



Dell Compellent Storage Center 6.5 SC4020 4,500 Mailbox Exchange 2013 Resiliency Storage Solution

Microsoft ESRP 4.0

Mark Boeser, Exchange Product Specialist
Dell Compellent Technical Solutions
June 2014

Revisions

Date	Description
June 2014	Initial release

© 2014 Dell Inc. All Rights Reserved. Dell, the Dell logo, and other Dell names and marks are trademarks of Dell Inc. in the US and worldwide. All other trademarks mentioned herein are the property of their respective owners.



Table of contents

Revisions.....	2
1 Executive summary	5
1.1 Simulated environment.....	5
1.2 Solution description.....	5
2 The Dell Compellent Storage Center (SC4020) solution	8
2.1 A modular hardware design	8
2.2 Powerful suite of software	8
2.3 Intuitive, unified interface	8
2.4 Targeted customer profile.....	10
2.5 Volume sizing	10
3 Tested deployment	11
3.1 Simulated Exchange configuration.....	11
3.2 Primary storage hardware	12
3.3 Primary storage software.....	13
3.4 Primary storage disk configuration (Mailbox store/Log disks)	13
4 Best practices	14
4.1 Using Dell Compellent Storage Center Data Progression.....	16
4.2 Core storage	17
4.3 Backup Strategy.....	18
4.4 Additional Information	19
5 Test results summary	20
5.1 Reliability.....	20
5.2 Storage performance results	20
5.2.1 Server 1 – JS13	21
5.2.2 Server 2 – JS14.....	21
5.3 Database Backup/Recovery performance.....	22
5.3.1 Database read-only performance.....	22
5.3.2 Transaction Log Recovery/Replay performance.....	22
6 Conclusion.....	23
7 Additional resources.....	24
7.1 Microsoft ESRP Program Website: http://technet.microsoft.com/en-us/exchange/ff182054.aspx	24



7.2	Dell Compellent Knowledge Center: http://kc.compellent.com	24
7.3	Dell Storage Website: http://www.dellstorage.com/compellent/	24
7.4	Dell TechCenter:	24
A	Performance testing.....	25
A.1	Server 1 – JS13	25
A.2	Test log	29
A.3	Server 2 – JS14.....	31
A.4	Test log	35
B	Stress testing.....	37
B.1	Server 1 – JS13	37
B.2	Test log	41
B.3	Server 2 – JS14.....	43
B.4	Test log	47
C	Backup testing.....	49
C.1	Server 1 – JS13	49
C.2	Test log	51
C.3	Server 2 – JS14.....	52
C.4	Test log	54
D	Recovery testing	55
D.1	Server 1 – JS13	55
D.2	Test log	57
D.3	Server 2 – JS14.....	60
D.4	Test log	63



1 Executive summary

This document provides information on Dell Compellent's storage solution for Microsoft Exchange Server, based the Microsoft Exchange Solution Reviewed Program (ESRP) – Storage program.

The ESRP – Storage program was developed by Microsoft Corporation to provide a common storage testing framework for vendors to provide information on its storage solutions for Microsoft Exchange Server software. For more details on the Microsoft ESRP – Storage program, please click <http://technet.microsoft.com/en-us/exchange/ff182054.aspx>

1.1 Simulated environment

The solution presented in this document is designed to simulate a medium-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 2013 have greatly enhanced the availability of Exchange Server, while also improving I/O performance. The solution presented here is a Mailbox Resiliency solution utilizing 1 Database Availability Group (DAG) and 2 copies of every database. The tested environment simulates all users in this DAG running on a single Storage Center, or half of the solution. The number of users simulated was 4,500 across 2 servers, with 2,250 users per server. The mailbox size was 1GB per user. Each server has 4 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 2013 DAG database replication engine. This is a very 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 a Dell Compellent Storage Center (SC4020) v6.5, a redundant controller pair, with redundant front-end and back-end connections. The front-end connections are fiber-channel based, over redundant fabrics, with 2 ports per server, and 4 ports per controller. One 24 bay 2.5" built-in drive enclosure is utilized with each Storage Center.

The disk connectivity is SAS 6Gbps. Disk drives used are SAS 7.2K 1TB. The spindle count is 23 disks/1 spares for database and logs, on a dedicated disk pool on each Storage Center. As this is a redundant solution, databases and logs are stored together on the same volumes. All volumes are RAID-10 DM (dual mirror).

For information about compatibility please use the following link:

<http://www.windowsservercatalog.com/item.aspx?itemId=467135f9-8f78-bfed-b511-f62d42b2d1cb&bCatID=1338>



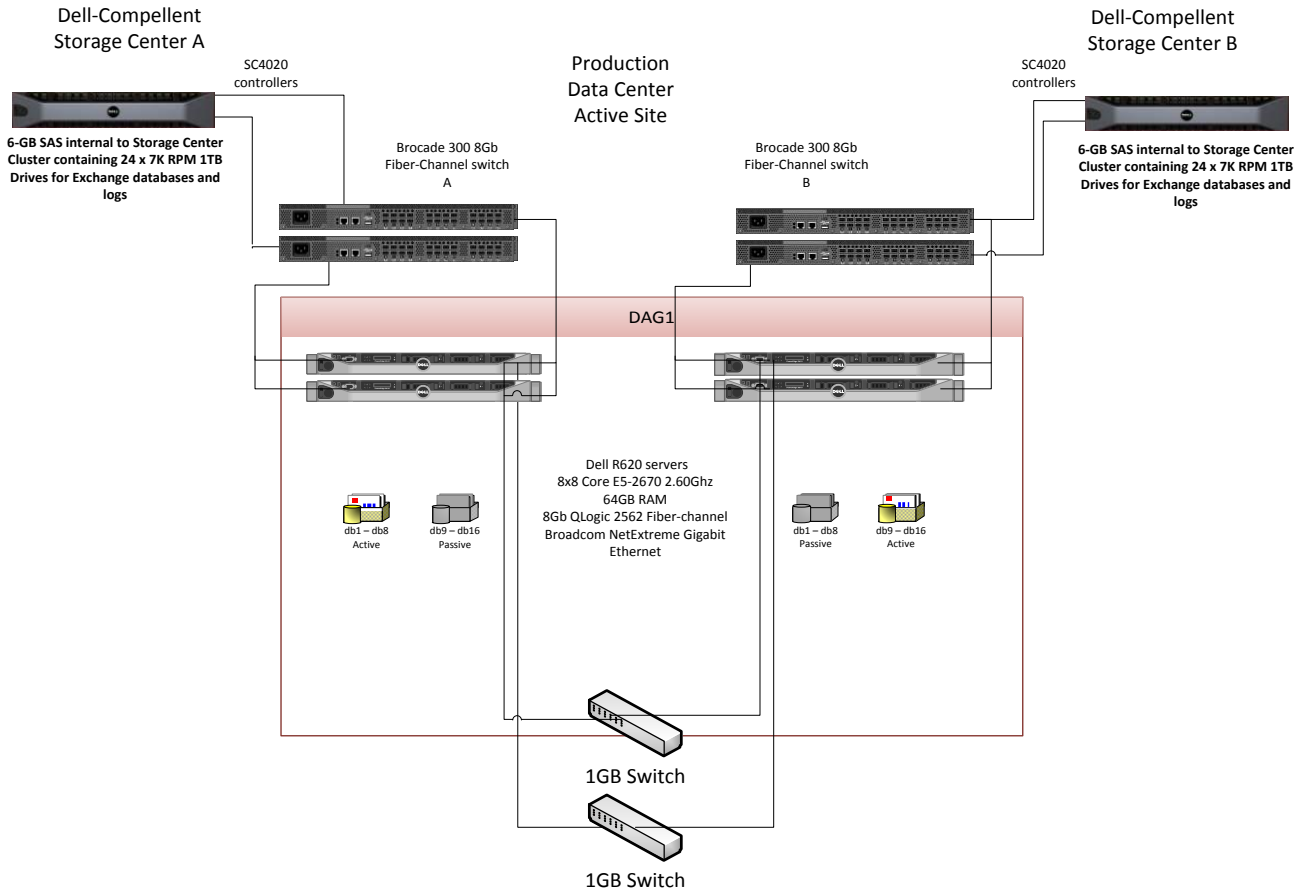


Figure 1 - Highly available data center design

The solution is designed around a highly available data center model (Figure 1). There are 2 disk arrays, for complete redundancy. The Exchange configuration is 1 DAG. The LAN ports are in a dedicated replication VLAN, for traffic isolation. There are 2 networks for redundancy.

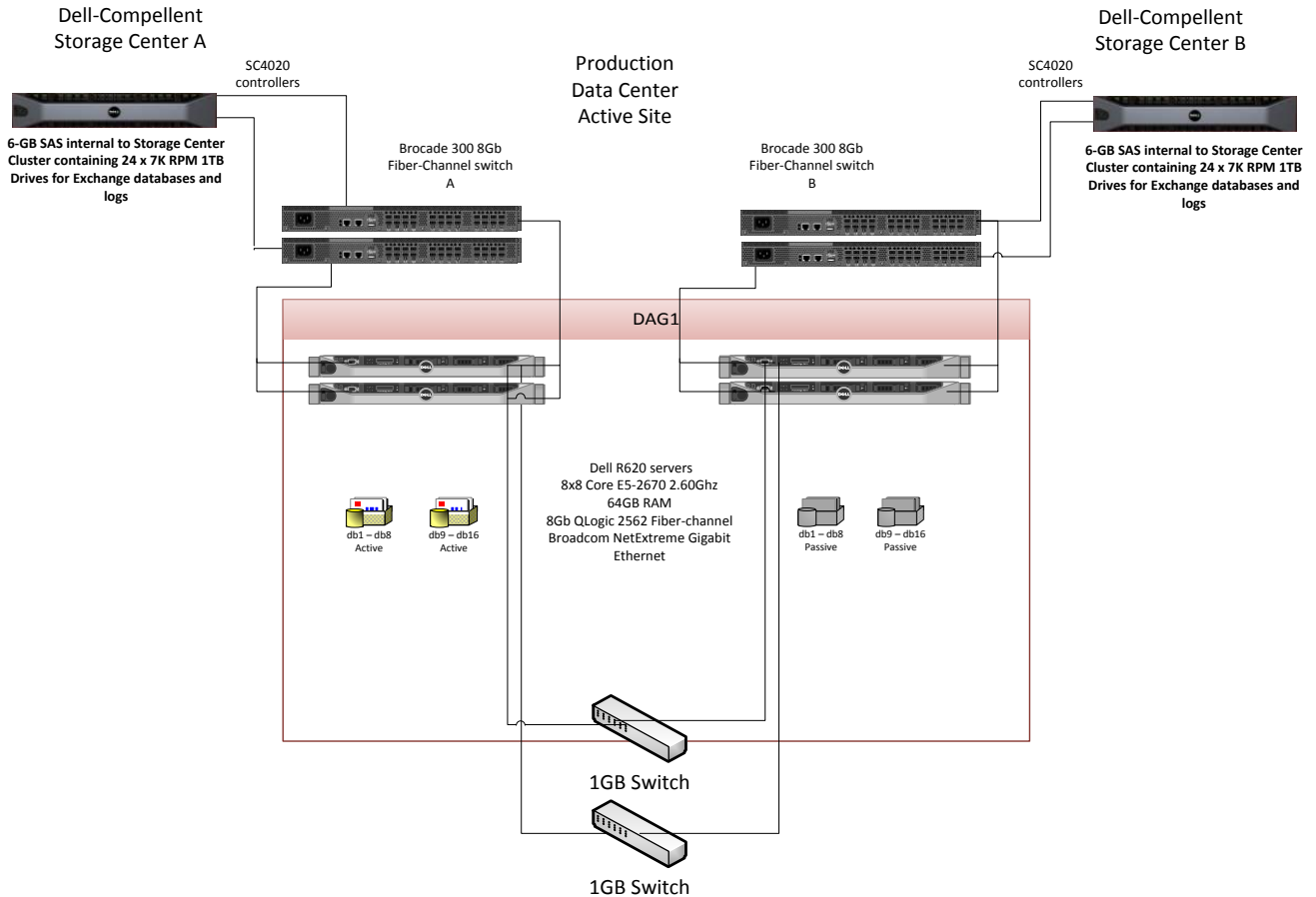


Figure 2 – Tested configuration with Storage Center A with full user load and Storage Center B offline

The tested configuration is a single Storage Center 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 Storage Center array, while either array could handle the entire workload at any given time.

The ability to handle the entire workload on a single Storage Center array means no IO 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 1 copy of each database on each array.

2 The Dell Compellent Storage Center (SC4020) solution

2.1 A modular hardware design

The hardware design consists of a 24 2.5" drives Dell 12G server-based system, plus dual controllers, providing automatic failover, combined in a single chassis. Dell Compellent can seamlessly connect to any open-systems server without the need for server side agents. Organizations can utilize Fiber Channel server connectivity, and disk enclosures support any external interface and disks based on Solid State, Fiber Channel, and/or Serial ATA

The new SC4020 arrays combine the benefits of proven Dell™ Fluid Data™ architecture with resilient Dell hardware design to provide efficiency, quality and durability. Compared to the larger SC8000 array, the SC4020 offers all of the enterprise-class features of the SC8000 in a compact "all in one" format targeted for smaller and mid-sized deployments.

2.2 Powerful suite of software

Storage Center offers a powerful suite of enterprise capabilities to manage data differently. Building on Dell Compellent's Dynamic Block Architecture, Storage Center software intelligently optimizes data movement and access at the block-level to maximize utilization, automate tiered storage, simplify replication and speed data recovery.

2.3 Intuitive, unified interface

A centralized management interface streamlines administration and speeds common storage management tasks. The interface features a point-and-click wizard-based setup and management, comprehensive Phone Home capabilities, automatic notification when user-defined capacity thresholds are reached, and advanced storage consumption and chargeback reporting.

Dell Compellent's Enterprise Manager further simplifies storage management by providing comprehensive monitoring of all local and remote Storage Center environments.

Enterprise Manager allows you to gain better insight into your Storage Center deployments and reduces planning and configuration time for remote replications.

The ESRP-Storage program focuses on storage solution testing to address performance and reliability issues with storage design. However, storage is not the only factor to take into consideration when designing a scale up Exchange solution. Other factors which affect the server scalability are: server processor utilization, server physical and virtual memory limitations, resource requirements for other applications, directory and network service latencies, network infrastructure limitations, replication and recovery requirements, and client usage profiles. All these factors are beyond the scope for ESRP-Storage. Therefore, the number of mailboxes hosted per server as part of the tested configuration may not necessarily be viable for some customer deployments.



For more information on identifying and addressing performance bottlenecks in an Exchange system, please refer to Microsoft's Troubleshooting Microsoft Exchange Server Performance, available at <http://go.microsoft.com/fwlink/?LinkId=23454>.



2.4 Targeted customer profile

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

1. A Storage Center solution can be sized for any size organization
2. Unlimited number of hosts can be attached via Fiber-Channel connection
3. User IO profile (.10 IOPS per user, .12 tested, giving 20% headroom).
4. User mailbox size (1 GB quota)
5. Backup strategy - VSS backup using SAN based snapshots, use Mailbox Resiliency as primary data protection mechanism.
6. Using SAN based snapshots, and boot from SAN, a complete server can be restored in minutes.
7. The tested RAID type was RAID 10-DM for database volumes and log volumes, while 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.

2.5 Volume sizing

The volume size tested was just large enough to support the database size. Volumes on Dell Compellent 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, as capacity can be added as needed.

Using Dell Compellent 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 74% storage utilization. If the storage requirement grows beyond the design specified, additional spindles 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

Number of Exchange mailboxes simulated	4,500
Number of Database Availability Groups (DAGs)	1
Number of servers/DAG	4
Number of active mailboxes/server	1125
Number of databases/host	4
Number of copies/database	2
Number of mailboxes/database	281 or 282
Simulated profile: I/O's per second per mailbox (IOPS, include 20% headroom)	.10 (.12 tested)
Database/Log LUN size	700 GB
Total database size for performance testing per Storage Center	5.6 TB
% storage capacity used by Exchange database**	74%

* Note: Database size and capacity utilized may not match on a thin-provisioned system, as 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 (Fiber Channel, SAS, SATA, iSCSI)	SAS
Storage model and OS/firmware revision	Dell Compellent Storage Center (SC4020) v6.5 http://www.windowsservercatalog.com/item.aspx?idItem=467135f9-8f78-bfed-b511-f62d42b2d1cb&bCatID=1338
Storage cache	16 GB
Number of storage controllers	2
Number of storage ports	4 active ports per controller
Maximum bandwidth of storage connectivity to host	32 Gb/sec (4x8Gb GB HBA)
Switch type/model/firmware revision	Brocade Model 300 24-port 8Gb Fiber Channel Switch Firmware version 7.0.0b
HBA model and firmware	QLogic QMH2564 (Driver FW 5.04.04, Flash FW 4.04.02)
Number of HBA's/host	1 Dual-port QLogic 2562 8Gb HBA
Host server type	2x8 Core E5-2670 2.60Ghz 64GB RAM
Total number of disks tested in solution	23 Active for DB and los 1 hot spare = 24 total spindles
Maximum number of spindles can be hosted in the storage	24 drive bay + dual controllers in a 2U chassis Scalable to 120 drives (409TB) via modular expansion enclosures



3.3 Primary storage software

Table 3 Primary storage software

Configuration	Detail
HBA driver	QLogic StorPort FC HBA Driver 9.1.9.27
HBA Queue Depth Setting	65535
Multi-Pathing	Microsoft Windows 2008 R2 MPIO Round-Robin(In-Box DSM)
Host OS	Microsoft Windows 2008 R2
ESE.dll file version	15.00.0712.008
Replication solution name/version	Microsoft Exchange Server 2013 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 7k 1TB, XRC0
Raw capacity per disk (GB)	931.51 GB
Number of physical disks in test	23
Total raw storage capacity (GB)	21.43 TB
Raid level	RAID 10-DM
Total formatted capacity	20.92 TB
Storage capacity utilization	75%
Database capacity utilization	25%



4 Best practices

Exchange Server 2013 has changed dramatically from previous versions. For a list of what has changed see the following: [http://technet.microsoft.com/en-us/library/jj150540\(v=exchg.150\).aspx](http://technet.microsoft.com/en-us/library/jj150540(v=exchg.150).aspx)

The best practices have also changed, based on the changes in behavior in Exchange 2013. Significant I/O reduction in Exchange 2013 has made it possible to utilize RAID-5 volumes for both Database and logs when using 10K drives or greater. This provides overall storage savings due to the smaller capacity overhead vs. RAID-10.

Because processor performance has increased dramatically, and servers support much larger memory models, sizing requirements for servers have changed to reflect this. For server sizing please refer to the Microsoft Exchange Server Role Calculator.

For general sizing and requirements please visit the following link:

<http://technet.microsoft.com/en-us/library/aa996719.aspx>

One of the Microsoft best practices states that transaction logs and databases be separated from each other and dedicated to their own set of spindles. Dell Compellent virtualizes at the disk level within Storage Center, accelerating data access by spreading read/write operations across all disk drives in the SAN so multiple requests are processed in parallel. Dell Compellent virtualization allows the creation of high performance, highly efficient virtual volumes in just seconds without allocating drives to specific servers, without complicated capacity planning and without manual performance tuning. By managing disk drives as a single resource, Dell Compellent provides increased storage performance, availability and utilization.

Dell Compellent's storage virtualization is optimized to take advantage of all available spindles as part of a single disk folder, but is flexible enough to be configured allowing storage configurations where specific spindles are dedicated to a particular volume.

Another best practice in past versions of Exchange Server has been to align Exchange IO with disk page boundaries. With Windows Server 2008 this is no longer required, as Windows 2008 automatically aligns to a 1024k page boundary.

The volume on which transaction logs are stored is critical to a well performing Exchange environment. Since all transactions are first written to a transaction log before being committed to the information store database, it is important that this volume has the lowest possible write latency. Transaction logs should be placed on volumes with faster rotational speeds. For optimal transaction log performance, consider using drives with a rotational speed of 10,000 RPM or greater. Exchange 2013 no longer requires log files to be stored on a volume separate from the database volumes; The Dell Compellent Storage Center can be flexibly designed for separate disk folders or as a single disk folder configuration.



For issues related to performance and server health please see the following:
[http://technet.microsoft.com/en-us/library/jj150551\(v=exchg.150\).aspx](http://technet.microsoft.com/en-us/library/jj150551(v=exchg.150).aspx)

For more information on Exchange best practices when implemented with Dell Compellent Storage Center, visit the Dell Compellent Knowledge Center at <http://kc.compellent.com/>.



4.1 Using Dell Compellent Storage Center Data Progression

Industry studies show that as much of 80% of Exchange data is inactive. This means that a lot of fast, higher-cost storage is being unnecessarily utilized.

Storage Center's Data Progression is a complete hardware and software architecture that delivers fully automated tiered storage. This patented technology cuts administrative time and reduces overall storage costs by dynamically classifying and moving data at the block-level between tiers of storage based on frequency of access. This complete Automated Tiered Storage solution does not require time consuming data classification and the repetitive manual transfer of data between tiers.

Each volume is configured by default with a recommended storage profile that manages the RAID configuration and provides optimal operation and performance for Exchange on the Dell Compellent Storage Center. With this configuration all data written to each volume is written at RAID10 providing the best possible I/O performance for Exchange database and log operations.

Snapshots, known as Replays on the Dell Compellent Storage Center, are an integral part of the Data Progression solution. As data grows and usage patterns change, Data Progression can automatically move inactive blocks of data to a lower tier of storage (both disk class and RAID level) on-the-fly. With the recommended storage profile, active data is always written at RAID10, while any replays are initially stored at Tier 1 on RAID-5. This data eventually makes its way down the RAID levels and tiers.

The following chart is an example of how Data Progression moves data to the most appropriate tier:

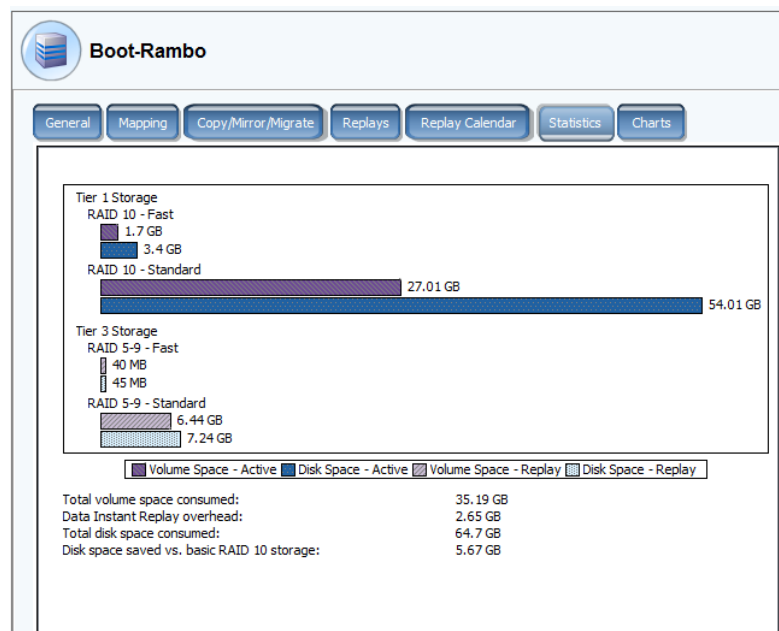


Figure 3 Volume Statistics showing Data Progression

4.2 Core storage

1. Dell Compellent storage by its nature does not need disk sector alignment to perform properly. Dell Compellent virtualizes all disk reads and writes, and applies them across system managed data pages, so by nature isolates disk IOs from sector boundaries. The page to sector alignment for all volumes and data pages is handled automatically by the system.
2. The Dell Compellent method of IO and disk capacity aggregation provides maximum IO to all hosted applications. All the IOPS for all of the assigned drives can be applied to all applications hosted on a Storage Center. If IOPS need to be dedicated to an application, such as Exchange, a dedicated disk pool can be created for each IO type, such as database or log files. As Exchange 2013 IO is mostly sequential, using a smaller number of database files will greatly improve the performance. This is due to the fact that the more sequential streams you have, the more random it looks. Minimizing the number of file streams while meeting business requirements will provide a more responsive solution. Isolating the log files can also provide a performance benefit in an IO constrained system. Using Dell Compellent Dynamic Storage, a small system can start with all volumes sharing spindles, and volumes can dynamically be moved to dedicated spindles and load increases.
3. Dell Compellent Storage Center is a true thin provisioned system. This means that volumes will truly only consume space when and where data is written. The volume sizes should be created to reflect the maximum size they will achieve. The volumes will only consume the space actually used by data, so the storage can be sized to host the actual storage requirement, rather than the volume sizes allocated. This allows the volumes to be sized properly to meet growth while requiring the minimum number of disks to meet the storage and IOP requirement.
4. Dell Compellent's Fluid Data architecture uses an IOP and storage aggregation model. This means that the IOPS and storage capacity of all available disks will be available to the entire disk pool. This provides a huge performance boost to all applications and all LUNs, as the combined IO performance of all spindles will apply to all configured storage. If dedicated spindles are desired, a disk pool can be created that will dedicate those spindles to the LUNs created in that pool. All disks in a disk pool will have multiple RAID types applied to them. This is done by virtualizing the RAID pools on the disks. For example, a write could come in on RAID 10, and would be mirrored at the block level, across a pair of disks. In essence each write could hit a different pair of disks, dramatically improving performance. The next write could be a RAID5 block, with the blocks striped across all the disks available to the pool. In this method a disk pool will balance the IO across all the available spindles.



5. Latency and IO load can be measured real-time, or logged historically for reporting purposes. This means if a volume is performing poorly, its IO can be reported over time, and compared to IO load on the server, for any length of time you wish to store. If you need to report on the last month of IO history, a report can be generated showing the IO graphically or as a summary chart. This provides the ability to trend and determine when IO performance changed. Volumes can also be summarized as a group, to determine if IO load is shifting, increasing, or disk performance is changing. Reporting can be done at any level, including at the disk device level. This allows reporting on the latency at the Server, LUN, or disk level to provide more accurate performance monitoring and diagnostics.
6. Because Storage Center manages block placement, defragmentation is not required. Dell Compellent Data Progression computes block placement and optimizes block placement based on access patterns. Because block placement is relative to other stored blocks Exchange On-line defragmentation is accounted for.
7. Dell Compellent Fluid Data also allows disks to be added to a pool to increase performance dynamically. This allows for accurate sizing on day one and disks to be added as performance requirements increase. If after one year IO requirements double, additional disks could simply be added (without any downtime), and RAID stripes rebalanced.
8. The most common cause of performance issues is low spindle count. To achieve a given IO level requires a spindle count equal to or greater than the IOP target. If the IO load exceeds the capabilities of the spindles poor performance will result. Dell Compellent, along with a business partner, will work with customers to determine the correct spindle count. As IO load grows the spindle count must increase to maintain performance. Using Dell Compellent Enterprise Manager, current IO loads can be tracked, and thresholds can be set for alerting, to warn of IO usage approaching or exceeding acceptable performance levels. Because IO patterns can be very diverse, creating a baseline and using historical reporting will be a key strategy for planning for and managing growth. With an accurate growth plan, disk can be added before it is needed, and performance as well as capacity can be increased with down time.

4.3 Backup Strategy

1. The Dell Compellent Storage Center has an integrated snapshot facility that provides basic volume based snapshots. In order to provide VSS integration with a graphical management interface, Dell Compellent Replay Manager should be implemented. This provides a full interface for scheduling database backups. Using Replay Manager, Exchange Servers can be restored in minutes to any available restore point. It also provides detailed reporting on snapshots. Because Dell Compellent Storage Center has the ability to manage thousands of snapshots, a fine grained backup strategy can be defined to greatly reduce reliance on tape for historical data recovery. Combined with a lagged database copy, data can be recovered very quickly with minimal



administrative effort.

2. Since Dell Compellent Replays take do not require page pre-allocation or disk allocation disk space requirements are much smaller for snapshots. Backup verification can also be passed to a secondary server to isolate the impact of backups on the production Exchange environment. By automating the creation and verification process using a secondary server, more frequent database backups and more frequent database scans can be implemented reducing exposure.
3. Replay restore points can also be replicated and tested in a remote environment without breaking replication. This allows Disaster Recovery testing of a production restore point without pausing replication, reducing exposure even further.

4.4 Additional Information

For more information on Dell Compellent Storage Center and other Dell Compellent solutions, visit our website at <http://www.compellent.com>.



5 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 later in this whitepaper.

5.1 Reliability

A number of tests in the framework are to check Reliability tests runs for 24 hours. The goal is to verify the storage can handle high IO load for a long period of time. Both log and database files will be analyzed for integrity after the stress test to ensure no database/log corruption.

The following list provides an overview: (click on the underlined word will show the html report after the reliability tests run)

1. No errors were reported in either the application or system log
2. No errors were reported during the [database](#) and [log](#) checksum process
3. No errors were reported during either the backup or restore process

5.2 Storage performance results

The Primary Storage performance testing is designed to exercise the storage with maximum sustainable Exchange type of IO for 2 hours. The test is to show how long it takes for the storage to respond to an IO under load. The data below is the sum of all of the logical disk I/O's and average of all the logical disks I/O latency in the 2 hours test duration. Each server is listed separately and the aggregate numbers across all servers is listed as well.

Individual Server Metrics:

The sum of I/O's across all Mailbox Databases and the average latency across all Databases on a per server basis.



5.2.1 Server 1 – JS13

Database I/O	
Database Disks Transfers/sec	320.837
Database Disks Reads/sec	218.092
Database Disks Writes/sec	102.745
Average Database Disk Read Latency (ms)	17.662
Average Database Disk Write Latency (ms)	2.076
Transaction Log I/O	
Log Disks Writes/sec	25.524
Average Log Disk Write Latency (ms)	1.293

5.2.2 Server 2 – JS14

Database I/O	
Database Disks Transfers/sec	295.541
Database Disks Reads/sec	202.696
Database Disks Writes/sec	92.845
Average Database Disk Read Latency (ms)	15.614
Average Database Disk Write Latency (ms)	1.969
Transaction Log I/O	
Log Disks Writes/sec	23.101
Average Log Disk Write Latency (ms)	1.338



5.3 Database Backup/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/replay performance (playing transaction logs in to the database).

5.3.1 Database read-only performance

The test is to measure the maximum rate at which databases could be backed up via VSS. The following table shows the average rate for a single database file.

Performance item	Detail
MB read/sec per database	83.68
MB read/sec total per server	334.72

5.3.2 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 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)	2.910



6 Conclusion

The testing shows the scalability and performance of the Dell Compellent Storage Center SC4020.

This document is developed by storage solution providers, and reviewed by the Microsoft Exchange Product team. The test results/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 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. So the data presented in this document should not be used for direct comparisons among the solutions.



7 Additional resources

- 7.1 Microsoft ESRP Program Website:
<http://technet.microsoft.com/en-us/exchange/ff182054.aspx>
- 7.2 Dell Compellent Knowledge Center:
<http://kc.compellent.com>
- 7.3 Dell Storage Website:
<http://www.dellstorage.com/compellent/>
- 7.4 Dell TechCenter:
<http://en.community.dell.com/techcenter/storage/>



A Performance testing

A.1 Server 1 – JS13

Table 5 Test Summary

Overall Test Result	Pass
Machine Name	JS13
Test Description	2250 users/server 2 servers 1GB mailboxes .10 IOPS/user .12 IOPS tested 4 dbs per server 700GB db/log combined volumes 2 copies 6 threads/db
Test Start Time	3/3/2014 1:44:08 PM
Test End Time	3/3/2014 3:49:40 PM
Collection Start Time	3/3/2014 1:48:55 PM
Collection End Time	3/3/2014 3:48:48 PM
Jetstress Version	15.00.0658.004
ESE Version	15.00.0712.008
Operating System	Windows Server 2008 R2 Enterprise Service Pack 1 (6.1.7601.65536)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2014_3_3_13_44_17.blg



Table 6 Database sizing and throughput

Performance counter	Value
Achieved Transactional I/O per Second	285.979
Target Transactional I/O per Second	270
Initial Database Size (bytes)	1882022215680
Final Database Size (bytes)	1882886242304
Database Files (Count)	4

Table 7 Jetstress system parameters

Performance counter	Value
Thread Count	6
Minimum Database Cache	128.0 MB
Maximum Database Cache	1024.0 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 8 Database configuration

Performance counter	Value
Instance3148.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance3148.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance3148.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance3148.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb

Table 9 Transactional I/O performance

MSEExchange 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
Instance3148.1	16.694	2.125	45.795	25.798	33013.296	37247.702	0.000	1.354	0.000	6.418	0.000	20549.960
Instance3148.2	17.927	2.065	45.933	25.615	32995.539	37201.330	0.000	1.271	0.000	6.364	0.000	20264.550
Instance3148.3	18.357	2.083	45.680	25.572	33029.292	37309.667	0.000	1.298	0.000	6.326	0.000	20698.387
Instance3148.4	17.671	2.029	45.826	25.760	33045.730	37278.053	0.000	1.247	0.000	6.416	0.000	20286.691



Table 10 Background Database Maintenance I/O performance

MSEExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3148.1	8.806	261254.035
Instance3148.2	8.855	261254.316
Instance3148.3	8.650	261223.347
Instance3148.4	8.547	261220.836

Table 11 Log replication I/O performance

MSEExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3148.1	0.563	212134.336
Instance3148.2	0.549	204504.136
Instance3148.3	0.556	210679.713
Instance3148.4	0.555	207773.267

Table 12 Total I/O performance

MSEExchange 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
Instance3148.1	16.694	2.125	54.601	25.798	69825.520	37247.702	14.844	1.354	0.563	6.418	212134.336	20549.960
Instance3148.2	17.927	2.065	54.788	25.615	69885.845	37201.330	17.143	1.271	0.549	6.364	204504.136	20264.550
Instance3148.3	18.357	2.083	54.330	25.572	69362.385	37309.667	17.733	1.298	0.556	6.326	210679.713	20698.387
Instance3148.4	17.671	2.029	54.373	25.760	68913.256	37278.053	16.099	1.247	0.555	6.416	207773.267	20286.691



Table 13 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.379	0.000	2.377
Available MBytes	60701.967	60691.000	60753.000
Free System Page Table Entries	33555672.150	33555671.000	33555674.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71519033.186	71512064.000	71565312.000
Pool Paged Bytes	178341541.678	178323456.000	178376704.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

A.2 Test log

3/3/2014 1:44:08 PM -- Preparing for testing ...
 3/3/2014 1:44:12 PM -- Attaching databases ...
 3/3/2014 1:44:12 PM -- Preparations for testing are complete.
 3/3/2014 1:44:12 PM -- Starting transaction dispatch ..
 3/3/2014 1:44:12 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 3/3/2014 1:44:12 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 3/3/2014 1:44:17 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 3/3/2014 1:44:17 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 3/3/2014 1:44:22 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/3/2014 1:44:22 PM -- Performance logging started (interval: 15000 ms).
 3/3/2014 1:44:22 PM -- Attaining prerequisites:
 3/3/2014 1:48:55 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 971968500.0 (lower bound: 966367600.0, upper bound: none)
 3/3/2014 3:48:55 PM -- Performance logging has ended.



3/3/2014 3:49:36 PM -- JetInterop batch transaction stats: 15533, 15533, 15532 and 15532.
3/3/2014 3:49:36 PM -- Dispatching transactions ends.
3/3/2014 3:49:37 PM -- Shutting down databases ...
3/3/2014 3:49:40 PM -- Instance3148.1 (complete), Instance3148.2 (complete), Instance3148.3 (complete) and Instance3148.4 (complete)
3/3/2014 3:49:40 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_3_13_44_17.blg has 497 samples.
3/3/2014 3:49:40 PM -- Creating test report ...
3/3/2014 3:49:43 PM -- Instance3148.1 has 16.7 for I/O Database Reads Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.1 has 1.4 for I/O Log Writes Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.1 has 1.4 for I/O Log Reads Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.2 has 17.9 for I/O Database Reads Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.2 has 1.3 for I/O Log Writes Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.2 has 1.3 for I/O Log Reads Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.3 has 18.4 for I/O Database Reads Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.3 has 1.3 for I/O Log Writes Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.3 has 1.3 for I/O Log Reads Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.4 has 17.7 for I/O Database Reads Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.4 has 1.2 for I/O Log Writes Average Latency.
3/3/2014 3:49:43 PM -- Instance3148.4 has 1.2 for I/O Log Reads Average Latency.
3/3/2014 3:49:43 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
3/3/2014 3:49:43 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
3/3/2014 3:49:43 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_3_13_44_17.xml has 478 samples queried.



A.3 Server 2 – JS14

Table 14 Test summary

Overall Test Result	Pass
Machine Name	JS14
Test Description	2250 users/server 2 servers 1GB mailboxes .10 IOPS/user .12 IOPS tested 4 dbs per server 700GB db/log combined volumes 2 copies 5 threads/db
Test Start Time	3/3/2014 1:44:05 PM
Test End Time	3/3/2014 3:49:31 PM
Collection Start Time	3/3/2014 1:49:21 PM
Collection End Time	3/3/2014 3:49:15 PM
Jetstress Version	15.00.0658.004
ESE Version	15.00.0712.008
Operating System	Windows Server 2008 R2 Enterprise Service Pack 1 (6.1.7601.65536)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2014_3_3_13_44_14.blg



Table 15 Database sizing and throughput

Performance counter	Value
Achieved Transactional I/O per Second	259.878
Target Transactional I/O per Second	270
Initial Database Size (bytes)	1882257096704
Final Database Size (bytes)	1883062403072
Database Files (Count)	4

Table 16 Jetstress system parameters

Performance counter	Value
Thread Count	5
Minimum Database Cache	128.0 MB
Maximum Database Cache	1024.0 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 17 Database configuration

Performance counter	Value
Instance3172.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance3172.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance3172.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance3172.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb

Table 18 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
Instance3172.1	14.934	1.984	41.830	23.362	33064.979	37237.813	0.000	1.390	0.000	5.771	0.000	20771.793
Instance3172.2	16.518	1.973	41.680	23.062	33064.013	37254.729	0.000	1.324	0.000	5.789	0.000	20570.146
Instance3172.3	16.073	1.956	41.745	23.160	33038.865	37119.612	0.000	1.363	0.000	5.758	0.000	20486.741
Instance3172.4	14.932	1.961	41.777	23.261	33067.297	37166.192	0.000	1.273	0.000	5.783	0.000	20648.314



Table 19 Background Database Maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3172.1	9.054	261289.155
Instance3172.2	8.735	261242.725
Instance3172.3	8.836	261261.528
Instance3172.4	9.039	261315.590

Table 20 Log Replication I/O performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3172.1	0.511	195562.372
Instance3172.2	0.508	195146.659
Instance3172.3	0.503	195080.040
Instance3172.4	0.510	194597.180

Table 21 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
Instance3172.1	14.934	1.984	50.884	23.362	73674.536	37237.813	14.325	1.390	0.511	5.771	195562.372	20771.793
Instance3172.2	16.518	1.973	50.414	23.062	72597.143	37254.729	12.887	1.324	0.508	5.789	195146.659	20570.146
Instance3172.3	16.073	1.956	50.582	23.160	72907.451	37119.612	13.747	1.363	0.503	5.758	195080.040	20486.741
Instance3172.4	14.932	1.961	50.816	23.261	73668.431	37166.192	13.172	1.273	0.510	5.783	194597.180	20648.314



Table 22 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.397	0.000	2.384
Available MBytes	60544.328	60532.000	60589.000
Free System Page Table Entries	33555160.008	33555160.000	33555162.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72203851.891	72183808.000	72314880.000
Pool Paged Bytes	224488950.380	224403456.000	224878592.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

A.4 Test log

3/3/2014 1:44:05 PM -- Preparing for testing ...
 3/3/2014 1:44:09 PM -- Attaching databases ...
 3/3/2014 1:44:09 PM -- Preparations for testing are complete.
 3/3/2014 1:44:09 PM -- Starting transaction dispatch ..
 3/3/2014 1:44:09 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 3/3/2014 1:44:09 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 3/3/2014 1:44:14 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 3/3/2014 1:44:14 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 3/3/2014 1:44:19 PM -- Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/3/2014 1:44:19 PM -- Performance logging started (interval: 15000 ms).
 3/3/2014 1:44:19 PM -- Attaining prerequisites:
 3/3/2014 1:49:21 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 970928100.0 (lower bound: 966367600.0, upper bound: none)



3/3/2014 3:49:22 PM -- Performance logging has ended.
3/3/2014 3:49:30 PM -- JetInterop batch transaction stats: 14152, 14152, 14152 and 14152.
3/3/2014 3:49:30 PM -- Dispatching transactions ends.
3/3/2014 3:49:30 PM -- Shutting down databases ...
3/3/2014 3:49:31 PM -- Instance3172.1 (complete), Instance3172.2 (complete), Instance3172.3 (complete) and Instance3172.4 (complete)
3/3/2014 3:49:31 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_3_13_44_14.blg has 499 samples.
3/3/2014 3:49:31 PM -- Creating test report ...
3/3/2014 3:49:34 PM -- Instance3172.1 has 14.9 for I/O Database Reads Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.1 has 1.4 for I/O Log Writes Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.1 has 1.4 for I/O Log Reads Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.2 has 16.5 for I/O Database Reads Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.2 has 1.3 for I/O Log Writes Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.2 has 1.3 for I/O Log Reads Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.3 has 16.1 for I/O Database Reads Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.3 has 1.4 for I/O Log Writes Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.3 has 1.4 for I/O Log Reads Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.4 has 14.9 for I/O Database Reads Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.4 has 1.3 for I/O Log Writes Average Latency.
3/3/2014 3:49:34 PM -- Instance3172.4 has 1.3 for I/O Log Reads Average Latency.
3/3/2014 3:49:34 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
3/3/2014 3:49:34 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
3/3/2014 3:49:34 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_3_13_44_14.xml has 478 samples queried.



B Stress testing

B.1 Server 1 – JS13

Table 23 Test summary

Overall Test Result	Pass
Machine Name	JS13
Test Description	2250 users/server 2 servers 1GB mailboxes .10 IOPS/user .12 IOPS tested 4 dbs per server 700GB db/log combined volumes 2 copies 6 threads/db
Test Start Time	3/5/2014 12:28:09 PM
Test End Time	3/6/2014 1:39:31 PM
Collection Start Time	3/5/2014 12:32:53 PM
Collection End Time	3/6/2014 12:32:53 PM
Jetstress Version	15.00.0658.004
ESE Version	15.00.0712.008
Operating System	Windows Server 2008 R2 Enterprise Service Pack 1 (6.1.7601.65536)
Performance Log	C:\Program Files\Exchange Jetstress\Stress_2014_3_5_12_28_18.blg



Table 24 Database sizing and throughput

Performance Counter	Value
Achieved Transactional I/O per Second	286.906
Target Transactional I/O per Second	270
Initial Database Size (bytes)	1882886242304
Final Database Size (bytes)	1893053235200
Database Files (Count)	4

Table 25 Jetstress system parameters

Performance Counter	Value
Thread Count	6
Minimum Database Cache	128.0 MB
Maximum Database Cache	1024.0 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 26 Database configuration

Performance Counter	Value
Instance3376.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance3376.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance3376.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance3376.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb

Table 27 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
Instance3376.1	17.225	2.070	46.025	25.673	33001.291	36251.001	0.000	1.230	0.000	6.149	0.000	20429.468
Instance3376.2	18.861	2.061	45.953	25.648	32992.615	36289.930	0.000	1.292	0.000	6.157	0.000	20451.697
Instance3376.3	18.776	2.038	46.000	25.647	32997.182	36258.938	0.000	1.254	0.000	6.137	0.000	20430.640
Instance3376.4	17.163	2.013	46.158	25.802	33004.869	36244.747	0.000	1.277	0.000	6.154	0.000	20336.989



Table 28 Background Database Maintenance I/O performance

MSEExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3376.1	8.575	261278.480
Instance3376.2	8.547	261293.332
Instance3376.3	8.519	261275.660
Instance3376.4	8.711	261289.860

Table 29 Log replication I/O performance

MSEExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3376.1	0.536	203003.291
Instance3376.2	0.537	203791.629
Instance3376.3	0.535	203722.166
Instance3376.4	0.534	203286.160

Table 30 Total I/O performance

MSEExchange 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
Instance3376.1	17.225	2.070	54.600	25.673	68853.156	36251.001	13.181	1.230	0.536	6.149	203003.291	20429.468
Instance3376.2	18.861	2.061	54.500	25.648	68797.015	36289.930	17.526	1.292	0.537	6.157	203791.629	20451.697
Instance3376.3	18.776	2.038	54.518	25.647	68666.073	36258.938	17.998	1.254	0.535	6.137	203722.166	20430.640
Instance3376.4	17.163	2.013	54.869	25.802	69247.081	36244.747	15.628	1.277	0.534	6.154	203286.160	20336.989



Table 31 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.392	0.000	2.665
Available MBytes	60687.014	60665.000	60792.000
Free System Page Table Entries	33555672.187	33555642.000	33555674.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71586232.078	71577600.000	71639040.000
Pool Paged Bytes	178211201.246	176697344.000	180985856.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

B.2 Test log

3/5/2014 12:28:09 PM -- Preparing for testing ...
 3/5/2014 12:28:13 PM -- Attaching databases ...
 3/5/2014 12:28:13 PM -- Preparations for testing are complete.
 3/5/2014 12:28:13 PM -- Starting transaction dispatch ..
 3/5/2014 12:28:13 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 3/5/2014 12:28:13 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 3/5/2014 12:28:18 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 3/5/2014 12:28:18 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 3/5/2014 12:28:23 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/5/2014 12:28:23 PM -- Performance logging started (interval: 15000 ms).
 3/5/2014 12:28:23 PM -- Attaining prerequisites:
 3/5/2014 12:32:53 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 968167400.0 (lower bound: 966367600.0, upper bound: none)



3/6/2014 12:32:53 PM -- Performance logging has ended.
3/6/2014 1:39:26 PM -- JetInterop batch transaction stats: 181930, 181930, 181929 and 181929.
3/6/2014 1:39:26 PM -- Dispatching transactions ends.
3/6/2014 1:39:28 PM -- Shutting down databases ...
3/6/2014 1:39:31 PM -- Instance3376.1 (complete), Instance3376.2 (complete), Instance3376.3 (complete) and Instance3376.4 (complete)
3/6/2014 1:39:31 PM -- [C:\Program Files\Exchange Jetstress\Stress_2014_3_5_12_28_18.blg](#) has 5769 samples.
3/6/2014 1:39:31 PM -- Creating test report ...
3/6/2014 1:39:51 PM -- Instance3376.1 has 17.2 for I/O Database Reads Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.1 has 1.2 for I/O Log Writes Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.1 has 1.2 for I/O Log Reads Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.2 has 18.9 for I/O Database Reads Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.2 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.2 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.3 has 18.8 for I/O Database Reads Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.3 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.3 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.4 has 17.2 for I/O Database Reads Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.4 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 1:39:51 PM -- Instance3376.4 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 1:39:51 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
3/6/2014 1:39:51 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
3/6/2014 1:39:51 PM -- [C:\Program Files\Exchange Jetstress\Stress_2014_3_5_12_28_18.xml](#) has 5751 samples queried.



B.3 Server 2 – JS14

Test Summary

Overall Test Result	Pass
Machine Name	JS14
Test Description	2250 users/server 2 servers 1GB mailboxes .10 IOPS/user .12 IOPS tested 4 dbs per server 700GB db/log combined volumes 2 copies 5 threads/db
Test Start Time	3/5/2014 12:28:11 PM
Test End Time	3/6/2014 1:39:25 PM
Collection Start Time	3/5/2014 12:33:31 PM
Collection End Time	3/6/2014 12:33:25 PM
Jetstress Version	15.00.0658.004
ESE Version	15.00.0712.008
Operating System	Windows Server 2008 R2 Enterprise Service Pack 1 (6.1.7601.65536)
Performance Log	C:\Program Files\Exchange Jetstress\Stress_2014_3_5_12_28_21.blg



Database Sizing and Throughput

Performance Counter	Value
Achieved Transactional I/O per Second	262.658
Target Transactional I/O per Second	270
Initial Database Size (bytes)	1883062403072
Final Database Size (bytes)	1892348592128
Database Files (Count)	4

Jetstress System Parameters

Performance Counter	Value
Thread Count	5
Minimum Database Cache	128.0 MB
Maximum Database Cache	1024.0 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 32 Database configuration

Performance Counter	Value
Instance3056.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance3056.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance3056.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance3056.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb

Table 33 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
Instance3056.1	15.756	2.112	42.156	23.440	33043.677	36316.226	0.000	1.239	0.000	5.616	0.000	20541.289
Instance3056.2	16.248	2.104	42.190	23.480	33043.609	36297.335	0.000	1.287	0.000	5.630	0.000	20491.217
Instance3056.3	16.122	2.087	42.177	23.474	33041.504	36324.141	0.000	1.244	0.000	5.622	0.000	20548.924
Instance3056.4	15.697	2.079	42.227	23.514	33035.351	36307.282	0.000	1.287	0.000	5.636	0.000	20497.343



Table 34 Background Database Maintenance I/O performance

MSEExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3056.1	8.812	261247.644
Instance3056.2	8.755	261292.612
Instance3056.3	8.792	261235.814
Instance3056.4	8.822	261288.751

Table 35 Log Replication I/O performance

MSEExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3056.1	0.492	190446.664
Instance3056.2	0.492	190027.946
Instance3056.3	0.493	190737.561
Instance3056.4	0.492	189837.491

Table 36 Total I/O performance

MSEExchange 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
Instance3056.1	15.756	2.112	50.968	23.440	72497.430	36316.226	13.787	1.239	0.492	5.616	190446.664	20541.289
Instance3056.2	16.248	2.104	50.945	23.480	72268.998	36297.335	12.434	1.287	0.492	5.630	190027.946	20491.217
Instance3056.3	16.122	2.087	50.969	23.474	72404.519	36324.141	12.963	1.244	0.493	5.622	190737.561	20548.924
Instance3056.4	15.697	2.079	51.049	23.514	72479.042	36307.282	12.555	1.287	0.492	5.636	189837.491	20497.343



Table 37 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.357	0.000	2.731
Available MBytes	60532.010	60511.000	60621.000
Free System Page Table Entries	33555160.034	33555157.000	33555162.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72094991.535	72081408.000	72167424.000
Pool Paged Bytes	223990789.876	222699520.000	226959360.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

B.4 Test log

3/5/2014 12:28:11 PM -- Preparing for testing ...
 3/5/2014 12:28:16 PM -- Attaching databases ...
 3/5/2014 12:28:16 PM -- Preparations for testing are complete.
 3/5/2014 12:28:16 PM -- Starting transaction dispatch ..
 3/5/2014 12:28:16 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 3/5/2014 12:28:16 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 3/5/2014 12:28:21 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
 3/5/2014 12:28:21 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
 3/5/2014 12:28:25 PM -- Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/5/2014 12:28:25 PM -- Performance logging started (interval: 15000 ms).
 3/5/2014 12:28:25 PM -- Attaining prerequisites:
 3/5/2014 12:33:31 PM -- \MSEExchange Database(JetstressWin)\Database Cache Size, Last: 969244700.0 (lower bound: 966367600.0, upper bound: none)



3/6/2014 12:33:32 PM -- Performance logging has ended.
3/6/2014 1:39:22 PM -- JetInterop batch transaction stats: 166403, 166403, 166403 and 166402.
3/6/2014 1:39:22 PM -- Dispatching transactions ends.
3/6/2014 1:39:22 PM -- Shutting down databases ...
3/6/2014 1:39:25 PM -- Instance3056.1 (complete), Instance3056.2 (complete), Instance3056.3 (complete) and Instance3056.4 (complete)
3/6/2014 1:39:25 PM -- C:\Program Files\Exchange Jetstress\Stress_2014_3_5_12_28_21.blg has 5771 samples.
3/6/2014 1:39:25 PM -- Creating test report ...
3/6/2014 1:39:46 PM -- Instance3056.1 has 15.8 for I/O Database Reads Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.1 has 1.2 for I/O Log Writes Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.1 has 1.2 for I/O Log Reads Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.2 has 16.2 for I/O Database Reads Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.2 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.2 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.3 has 16.1 for I/O Database Reads Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.3 has 1.2 for I/O Log Writes Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.3 has 1.2 for I/O Log Reads Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.4 has 15.7 for I/O Database Reads Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.4 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 1:39:46 PM -- Instance3056.4 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 1:39:46 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
3/6/2014 1:39:46 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
3/6/2014 1:39:46 PM -- C:\Program Files\Exchange Jetstress\Stress_2014_3_5_12_28_21.xml has 5750 samples queried.



C Backup testing

C.1 Server 1 – JS13

Table 38 Database backup statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance3148.1	448921.09	01:25:42	87.29
Instance3148.2	448905.09	01:33:06	80.36
Instance3148.3	448905.09	01:33:26	80.07
Instance3148.4	448897.09	01:32:26	80.93
Avg			82.16
Sum			328.65

Table 39 Jetstress system parameters

Performance Counter	Value
Thread Count	6
Minimum Database Cache	128.0 MB
Maximum Database Cache	1024.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%



Read Operations	35%
Lazy Commits	70%

Table 40 Database configuration

Performance Counter	Value
Instance3148.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance3148.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance3148.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance3148.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb

Table 41 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
Instance3148.1	4.343	0.000	349.328	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3148.2	4.589	0.000	321.478	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3148.3	4.681	0.000	319.251	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3148.4	4.672	0.000	323.517	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Table 42 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.539	0.000	1.480
Available MBytes	61713.677	61688.000	61718.000
Free System Page Table Entries	33555672.161	33555672.000	33555674.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71689909.677	71680000.000	71708672.000
Pool Paged Bytes	178786370.065	176443392.000	180547584.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

C.2 Test log

3/4/2014 9:24:14 AM -- Preparing for testing ...
 3/4/2014 9:24:19 AM -- Attaching databases ...
 3/4/2014 9:24:19 AM -- Preparations for testing are complete.
 3/4/2014 9:24:27 AM -- Performance logging started (interval: 30000 ms).
 3/4/2014 9:24:27 AM -- Backing up databases ...
 3/4/2014 10:57:53 AM -- Performance logging has ended.
 3/4/2014 10:57:53 AM -- Instance3148.1 (100% processed), Instance3148.2 (100% processed), Instance3148.3 (100% processed) and Instance3148.4 (100% processed)
 3/4/2014 10:57:53 AM -- C:\Program Files\Exchange Jetstress\DatabaseBackup_2014_3_4_9_24_19.blg has 186 samples.
 3/4/2014 10:57:53 AM -- Creating test report ...



C.3 Server 2 – JS14

Table 43 Database backup statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance3172.1	448953.09	01:23:21	89.77
Instance3172.2	448945.09	01:29:37	83.49
Instance3172.3	448953.09	01:29:41	83.42
Instance3172.4	448945.09	01:28:57	84.12
Avg			85.20
Sum			340.80

Table 44 Jetstress system parameters

Performance Counter	Value
Thread Count	5
Minimum Database Cache	128.0 MB
Maximum Database Cache	1024.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%



Table 45 Database configuration

Performance Counter	Value
Instance3172.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance3172.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance3172.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance3172.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb

Table 46 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
Instance3172.1	4.177	0.000	359.502	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3172.2	4.497	0.000	334.204	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3172.3	4.472	0.000	333.438	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance3172.4	4.407	0.000	335.806	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 47 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	0.501	0.000	1.305



Available MBytes	61553.274	61542.000	61567.000
Free System Page Table Entries	33555160.084	33555159.000	33555162.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72245179.352	72232960.000	72278016.000
Pool Paged Bytes	225122612.916	222195712.000	227950592.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

C.4 Test log

3/4/2014 9:24:17 AM -- Preparing for testing ...
 3/4/2014 9:24:22 AM -- Attaching databases ...
 3/4/2014 9:24:22 AM -- Preparations for testing are complete.
 3/4/2014 9:24:30 AM -- Performance logging started (interval: 30000 ms).
 3/4/2014 9:24:30 AM -- Backing up databases ...
 3/4/2014 10:54:12 AM -- Performance logging has ended.
 3/4/2014 10:54:12 AM -- Instance3172.1 (100% processed), Instance3172.2 (100% processed), Instance3172.3 (100% processed) and Instance3172.4 (100% processed)
 3/4/2014 10:54:12 AM -- C:\Program Files\Exchange Jetstress\DatabaseBackup_2014_3_4_9_24_22.blg has 179 samples.
 3/4/2014 10:54:12 AM -- Creating test report ...



D Recovery testing

D.1 Server 1 – JS13

Table 48 Soft Recovery statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance3376.1	501	1436.0856165
Instance3376.2	505	1497.0827895
Instance3376.3	505	1481.9660988
Instance3376.4	506	1453.8543582
Avg	504	1467.247
Sum	2017	5868.988863

Table 49 Database configuration

Performance Counter	Value
Instance3376.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance3376.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance3376.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance3376.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb



Table 50 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
Instance3376.1	21.794	0.837	206.364	1.392	39821.682	24193.629	13.256	0.000	1.740	0.000	151945.061	0.000
Instance3376.2	24.015	0.808	195.659	1.346	40208.130	22675.278	12.727	0.000	1.683	0.000	142224.701	0.000
Instance3376.3	23.965	0.875	197.299	1.358	40331.465	23283.709	12.273	0.000	1.698	0.000	147297.866	0.000
Instance3376.4	22.310	0.910	199.438	1.388	40180.910	24106.249	13.186	0.000	1.734	0.000	150729.317	0.000

Table 51 Background Database Maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3376.1	7.865	261442.757
Instance3376.2	7.764	261596.556
Instance3376.3	7.766	261564.472
Instance3376.4	7.925	261493.493



Table 52 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
Instance3376.1	21.794	0.837	214.229	1.392	47958.265	24193.629	13.256	0.000	1.740	0.000	151945.061	0.000
Instance3376.2	24.015	0.808	203.423	1.346	48657.606	22675.278	12.727	0.000	1.683	0.000	142224.701	0.000
Instance3376.3	23.965	0.875	205.064	1.358	48709.591	23283.709	12.273	0.000	1.698	0.000	147297.866	0.000
Instance3376.4	22.310	0.910	207.363	1.388	48638.790	24106.249	13.186	0.000	1.734	0.000	150729.317	0.000

Table 53 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	1.960	0.000	17.213
Available MBytes	60688.333	60654.000	61667.000
Free System Page Table Entries	33555672.604	33555671.000	33555674.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	71695495.978	71688192.000	71720960.000
Pool Paged Bytes	183770553.236	183750656.000	183808000.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

D.2 Test log



3/6/2014 3:52:32 PM -- Preparing for testing ...
 3/6/2014 3:52:36 PM -- Attaching databases ...
 3/6/2014 3:52:36 PM -- Preparations for testing are complete.
 3/6/2014 3:52:36 PM -- Starting transaction dispatch ..
 3/6/2014 3:52:36 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
 3/6/2014 3:52:36 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
 3/6/2014 3:52:41 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
 3/6/2014 3:52:41 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
 3/6/2014 3:52:44 PM -- Operation mix: Sessions 6, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
 3/6/2014 3:52:44 PM -- Performance logging started (interval: 15000 ms).
 3/6/2014 3:52:44 PM -- Generating log files ...
 3/6/2014 6:14:51 PM -- C:\DB\DB1 (100.2% generated), C:\DB\DB2 (101.0% generated), C:\DB\DB3 (101.0% generated) and C:\DB\DB4 (101.2% generated)
 3/6/2014 6:14:51 PM -- Performance logging has ended.
 3/6/2014 6:14:51 PM -- JetInterop batch transaction stats: 17021, 17021, 17021 and 17020.
 3/6/2014 6:14:51 PM -- Dispatching transactions ends.
 3/6/2014 6:14:52 PM -- Shutting down databases ...
 3/6/2014 6:14:52 PM -- Instance3376.1 (complete), Instance3376.2 (complete), Instance3376.3 (complete) and Instance3376.4 (complete)
 3/6/2014 6:14:52 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_6_15_52_41.blg has 567 samples.
 3/6/2014 6:14:52 PM -- Creating test report ...
 3/6/2014 6:14:54 PM -- Instance3376.1 has 17.9 for I/O Database Reads Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.1 has 1.2 for I/O Log Writes Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.1 has 1.2 for I/O Log Reads Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.2 has 20.0 for I/O Database Reads Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.2 has 1.3 for I/O Log Writes Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.2 has 1.3 for I/O Log Reads Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.3 has 19.9 for I/O Database Reads Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.3 has 1.3 for I/O Log Writes Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.3 has 1.3 for I/O Log Reads Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.4 has 18.2 for I/O Database Reads Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.4 has 1.3 for I/O Log Writes Average Latency.
 3/6/2014 6:14:54 PM -- Instance3376.4 has 1.3 for I/O Log Reads Average Latency.
 3/6/2014 6:14:54 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
 3/6/2014 6:14:54 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
 3/6/2014 6:14:54 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_6_15_52_41.xml has 566 samples queried.
 3/6/2014 6:14:55 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_6_15_52_41.html was saved.



3/6/2014 10:00:31 PM -- Performance logging started (interval: 2000 ms).
3/6/2014 10:00:31 PM -- Recovering databases ...
3/6/2014 10:25:28 PM -- Performance logging has ended.
3/6/2014 10:25:28 PM -- Instance3376.1 (1436.0856165), Instance3376.2 (1497.0827895), Instance3376.3 (1481.9660988) and Instance3376.4 (1453.8543582)
3/6/2014 10:25:29 PM -- C:\Program Files\Exchange Jetstress\SoftRecovery_2014_3_6_22_0_28.blg has 738 samples.
3/6/2014 10:25:29 PM -- Creating test report ...
.



D.3 Server 2 – JS14

Table 54 Soft Recovery statistics - All

Database Instance	Log files replayed	Elapsed seconds
Instance3056.1	504	1375.6276716
Instance3056.2	501	1419.3867936
Instance3056.3	507	1431.8515132
Instance3056.4	501	1392.6009068
Avg	503	1404.867
Sum	2013	5619.4668852

Table 55 Database configuration

Performance Counter	Value
Instance3056.1	Log path: C:\DB\DB1 Database: C:\DB\DB1\Jetstress001001.edb
Instance3056.2	Log path: C:\DB\DB2 Database: C:\DB\DB2\Jetstress002001.edb
Instance3056.3	Log path: C:\DB\DB3 Database: C:\DB\DB3\Jetstress003001.edb
Instance3056.4	Log path: C:\DB\DB4 Database: C:\DB\DB4\Jetstress004001.edb



Table 56 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
Instance3056.1	19.980	0.928	224.064	1.463	40250.468	24781.708	13.353	0.000	1.828	0.000	156277.374	0.000
Instance3056.2	20.408	0.798	216.218	1.410	40237.602	23707.507	13.226	0.000	1.763	0.000	150361.208	0.000
Instance3056.3	20.393	0.890	214.896	1.413	40163.770	23750.990	13.540	0.000	1.772	0.000	151533.602	0.000
Instance3056.4	20.038	0.898	220.776	1.434	40307.867	24635.796	13.467	0.000	1.792	0.000	154366.993	0.000

Table 57 Background Database Maintenance I/O performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3056.1	8.273	261430.289
Instance3056.2	8.220	261549.056
Instance3056.3	8.218	261527.256
Instance3056.4	8.262	261156.849



Table 58 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
Instance3056.1	19.980	0.928	232.338	1.463	48126.553	24781.708	13.353	0.000	1.828	0.000	156277.374	0.000
Instance3056.2	20.408	0.798	224.438	1.410	48343.285	23707.507	13.226	0.000	1.763	0.000	150361.208	0.000
Instance3056.3	20.393	0.890	223.114	1.413	48317.580	23750.990	13.540	0.000	1.772	0.000	151533.602	0.000
Instance3056.4	20.038	0.898	229.039	1.434	48274.890	24635.796	13.467	0.000	1.792	0.000	154366.993	0.000

Table 59 Host system performance

Counter	Average	Minimum	Maximum
% Processor Time	2.095	0.000	18.655
Available MBytes	60529.486	60493.000	61514.000
Free System Page Table Entries	33555160.003	33555159.000	33555162.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	72086072.567	72081408.000	72134656.000
Pool Paged Bytes	228921767.524	228913152.000	228937728.000
Database Page Fault Stalls/sec	0.000	0.000	0.000



D.4 Test log

3/6/2014 3:52:39 PM -- Preparing for testing ...
3/6/2014 3:52:44 PM -- Attaching databases ...
3/6/2014 3:52:44 PM -- Preparations for testing are complete.
3/6/2014 3:52:44 PM -- Starting transaction dispatch ..
3/6/2014 3:52:44 PM -- Database cache settings: (minimum: 128.0 MB, maximum: 1.0 GB)
3/6/2014 3:52:44 PM -- Database flush thresholds: (start: 10.2 MB, stop: 20.5 MB)
3/6/2014 3:52:49 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
3/6/2014 3:52:49 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
3/6/2014 3:52:52 PM -- Operation mix: Sessions 5, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
3/6/2014 3:52:52 PM -- Performance logging started (interval: 15000 ms).
3/6/2014 3:52:52 PM -- Generating log files ...
3/6/2014 6:21:25 PM -- C:\DB\DB1 (100.8% generated), C:\DB\DB2 (100.2% generated), C:\DB\DB3 (101.4% generated) and C:\DB\DB4 (100.2% generated)
3/6/2014 6:21:25 PM -- Performance logging has ended.
3/6/2014 6:21:25 PM -- JetInterop batch transaction stats: 16939, 16939, 16938 and 16938.
3/6/2014 6:21:25 PM -- Dispatching transactions ends.
3/6/2014 6:21:25 PM -- Shutting down databases ...
3/6/2014 6:21:28 PM -- Instance3056.1 (complete), Instance3056.2 (complete), Instance3056.3 (complete) and Instance3056.4 (complete)
3/6/2014 6:21:28 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_6_15_52_49.blg has 593 samples.
3/6/2014 6:21:28 PM -- Creating test report ...
3/6/2014 6:21:30 PM -- Instance3056.1 has 16.9 for I/O Database Reads Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.1 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.1 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.2 has 17.0 for I/O Database Reads Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.2 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.2 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.3 has 17.0 for I/O Database Reads Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.3 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.3 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.4 has 16.8 for I/O Database Reads Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.4 has 1.3 for I/O Log Writes Average Latency.
3/6/2014 6:21:30 PM -- Instance3056.4 has 1.3 for I/O Log Reads Average Latency.
3/6/2014 6:21:30 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.



3/6/2014 6:21:30 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
3/6/2014 6:21:30 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_6_15_52_49.xml has 592 samples queried.
3/6/2014 6:21:30 PM -- C:\Program Files\Exchange Jetstress\Performance_2014_3_6_15_52_49.html was saved.
3/6/2014 10:00:36 PM -- Performance logging started (interval: 2000 ms).
3/6/2014 10:00:36 PM -- Recovering databases ...
3/6/2014 10:24:27 PM -- Performance logging has ended.
3/6/2014 10:24:27 PM -- Instance3056.1 (1375.6276716), Instance3056.2 (1419.3867936), Instance3056.3 (1431.8515132) and Instance3056.4 (1392.6009068)
3/6/2014 10:24:28 PM -- C:\Program Files\Exchange Jetstress\SoftRecovery_2014_3_6_22_0_32.blg has 706 samples.
3/6/2014 10:24:28 PM -- Creating test report ...

