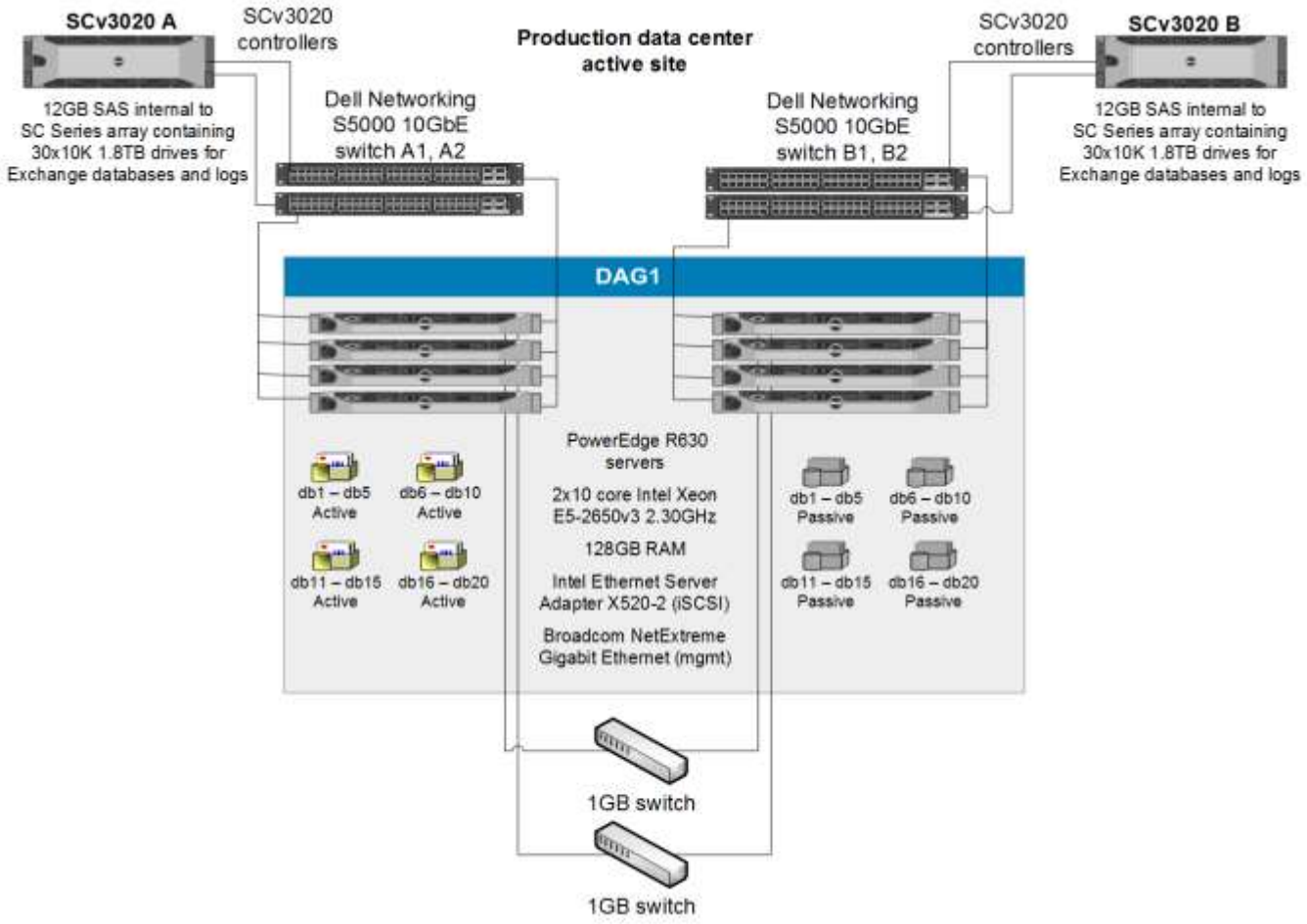


Figure 2 Tested configuration with SCv3020 A with full user load and SCv3020 B offline

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 new SCv3000 Series 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. 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: enables native business continuity /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 capacity[1]
- Up to 3x more bandwidth[1]
- 2x maximum snapshots

[1]Based 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 | 14,000 |
| Database availability groups (DAGs) | 1 |
| Servers per DAG | 8 |
| Active mailboxes per server | 1,750 |
| Databases per host | 5 |
| Copies per database | 2 |
| Mailboxes per database | 350 |
| 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 | 38.6 TB |
| % storage capacity used by Exchange database* | 84% |

*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

| | |
|---|---|
| Storage connectivity (Fibre Channel, SAS, SATA, iSCSI) | iSCSI 10GbE |
| 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 | Dell Networking S5000; software version: 9.10(0.1P5) |
| HBA model and firmware | Intel® XL710 Quad Port 10Gig SFI iSCSI Adapter |
| Number of HBAs per host | 1 Intel® Ethernet 10G 4P X520/I350 rNDC |
| 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 can be hosted in the storage | 30 drive bays + dual controllers in a 3U chassis;<br>Scalable 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 ver. 3.12.11.1 |
| HBA queue depth setting | 65535 |
| Multipathing | Microsoft Windows Server 2016 R2 MPIO Round-Robin (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 10K 1.8 TB |
| Raw capacity per disk (GB) | 1.64 TB |
| Number of physical disks in test | 28 (+2 hot spares) = 30 drives |
| Total raw storage capacity (GB) | 45.85 TB |
| RAID level | RAID 5 |
| Total formatted capacity | 38.60 TB |
| Storage capacity utilization | 84.19% |
| Database capacity utilization | 85% |

# 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 white 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 IO under load. The following data is the sum of all of the logical disk I/Os and average of all the logical disks 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 | 433.496 |
| Database Disks Reads/sec | 317.776 |
| Database Disks Writes/sec | 115.72 |
| Average Database Disk Read Latency (ms) | 16.576 |
| Average Database Disk Write Latency (ms) | 1.277 |
| **Transaction Log I/O** | **Value** |
| Log Disks Writes/sec | 29.446 |
| Average Log Disk Write Latency (ms) | 0.828 |

Table 6 Server 2 test results

| Database I/O | Value |
|---|---|
| Database Disks Transfers/sec | 434.456 |
| Database Disks Reads/sec | 318.363 |
| Database Disks Writes/sec | 116.093 |
| Average Database Disk Read Latency (ms) | 16.428 |
| Average Database Disk Write Latency (ms) | 1.149 |
| **Transaction Log I/O** | **Value** |
| Log Disks Writes/sec | 29.479 |
| Average Log Disk Write Latency (ms) | 0.795 |

Table 7 Server 3 test results

| Database I/O | Value |
|---|---|
| Database Disks Transfers/sec | 426 |
| Database Disks Reads/sec | 311.896 |
| Database Disks Writes/sec | 114.104 |
| Average Database Disk Read Latency (ms) | 17.504 |
| Average Database Disk Write Latency (ms) | 1.360 |
| **Transaction Log I/O** | **Value** |
| Log Disks Writes/sec | 28.89 |
| Average Log Disk Write Latency (ms) | 0.819 |

Table 8 Server 4 test results

| Database I/O | Value |
|---|---|
| Database Disks Transfers/sec | 413.465 |
| Database Disks Reads/sec | 303.21 |
| Database Disks Writes/sec | 110.255 |
| Average Database Disk Read Latency (ms) | 17.175 |
| Average Database Disk Write Latency (ms) | 1.464 |
| **Transaction Log I/O** | **Value** |
| Log Disks Writes/sec | 28.016 |
| Average Log Disk Write Latency (ms) | 0.999 |

## 4.3 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).

### 4.3.1 Database read-only performance

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

| Performance item | Detail |
|---|---|
| MB read/sec per database | 37.13 |
| MB read/sec total per server | 185.63 |

### 4.3.2 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) | 2.456 |

# 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 204% and transaction logs improved by 146% 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 his/her 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 two-hour performance on all servers in the test study.

## A.1 Server 1

### A.1.1 Test results

Table 9 Test Summary

| Parameter | Detail |
|---|---|
| **Overall Test Result** | **Pass** |
| Machine Name | JS16 |
| Test Description | 3,500 Mailboxes<br>.084 Mailbox Profile 0.10 Tested<br>2.5GB Mailboxes |
| Test Start Time | 9/15/2017 11:29:50 AM |
| Test End Time | 9/15/2017 1:34:50 PM |
| Collection Start Time | 9/15/2017 11:34:10 AM |
| Collection End Time | 9/15/2017 1:33:58 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_9_15_11_30_4.blg |

Table 10 Database sizing and throughput

| Performance counter | Value |
|---|---|
| Achieved Transactional I/O per Second | 389.507 |
| Target Transactional I/O per Second | 350 |
| Initial Database Size (bytes) | 9397052899328 |
| Final Database Size (bytes) | 9398051143680 |
| Database Files (Count) | 5 |

Table 11 Jetstress system parameters

| Performance counter | Value |
|---|---|
| Thread Count | 10 |
| Minimum Database Cache | 160.0 MB |
| Maximum Database Cache | 1280.0 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 |
|---|---|
| Instance3296.1 | Log path: C:\DB\DB1<br>Database: C:\DB\DB1\Jetstress001001.edb |
| Instance3296.2 | Log path: C:\DB\DB2<br>Database: C:\DB\DB2\Jetstress002001.edb |
| Instance3296.3 | Log path: C:\DB\DB3<br>Database: C:\DB\DB3\Jetstress003001.edb |
| Instance3296.4 | Log path: C:\DB\DB4<br>Database: C:\DB\DB4\Jetstress004001.edb |
| Instance3296.5 | Log path: C:\DB\DB5<br>Database: C:\DB\DB5\Jetstress005001.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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instance3296.1 | 16.534 | 1.478 | 54.768 | 23.321 | 32947.705 | 36796.893 | 0.000 | 0.869 | 0.000 | 5.935 | 0.000 | 19218.706 |
| Instance3296.2 | 16.016 | 1.511 | 54.436 | 22.751 | 32927.611 | 36833.082 | 0.000 | 0.867 | 0.000 | 5.795 | 0.000 | 19254.431 |
| Instance3296.3 | 15.981 | 1.509 | 54.734 | 23.163 | 32932.724 | 36877.534 | 0.000 | 0.866 | 0.000 | 5.912 | 0.000 | 19123.677 |
| Instance3296.4 | 15.692 | 0.858 | 54.987 | 23.225 | 32941.591 | 36793.113 | 0.000 | 0.762 | 0.000 | 5.869 | 0.000 | 19197.986 |
| Instance3296.5 | 18.656 | 1.031 | 54.861 | 23.260 | 32932.971 | 36784.622 | 0.000 | 0.778 | 0.000 | 5.935 | 0.000 | 19043.175 |

Table 14 Background database maintenance I/O performance

| MSExchange Database ==> Instances | Database Maintenance IO Reads/sec | Database Maintenance IO Reads Average Bytes |
|---|---|---|
| Instance3296.1 | 9.008 | 261886.409 |
| Instance3296.2 | 9.011 | 261912.477 |
| Instance3296.3 | 9.017 | 261845.580 |
| Instance3296.4 | 9.069 | 261876.062 |
| Instance3296.5 | 7.884 | 261902.339 |

Table 15 Log replication I/O performance

| MSExchange Database ==> Instances | I/O Log Reads/sec | I/O Log Reads Average Bytes |
|---|---|---|
| Instance3296.1 | 0.485 | 187875.131 |
| Instance3296.2 | 0.476 | 185808.020 |
| Instance3296.3 | 0.483 | 188880.789 |
| Instance3296.4 | 0.480 | 186837.155 |
| Instance3296.5 | 0.481 | 186827.872 |

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instance3296.1 | 16.534 | 1.478 | 63.777 | 23.321 | 65284.562 | 36796.893 | 13.491 | 0.869 | 0.485 | 5.935 | 187875.131 | 19218.706 |
| Instance3296.2 | 16.016 | 1.511 | 63.448 | 22.751 | 65449.260 | 36833.082 | 13.019 | 0.867 | 0.476 | 5.795 | 185808.020 | 19254.431 |
| Instance3296.3 | 15.981 | 1.509 | 63.751 | 23.163 | 65310.849 | 36877.534 | 13.236 | 0.866 | 0.483 | 5.912 | 188880.789 | 19123.677 |
| Instance3296.4 | 15.692 | 0.858 | 64.056 | 23.225 | 65352.399 | 36793.113 | 11.848 | 0.762 | 0.480 | 5.869 | 186837.155 | 19197.986 |
| Instance3296.5 | 18.656 | 1.031 | 62.744 | 23.260 | 61701.945 | 36784.622 | 12.717 | 0.778 | 0.481 | 5.935 | 186827.872 | 19043.175 |

Table 17 Host system performance

| Counter | Average | Minimum | Maximum |
|---|---|---|---|
| % Processor Time | 0.117 | 0.000 | 0.407 |
| Available MBytes | 191049.785 | 191020.000 | 191132.000 |
| Free System Page Table Entries | 12282409.061 | 12281849.000 | 12282724.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 185570776.451 | 184635392.000 | 186155008.000 |
| Pool Paged Bytes | 194745739.491 | 193458176.000 | 200658944.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

## A.1.2 Test log

9/15/2017 11:29:50 AM -- Preparing for testing ...
9/15/2017 11:29:56 AM -- Attaching databases ...
9/15/2017 11:29:56 AM -- Preparations for testing are complete.
9/15/2017 11:29:56 AM -- Starting transaction dispatch ..
9/15/2017 11:29:56 AM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
9/15/2017 11:29:56 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
9/15/2017 11:30:04 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
9/15/2017 11:30:04 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
9/15/2017 11:30:04 AM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
9/15/2017 11:30:04 AM -- Performance logging started (interval: 15000 ms).
9/15/2017 11:30:04 AM -- Attaining prerequisites:
9/15/2017 11:34:10 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1209221000.0 (lower bound: 1207960000.0, upper bound: none)
9/15/2017 1:34:11 PM -- Performance logging has ended.
9/15/2017 1:34:34 PM -- JetInterop batch transaction stats: 14416, 14415, 14415, 14415 and 14415.
9/15/2017 1:34:34 PM -- Dispatching transactions ends.
9/15/2017 1:34:35 PM -- Shutting down databases ...
9/15/2017 1:34:50 PM -- Instance3296.1 (complete), Instance3296.2 (complete), Instance3296.3 (complete), Instance3296.4 (complete) and Instance3296.5 (complete)
9/15/2017 1:34:50 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_30_4.blg has 495 samples.
9/15/2017 1:34:50 PM -- Creating test report ...
9/15/2017 1:34:52 PM -- Instance3296.1 has 16.5 for I/O Database Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.1 has 0.9 for I/O Log Writes Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.1 has 0.9 for I/O Log Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.2 has 16.0 for I/O Database Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.2 has 0.9 for I/O Log Writes Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.2 has 0.9 for I/O Log Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.3 has 16.0 for I/O Database Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.3 has 0.9 for I/O Log Writes Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.3 has 0.9 for I/O Log Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.4 has 15.7 for I/O Database Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.4 has 0.8 for I/O Log Writes Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.4 has 0.8 for I/O Log Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.5 has 18.7 for I/O Database Reads Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.5 has 0.8 for I/O Log Writes Average Latency.
9/15/2017 1:34:52 PM -- Instance3296.5 has 0.8 for I/O Log Reads Average Latency.
9/15/2017 1:34:52 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
9/15/2017 1:34:52 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
9/15/2017 1:34:52 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_30_4.xml has 478 samples queried.

## A.2 Server 2

### A.2.1 Test results

Table 18 Test summary

| Parameter | Detail |
|---|---|
| **Overall Test Result** | **Pass** |
| Machine Name | JS17 |
| Test Description | 3,500 Mailboxes<br>.084 Profile / .10 Tested<br>2.5GB Mailbox |
| Test Start Time | 9/15/2017 11:29:53 AM |
| Test End Time | 9/15/2017 1:34:52 PM |
| Collection Start Time | 9/15/2017 11:34:14 AM |
| Collection End Time | 9/15/2017 1:34:01 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_9_15_11_30_7.blg |

Table 19 Database sizing and throughput

| Performance counter | Value |
|---|---|
| Achieved Transactional I/O per Second | 390.285 |
| Target Transactional I/O per Second | 350 |
| Initial Database Size (bytes) | 9397036122112 |
| Final Database Size (bytes) | 9398034366464 |
| Database Files (Count) | 5 |

Table 20 Jetstress system parameters

| Performance counter | Value |
|---|---|
| Thread Count | 10 |
| Minimum Database Cache | 160.0 MB |
| Maximum Database Cache | 1280.0 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 |
|---|---|
| Instance1692.1 | Log path: C:\DB\DB6<br>Database: C:\DB\DB6\Jetstress001001.edb |
| Instance1692.2 | Log path: C:\DB\DB7<br>Database: C:\DB\DB7\Jetstress002001.edb |
| Instance1692.3 | Log path: C:\DB\DB8<br>Database: C:\DB\DB8\Jetstress003001.edb |
| Instance1692.4 | Log path: C:\DB\DB9<br>Database: C:\DB\DB9\Jetstress004001.edb |
| Instance1692.5 | Log path: C:\DB\DB10<br>Database: C:\DB\DB10\Jetstress005001.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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instance1692.1 | 15.802 | 0.866 | 54.913 | 23.414 | 32961.002 | 36745.590 | 0.000 | 0.722 | 0.000 | 5.959 | 0.000 | 19175.859 |
| Instance1692.2 | 15.414 | 0.865 | 54.764 | 22.962 | 32944.681 | 36863.459 | 0.000 | 0.721 | 0.000 | 5.842 | 0.000 | 19183.220 |
| Instance1692.3 | 16.014 | 1.255 | 55.016 | 23.290 | 32941.268 | 36759.964 | 0.000 | 0.832 | 0.000 | 5.855 | 0.000 | 19133.729 |
| Instance1692.4 | 16.084 | 1.256 | 54.798 | 23.146 | 32938.653 | 36781.842 | 0.000 | 0.833 | 0.000 | 5.871 | 0.000 | 19234.362 |
| Instance1692.5 | 18.824 | 1.504 | 54.700 | 23.281 | 32934.119 | 36840.851 | 0.000 | 0.865 | 0.000 | 5.952 | 0.000 | 19135.881 |

Table 23 Background database maintenance I/O performance

| MSExchange Database ==> Instances | Database Maintenance IO Reads/sec | Database Maintenance IO Reads Average Bytes |
|---|---|---|
| Instance1692.1 | 9.147 | 261937.723 |
| Instance1692.2 | 9.149 | 261888.441 |
| Instance1692.3 | 9.015 | 261880.237 |
| Instance1692.4 | 9.020 | 261914.098 |
| Instance1692.5 | 7.842 | 261879.588 |

Table 24 Log replication I/O performance

| MSExchange Database ==> Instances | I/O Log Reads/sec | I/O Log Reads Average Bytes |
|---|---|---|
| Instance1692.1 | 0.486 | 188677.547 |
| Instance1692.2 | 0.478 | 184876.416 |
| Instance1692.3 | 0.478 | 187644.338 |
| Instance1692.4 | 0.480 | 186336.009 |
| Instance1692.5 | 0.486 | 189421.366 |

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instance1692.1 | 15.802 | 0.866 | 64.060 | 23.414 | 65657.159 | 36745.590 | 10.848 | 0.722 | 0.486 | 5.959 | 188677.547 | 19175.859 |
| Instance1692.2 | 15.414 | 0.865 | 63.913 | 22.962 | 65718.006 | 36863.459 | 11.380 | 0.721 | 0.478 | 5.842 | 184876.416 | 19183.220 |
| Instance1692.3 | 16.014 | 1.255 | 64.031 | 23.290 | 65173.393 | 36759.964 | 13.311 | 0.832 | 0.478 | 5.855 | 187644.338 | 19133.729 |
| Instance1692.4 | 16.084 | 1.256 | 63.818 | 23.146 | 65301.203 | 36781.842 | 12.975 | 0.833 | 0.480 | 5.871 | 186336.009 | 19234.362 |
| Instance1692.5 | 18.824 | 1.504 | 62.541 | 23.281 | 61640.142 | 36840.851 | 13.544 | 0.865 | 0.486 | 5.952 | 189421.366 | 19135.881 |

Table 26 Host system performance

| Counter | Average | Minimum | Maximum |
|---|---|---|---|
| % Processor Time | 0.112 | 0.000 | 0.539 |
| Available MBytes | 191003.827 | 190975.000 | 191087.000 |
| Free System Page Table Entries | 12282855.203 | 12282313.000 | 12283126.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 183649324.894 | 183181312.000 | 183980032.000 |
| Pool Paged Bytes | 192935350.246 | 192315392.000 | 198483968.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

## A.2.2 Test log

9/15/2017 11:29:53 AM -- Preparing for testing ...
9/15/2017 11:29:59 AM -- Attaching databases ...
9/15/2017 11:29:59 AM -- Preparations for testing are complete.
9/15/2017 11:29:59 AM -- Starting transaction dispatch ..
9/15/2017 11:29:59 AM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
9/15/2017 11:29:59 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
9/15/2017 11:30:06 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
9/15/2017 11:30:06 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
9/15/2017 11:30:07 AM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
9/15/2017 11:30:07 AM -- Performance logging started (interval: 15000 ms).
9/15/2017 11:30:07 AM -- Attaining prerequisites:
9/15/2017 11:34:14 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1210175000.0 (lower bound: 1207960000.0, upper bound: none)
9/15/2017 1:34:15 PM -- Performance logging has ended.
9/15/2017 1:34:37 PM -- JetInterop batch transaction stats: 14397, 14397, 14396, 14396 and 14396.
9/15/2017 1:34:37 PM -- Dispatching transactions ends.
9/15/2017 1:34:38 PM -- Shutting down databases ...
9/15/2017 1:34:52 PM -- Instance1692.1 (complete), Instance1692.2 (complete), Instance1692.3 (complete), Instance1692.4 (complete) and Instance1692.5 (complete)
9/15/2017 1:34:52 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_30_7.blg has 495 samples.
9/15/2017 1:34:52 PM -- Creating test report ...
9/15/2017 1:34:54 PM -- Instance1692.1 has 15.8 for I/O Database Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.1 has 0.7 for I/O Log Writes Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.1 has 0.7 for I/O Log Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.2 has 15.4 for I/O Database Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.2 has 0.7 for I/O Log Writes Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.2 has 0.7 for I/O Log Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.3 has 16.0 for I/O Database Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.3 has 0.8 for I/O Log Writes Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.3 has 0.8 for I/O Log Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.4 has 16.1 for I/O Database Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.4 has 0.8 for I/O Log Writes Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.4 has 0.8 for I/O Log Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.5 has 18.8 for I/O Database Reads Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.5 has 0.9 for I/O Log Writes Average Latency.
9/15/2017 1:34:54 PM -- Instance1692.5 has 0.9 for I/O Log Reads Average Latency.
9/15/2017 1:34:54 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
9/15/2017 1:34:54 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
9/15/2017 1:34:54 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_30_7.xml has 478 samples queried.

# A.3 Server 3

## A.3.1 Test results

Table 27 Test summary

| Parameter | Detail |
|---|---|
| **Overall Test Result** | **Pass** |
| Machine Name | JS8 |
| Test Description | 3,500 Mailboxes<br>.084 Mailbox Profile 0.10 Tested<br>2.5GB Mailboxes |
| Test Start Time | 9/15/2017 11:29:44 AM |
| Test End Time | 9/15/2017 1:34:29 PM |
| Collection Start Time | 9/15/2017 11:34:05 AM |
| Collection End Time | 9/15/2017 1:33:51 PM |
| Jetstress Version | 15.01.1019.000 |
| ESE Version | 15.01.1034.026 |
| Operating System | Windows Server 2012 R2 Datacenter (6.2.9200.0) |
| Performance Log | C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_29_57.blg |

Table 28 Database sizing and throughput

| Performance counter | Value |
|---|---|
| Achieved Transactional I/O per Second | 383.074 |
| Target Transactional I/O per Second | 350 |
| Initial Database Size (bytes) | 9396952236032 |
| Final Database Size (bytes) | 9397942091776 |
| Database Files (Count) | 5 |

Table 29 Jetstress system parameters

| Performance counter | Value |
|---|---|
| Thread Count | 10 |
| Minimum Database Cache | 160.0 MB |
| Maximum Database Cache | 1280.0 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 |
|---|---|
| Instance4552.1 | Log path: C:\DB\DB11<br>Database: C:\DB\DB11\Jetstress001001.edb |
| Instance4552.2 | Log path: C:\DB\DB12<br>Database: C:\DB\DB12\Jetstress002001.edb |
| Instance4552.3 | Log path: C:\DB\DB13<br>Database: C:\DB\DB13\Jetstress003001.edb |
| Instance4552.4 | Log path: C:\DB\DB14<br>Database: C:\DB\DB14\Jetstress004001.edb |
| Instance4552.5 | Log path: C:\DB\DB15<br>Database: C:\DB\DB15\Jetstress005001.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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instance4552.1 | 17.686 | 1.693 | 53.978 | 23.154 | 32949.881 | 36806.992 | 0.000 | 0.898 | 0.000 | 5.803 | 0.000 | 19321.595 |
| Instance4552.2 | 16.523 | 1.756 | 53.771 | 22.856 | 32938.993 | 36856.710 | 0.000 | 0.886 | 0.000 | 5.787 | 0.000 | 19192.589 |
| Instance4552.3 | 16.342 | 1.762 | 53.674 | 22.647 | 32960.814 | 36839.981 | 0.000 | 0.886 | 0.000 | 5.762 | 0.000 | 19176.441 |
| Instance4552.4 | 18.463 | 0.795 | 53.753 | 22.728 | 32932.601 | 36868.558 | 0.000 | 0.711 | 0.000 | 5.781 | 0.000 | 19210.311 |
| Instance4552.5 | 18.506 | 0.793 | 53.795 | 22.719 | 32939.659 | 36809.119 | 0.000 | 0.713 | 0.000 | 5.757 | 0.000 | 19257.900 |

Table 32 Background database maintenance I/O performance

| MSExchange Database ==> Instances | Database Maintenance IO Reads/sec | Database Maintenance IO Reads Average Bytes |
|---|---|---|
| Instance4552.1 | 8.946 | 261936.316 |
| Instance4552.2 | 8.913 | 261881.392 |
| Instance4552.3 | 8.964 | 261928.934 |
| Instance4552.4 | 8.051 | 261906.333 |
| Instance4552.5 | 8.050 | 261923.701 |

Table 33 Log replication I/O performance

| MSExchange Database ==> Instances | I/O Log Reads/sec | I/O Log Reads Average Bytes |
|---|---|---|
| Instance4552.1 | 0.476 | 184531.846 |
| Instance4552.2 | 0.473 | 185237.105 |
| Instance4552.3 | 0.471 | 183789.604 |
| Instance4552.4 | 0.474 | 184513.551 |
| Instance4552.5 | 0.473 | 182339.437 |

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instance4552.1 | 17.686 | 1.693 | 62.924 | 23.154 | 65506.368 | 36806.992 | 15.696 | 0.898 | 0.476 | 5.803 | 184531.846 | 19321.595 |
| Instance4552.2 | 16.523 | 1.756 | 62.684 | 22.856 | 65493.626 | 36856.710 | 15.706 | 0.886 | 0.473 | 5.787 | 185237.105 | 19192.589 |
| Instance4552.3 | 16.342 | 1.762 | 62.639 | 22.647 | 65728.678 | 36839.981 | 15.733 | 0.886 | 0.471 | 5.762 | 183789.604 | 19176.441 |
| Instance4552.4 | 18.463 | 0.795 | 61.804 | 22.728 | 62760.797 | 36868.558 | 13.271 | 0.711 | 0.474 | 5.781 | 184513.551 | 19210.311 |
| Instance4552.5 | 18.506 | 0.793 | 61.845 | 22.719 | 62745.330 | 36809.119 | 13.160 | 0.713 | 0.473 | 5.757 | 182339.437 | 19257.900 |

Table 35 Host system performance

| Counter | Average | Minimum | Maximum |
|---|---|---|---|
| % Processor Time | 0.183 | 0.092 | 0.583 |
| Available MBytes | 62124.035 | 62090.000 | 62221.000 |
| Free System Page Table Entries | 16493557.877 | 16493108.000 | 16493829.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 118131196.793 | 118038528.000 | 118345728.000 |
| Pool Paged Bytes | 148532675.073 | 148430848.000 | 149151744.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

## A.3.2 Test log

9/15/2017 11:29:44 AM -- Preparing for testing ...
9/15/2017 11:29:50 AM -- Attaching databases ...
9/15/2017 11:29:50 AM -- Preparations for testing are complete.
9/15/2017 11:29:50 AM -- Starting transaction dispatch ..
9/15/2017 11:29:50 AM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
9/15/2017 11:29:50 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
9/15/2017 11:29:57 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
9/15/2017 11:29:57 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
9/15/2017 11:29:58 AM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
9/15/2017 11:29:58 AM -- Performance logging started (interval: 15000 ms).
9/15/2017 11:29:58 AM -- Attaining prerequisites:
9/15/2017 11:34:05 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1211982000.0 (lower bound: 1207960000.0, upper bound: none)
9/15/2017 1:34:05 PM -- Performance logging has ended.
9/15/2017 1:34:28 PM -- JetInterop batch transaction stats: 14149, 14149, 14149, 14148 and 14148.
9/15/2017 1:34:28 PM -- Dispatching transactions ends.
9/15/2017 1:34:28 PM -- Shutting down databases ...
9/15/2017 1:34:29 PM -- Instance4552.1 (complete), Instance4552.2 (complete), Instance4552.3 (complete), Instance4552.4 (complete) and Instance4552.5 (complete)
9/15/2017 1:34:29 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_29_57.blg has 495 samples.
9/15/2017 1:34:29 PM -- Creating test report ...
9/15/2017 1:34:32 PM -- Instance4552.1 has 17.7 for I/O Database Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.1 has 0.9 for I/O Log Writes Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.1 has 0.9 for I/O Log Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.2 has 16.5 for I/O Database Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.2 has 0.9 for I/O Log Writes Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.2 has 0.9 for I/O Log Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.3 has 16.3 for I/O Database Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.3 has 0.9 for I/O Log Writes Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.3 has 0.9 for I/O Log Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.4 has 18.5 for I/O Database Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.4 has 0.7 for I/O Log Writes Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.4 has 0.7 for I/O Log Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.5 has 18.5 for I/O Database Reads Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.5 has 0.7 for I/O Log Writes Average Latency.
9/15/2017 1:34:32 PM -- Instance4552.5 has 0.7 for I/O Log Reads Average Latency.
9/15/2017 1:34:32 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
9/15/2017 1:34:32 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
9/15/2017 1:34:32 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_29_57.xml has 478 samples queried.

## A.4 Server 4

### A.4.1 Test results

Table 36 Test summary

| Parameter | Detail |
|---|---|
| **Overall Test Result** | **Pass** |
| Machine Name | JS9 |
| Test Description | 3,500 Mailboxes<br>.084 Mailbox Profile 0.10 Tested<br>2.5GB Mailboxes |
| Test Start Time | 9/15/2017 11:29:47 AM |
| Test End Time | 9/15/2017 1:34:34 PM |
| Collection Start Time | 9/15/2017 11:34:23 AM |
| Collection End Time | 9/15/2017 1:34:10 PM |
| Jetstress Version | 15.01.1019.000 |
| ESE Version | 15.01.1034.026 |
| Operating System | Windows Server 2012 R2 Datacenter (6.2.9200.0) |
| Performance Log | C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_30_1.blg |

Table 37 Database sizing and throughput

| Performance counter | Value |
|---|---|
| Achieved Transactional I/O per Second | 369.17 |
| Target Transactional I/O per Second | 350 |
| Initial Database Size (bytes) | 9396876738560 |
| Final Database Size (bytes) | 9397816262656 |
| Database Files (Count) | 5 |

Table 38 Jetstress system parameters

| Performance counter | Value |
|---|---|
| Thread Count | 10 |
| Minimum Database Cache | 160.0 MB |
| Maximum Database Cache | 1280.0 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 |
|---|---|
| Instance1436.1 | Log path: C:\DB\DB16<br>Database: C:\DB\DB16\Jetstress001001.edb |
| Instance1436.2 | Log path: C:\DB\DB17<br>Database: C:\DB\DB17\Jetstress002001.edb |
| Instance1436.3 | Log path: C:\DB\DB18<br>Database: C:\DB\DB18\Jetstress003001.edb |
| Instance1436.4 | Log path: C:\DB\DB19<br>Database: C:\DB\DB19\Jetstress004001.edb |
| Instance1436.5 | Log path: C:\DB\DB20<br>Database: C:\DB\DB20\Jetstress005001.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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instance1436.1 | 16.946 | 1.399 | 51.698 | 21.992 | 32968.180 | 36866.900 | 0.000 | 0.989 | 0.000 | 5.597 | 0.000 | 19245.382 |
| Instance1436.2 | 16.993 | 1.430 | 52.035 | 22.265 | 32953.033 | 36784.182 | 0.000 | 0.997 | 0.000 | 5.639 | 0.000 | 19076.024 |
| Instance1436.3 | 16.923 | 1.477 | 51.614 | 21.784 | 32970.957 | 36882.098 | 0.000 | 1.002 | 0.000 | 5.554 | 0.000 | 19298.417 |
| Instance1436.4 | 16.826 | 1.465 | 51.824 | 22.141 | 32956.833 | 36804.037 | 0.000 | 0.998 | 0.000 | 5.648 | 0.000 | 19138.889 |
| Instance1436.5 | 18.189 | 1.550 | 51.745 | 22.073 | 32935.906 | 36844.257 | 0.000 | 1.010 | 0.000 | 5.578 | 0.000 | 19286.532 |

Table 41 Background database maintenance I/O performance

| MSExchange Database ==> Instances | Database Maintenance IO Reads/sec | Database Maintenance IO Reads Average Bytes |
|---|---|---|
| Instance1436.1 | 8.901 | 261925.698 |
| Instance1436.2 | 8.931 | 261932.455 |
| Instance1436.3 | 8.986 | 261935.148 |
| Instance1436.4 | 9.006 | 261872.252 |
| Instance1436.5 | 8.471 | 261938.958 |

Table 42 Log replication I/O performance

| MSExchange Database ==> Instances | I/O Log Reads/sec | I/O Log Reads Average Bytes |
|---|---|---|
| Instance1436.1 | 0.459 | 179839.834 |
| Instance1436.2 | 0.459 | 178610.121 |
| Instance1436.3 | 0.456 | 179295.077 |
| Instance1436.4 | 0.460 | 179029.214 |
| Instance1436.5 | 0.459 | 180370.565 |

Table 43 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instance1436.1 | 16.946 | 1.399 | 60.599 | 21.992 | 66599.685 | 36866.900 | 14.551 | 0.989 | 0.459 | 5.597 | 179839.834 | 19245.382 |
| Instance1436.2 | 16.993 | 1.430 | 60.965 | 22.265 | 66495.155 | 36784.182 | 15.221 | 0.997 | 0.459 | 5.639 | 178610.121 | 19076.024 |
| Instance1436.3 | 16.923 | 1.477 | 60.600 | 21.784 | 66921.196 | 36882.098 | 15.163 | 1.002 | 0.456 | 5.554 | 179295.077 | 19298.417 |
| Instance1436.4 | 16.826 | 1.465 | 60.830 | 22.141 | 66848.848 | 36804.037 | 14.728 | 0.998 | 0.460 | 5.648 | 179029.214 | 19138.889 |
| Instance1436.5 | 18.189 | 1.550 | 60.216 | 22.073 | 65152.651 | 36844.257 | 15.277 | 1.010 | 0.459 | 5.578 | 180370.565 | 19286.532 |

Table 44 Host system performance

| Counter | Average | Minimum | Maximum |
|---|---|---|---|
| % Processor Time | 0.429 | 0.194 | 1.463 |
| Available MBytes | 62142.937 | 62115.000 | 62215.000 |
| Free System Page Table Entries | 16476733.946 | 16476388.000 | 16477002.000 |
| Transition Pages RePurposed/sec | 0.000 | 0.000 | 0.000 |
| Pool Nonpaged Bytes | 146866801.540 | 146071552.000 | 147292160.000 |
| Pool Paged Bytes | 145367922.611 | 144723968.000 | 145727488.000 |
| Database Page Fault Stalls/sec | 0.000 | 0.000 | 0.000 |

## A.4.2 Test log

4 9/15/2017 11:29:47 AM -- Preparing for testing ...
9/15/2017 11:29:53 AM -- Attaching databases ...
9/15/2017 11:29:53 AM -- Preparations for testing are complete.
9/15/2017 11:29:53 AM -- Starting transaction dispatch ..
9/15/2017 11:29:53 AM -- Database cache settings: (minimum: 160.0 MB, maximum: 1.2 GB)
9/15/2017 11:29:53 AM -- Database flush thresholds: (start: 12.8 MB, stop: 25.6 MB)
9/15/2017 11:30:01 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
9/15/2017 11:30:01 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
9/15/2017 11:30:03 AM -- Operation mix: Sessions 10, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
9/15/2017 11:30:03 AM -- Performance logging started (interval: 15000 ms).
9/15/2017 11:30:03 AM -- Attaining prerequisites:
9/15/2017 11:34:23 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1211363000.0 (lower bound: 1207960000.0, upper bound: none)
9/15/2017 1:34:24 PM -- Performance logging has ended.
9/15/2017 1:34:30 PM -- JetInterop batch transaction stats: 13634, 13634, 13634, 13633 and 13633.
9/15/2017 1:34:30 PM -- Dispatching transactions ends.
9/15/2017 1:34:32 PM -- Shutting down databases ...
9/15/2017 1:34:34 PM -- Instance1436.1 (complete), Instance1436.2 (complete), Instance1436.3 (complete), Instance1436.4 (complete) and Instance1436.5 (complete)
9/15/2017 1:34:34 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_30_1.blg has 495 samples.
9/15/2017 1:34:34 PM -- Creating test report ...
9/15/2017 1:34:37 PM -- Instance1436.1 has 16.9 for I/O Database Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.1 has 1.0 for I/O Log Writes Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.1 has 1.0 for I/O Log Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.2 has 17.0 for I/O Database Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.2 has 1.0 for I/O Log Writes Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.2 has 1.0 for I/O Log Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.3 has 16.9 for I/O Database Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.3 has 1.0 for I/O Log Writes Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.3 has 1.0 for I/O Log Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.4 has 16.8 for I/O Database Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.4 has 1.0 for I/O Log Writes Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.4 has 1.0 for I/O Log Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.5 has 18.2 for I/O Database Reads Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.5 has 1.0 for I/O Log Writes Average Latency.
9/15/2017 1:34:37 PM -- Instance1436.5 has 1.0 for I/O Log Reads Average Latency.
9/15/2017 1:34:37 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
9/15/2017 1:34:37 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
9/15/2017 1:34:38 PM -- C:\Program Files\Exchange Jetstress\Performance_2017_9_15_11_30_1.xml has 477 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 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