



Dell PowerVault MD3860f 10,000 user Mailbox Exchange 2013 Resiliency Storage Solution — FC SAN using dual QLogic QLE2662 16Gb FC adapters and Brocade 6505 16Gb FC switch

Microsoft ESRP 4.0

Dell MD3 Series storage solutions
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About Microsoft ESRP-Storage program

The Microsoft 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 of this paper. 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>.

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1 Executive summary

1.1 Overview

This technical paper describes a tested and validated resilient storage solution for a 10,000 user mailbox Microsoft Exchange 2013 site, with Data Availability Group (DAG). A DAG is a high availability mechanism in Microsoft Exchange 2013.

The “Low Maintenance” concept of this configuration is based on the self-healing data protection capability of the Dell PowerVault MD3860f storage array using Dynamic Disk Pooling (DDP) technology. DDP enables the solution to withstand multiple drive failures over time without requiring drive maintenance actions by the customer. In addition to up to 8x faster rebuilds during a drive failure, DDP also provides higher levels of system performance during drive failures, delivering improved service to the infrastructure end-users. This capability can be used to design system solutions that require no drive maintenance for multiple years, significantly lowering the operational and therefore total cost of system ownership. Dynamic Disk Pooling is a standard (no-cost) feature of the PowerVault MD3 Series storage. DDP requires a minimum of 11 drives in the pool, so to see the benefits of “low maintenance” it is recommended to add two additional drives to the pool. This will provide at least two years of predicted “no drive maintenance” based on standard drive failure rates.

This mailbox resiliency model supports multiple copies (up to 16) of Exchange database in a DAG. There can be only one active copy of a given Exchange 2013 database at any given time. Secondary copies, including the copies located at remote sites, are periodically synched with the primary copy. Mail clients access the primary (active) copy, and database changes to the primary copy are copied to the secondary (passive) copies in the form of transaction logs. The copied log records are played on the secondary copy to keep the secondary database copies consistent with the primary copy. All hosts within a DAG are configured to be identical in terms of storage resources for Exchange 2013 databases and logs. The primary and secondary copies do not share any storage resources and reside on their own dedicated storage resources, as discussed later in this document.

This document provides information on a specific Dell MD3860f solution for Microsoft Exchange Server, based on 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 for information on its storage solutions with Microsoft Exchange Server software. Details about the Microsoft ESRP – Storage program are available at <http://technet.microsoft.com/en-us/exchange/ff182054.aspx>.



1.2 Simulated environment

This Mailbox Resiliency solution utilizes one Database Availability Group (DAG) and two copies of every database with (DDP) Dynamic Disk Pool technology. The tested environment simulates all users in this DAG running on a single MD3860f array. The tested environment simulates up to 10,000 users with a 2GB Mailbox size and 200 messages a day, or 0.12 IOPS for every user, including 20% headroom.

1.3 Solution description

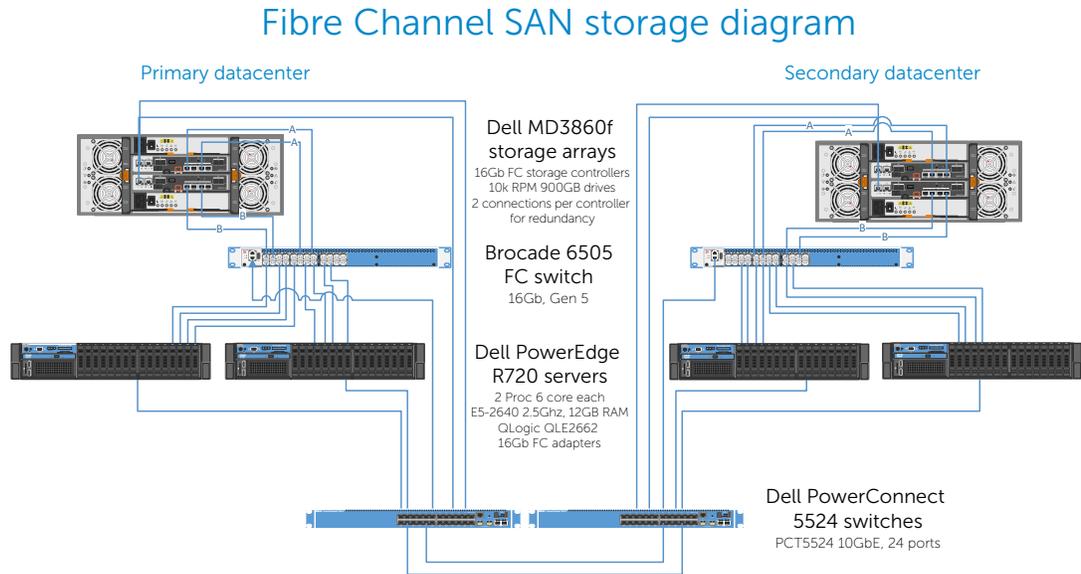
Testing was performed on a Dell R720 server, dual QLogic QLE2662 16Gb FC HBAs, Brocade 6505 16Gb FC switch and a Dell MD3860f storage array with redundant controller pair; front-end connections and back-end connections. Exchange is a critical application in most businesses today and the design of the system supporting Exchange should have redundant components and a design to support continued operation in case a single component fails. This solution was designed with the ability to support continuous operation during component failure.

The MD3860f is a 4U drive enclosure with 60 2.5" or 3.5" drive slots offering four 16Gb Fibre Channel and two 12Gb SAS host connections per controller. Thirty-nine 10k 900GB 6Gbps SAS drives were used in the dedicated dynamic disk pool (DDP). As a redundant solution, databases and logs were stored together on the same volumes using Microsoft best practices. Given the self healing benefits of DDP consideration should be given to add additional HDDs to provide for a long term "no drive replacement" scenario. Adding 5% drive overhead to the drive pool provides for a predicted two years, or more, of no drive maintenance, based on typical drive failure rates. The cost of two additional drives is very low when compared to a skilled professional's time to have to order a new drive and travel to a remote site to replace a single drive.

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



This figure illustrates the architectural design of the solution showing both primary site and secondary site configurations. This solution was tested on the primary site. The secondary site illustrates what a typical configuration would look like if a redundant Exchange environment were implemented.



2 The Dell MD3860f solution for Microsoft ESRP

2.1 A modular hardware design

The PowerVault MD3860f enclosure is designed to scale the needs of applications requiring large amounts of data storage. The MD3860f is a 60-drive, 4U standard rack enclosure and can scale up to 180 drives using MD3060e expansion enclosures. The MD3 Series is available in 16Gb Fibre Channel and 12Gb SAS host interfaces, 10Gb iSCSI and 12Gb SAS host interfaces or 12Gb SAS host interfaces. The MD3 Series also comes in a 2U 12-drive 3.5 inch drive module, 2U 24-drive 2.5 inch drive module or 4U 60-drive module supporting either 2.5 or 3.5 inch drives. The PowerVault MD3 Series supports simultaneous use of multiple host protocols making it highly adaptable to customer infrastructure environments. The solution described in this paper utilizes the 16Gb FC interface.



Figure 1 Dell PowerVault MD3860f front and back view



The MD3860f supports SAS, SED SAS, near-line SAS (NL-SAS), SED NL-SAS and SSD drives. The ability to mix SAS, near-line SAS and SSD drives within the same enclosure enables the user to blend drives to best suit their application storage needs across three tiers of performance offerings. Non-disruptive and on-line firmware upgrades are designed to enable high availability.

The storage management software, PowerVault Modular Disk Storage Manager (MDSM), was used to configure the storage for this solution. The MD storage management software has three major components:

- Client management software
- Host-agent management software
- Multi-path driver software

The client management software contains the graphical user interface for managing the storage array. It also contains an optional monitor service that sends alerts when an event occurs in the storage array.

The host-agent management software is installed on one or more hosts that are connected to the storage arrays to enable in-band management. The host-agent management software, along with the Ethernet connection on the host, provides another network management connection to the storage array, rather than using the individual Ethernet connections on each RAID controller module in the storage array.

The multi-path driver is also referred to as the I/O path failover driver. With the redundant pair of active RAID controller modules in a storage array, when a virtual disk is created, one of the RAID controller modules is automatically or manually chosen to "own" the virtual disk. The I/O between the virtual disk and the application host along the I/O path is controlled by the RAID controller "owning" virtual disk. When a component along the I/O



path to a RAID controller module or the RAID controller module itself fails, ownership of the virtual disks that had been assigned to that RAID controller module automatically transfer to the other RAID controller module. The multi-path driver manages this failover process.

Figure 2 shows the view of disk groups, virtual disks, and the physical disks as displayed in PowerVault Modular Disk Storage Manager. Figure 3 provides an overall summary view of the PowerVault MD3860f. The features of Dell PowerVault MD3860f are detailed in Table 1.

Figure 2 MDSM view of disk groups, virtual disks and physical disks

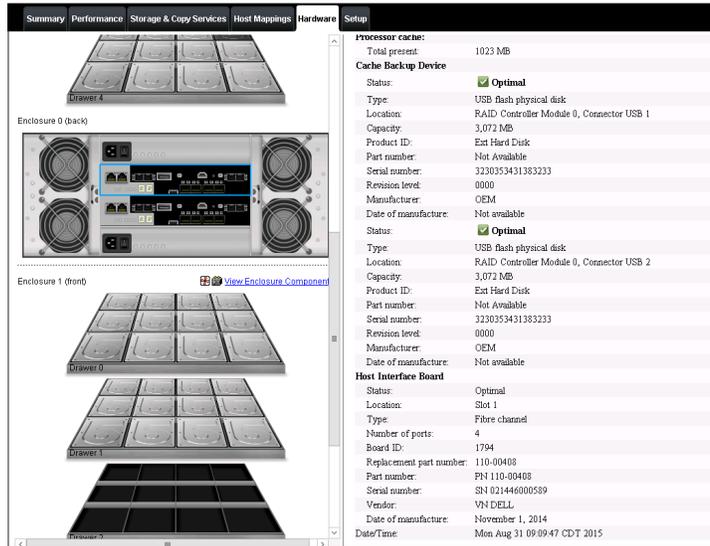


Figure 3 MDSM summary view

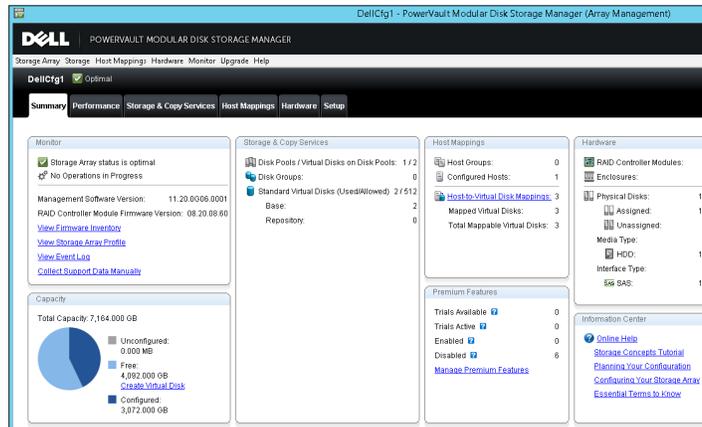


Table 1 Dell PowerVault MD3860f Features

Feature	Details
4U, 60 drive FC enclosure	Designed to fit standard 1000mm cabinets (32" max depth).
6Gb/s SAS-based storage system	Provides a high availability and high capacity storage offering when using 6GB near-line SAS drives.
Ports	Eight 16Gb/s FC ports (4 per each controller) and four 12Gb/s SAS ports (2 per controller)
Scales to support up to 180 2.5-in or 3.5-in. SAS drives	<ul style="list-style-type: none"> Up to 120 drive slots are supported as part of the base; moving from 121-180 drive slots requires purchase of the Premium Feature Key (PFK) for firmware High performance SAS, NL-SAS, SEDs and SSDs drives Configuration supports up to seven additional MD1220 expansion modules.
Support for SAS, near-line SAS and Solid State Disk drives	The ability to mix SAS, near-line SAS and SSD drives within the same enclosure supports a user's ability to blend drives to best suit their applications' storage needs across three tiers of performance offerings.
Non-disruptive, on-line firmware upgrades	Improved data availability
High Performance Tiering (HPT)	Increases system performance
SSD Cache (included as part of HPT)	Increases execution speed of applications by caching previously read data.
Thin Provisioning	<ul style="list-style-type: none"> Allocate and consume physical storage capacity as needed Thin virtual disk can only be created from a disk pool Reduces the likelihood of having excess, unused capacity in the disk pool
Support for self-encrypting drives (SED)	Secures data at rest.
VMware VAAI support	<ul style="list-style-type: none"> The ability to integrate array commands with VMware, allowing for an increased number of VM's. Reduces SAN traffic as functions are executed in the array.
Dynamic Disk Pools	<ul style="list-style-type: none"> Dynamically rebalances data in the event of a drive failure Allows for the creation of pools without the complexity of RAID Enables Thin Provisioning
Asymmetric Logical Unit Access (ALUA)	Enables the array to service I/O requests through either RAID controller module

2.2 Dell PowerEdge R720 Features

Dell PowerEdge™ R720 is a 2-socket CPU, 1U, multi-purpose server, offering an excellent balance of redundancy and value in a compact form factor. It is a most suitable hardware building block for any mid-size or large business. It delivers enormous performance in a dense 1U form-factor, enabling larger and more efficient databases and mail servers. Major features of the server/storage system include:

- Intel® Xeon® processor E5-2600 or E5-2600 v2 product family
- Dual processor sockets
- Up to 768 GB of Memory with 24 DIMMs
- Integrated RAID support through PERC H310, PERC H710, PERC H710P



- Up to three PCIe 3.0 expansion slots
- Choice of NIC technologies
- Dell OpenManage™ Essentials and Dell Management Console, Dell OpenManage Power Center and Dell OpenManage Connections

For more information, see Dell PowerEdge R720 Server product page.

2.3 QLogic QLE2662 FC adapter

The QLogic Fibre Channel adapters have the following design characteristics:

- 16Gbps per port maximum throughput for high bandwidth (SAN) traffic
- Over 1.2 million IOPS reduces latency in high transaction intensive applications and virtualized environments
- Optimization for virtualized environments: with increasing numbers of VMs on virtualized servers it is essential that the I/O performance scales as the VM count grows and doesn't become a bottleneck
- Decreased power and cooling costs by using the fewest PCI Express® lanes in PCIe® Gen 3 environments
- Overlapping protection domains (OPDs) to ensure a high level of reliability as data moves to and from the PCI bus and Fibre Channel network
- Complete investment protection for legacy 8Gb Fibre Channel infrastructure

2.4 Brocade 6505 FC switch

The Brocade 6505 SAN Switch has the following design features:

- Provides exceptional price/performance value, combining flexibility, simplicity, and enterprise-class functionality in a 24-port, 1U entry-level switch
- Enables fast, easy, and cost-effective scaling from 12 to 24 ports using Ports on Demand (PoD) capabilities
- Simplifies management through Brocade Fabric Vision technology, reducing operational costs and optimizing application performance
- Simplifies deployment and supports high-performance fabrics by using Brocade Clear-Link Diagnostic Ports (D_Ports) to identify optic and cable issues
- Maximizes resiliency with non-disruptive software upgrades and an optional redundant power supply
- Simplifies deployment with the Brocade EZSwitch Setup wizard
- Simplifies server connectivity by deploying as a full-fabric switch or a Brocade Access Gateway



2.5 Storage Sizing

Storage sizing typically involves the type of data protection chosen, type of disks, and the number of disks, both from a capacity and IOPS perspective. Selecting the right storage is crucial to achieve the balance between cost and performance. Jetstress tools provide a way of capturing the storage subsystem IOPS. Storage design also depends on the actual size of the mailbox on the disk, content indexing space and log space required. Microsoft Exchange 2013 Server Role Requirements Calculator can be used to derive the required IOPS for a particular user profile. Figure 4 shows the Mailbox Calculator output for 10,000 users with 200 messages/day profile. The recommended IOPS per server is 1,200. This will be the target IOPs that will be verified and tested as part of ESRP Jetstress verification. More details on this are provided in Section 6.

Figure 4 Recommended IOPS from the Microsoft Exchange 2013 Server Role Requirements Calculator

Role Requirements Results Pane - Log, Disk Space, and IO Requirements				
Transaction Log Requirements				
	/ Database	/ Server	/ DAG	/ Environment
User Transaction Logs Generated / Day	5000	5000	10000	20000
Average Move Mailbox Transaction Logs Generated / Day	1945	1945	3889	7779
Average Transaction Logs Generated / Day	6945	6945	13889	27779
Disk Space Requirements				
	/ Database	/ Server	/ DAG	/ Environment
Transport Database Space Required	--	64 GB	257 GB	515 GB
Database Space Required	1329 GB	1329 GB	10635 GB	21270 GB
Log Space Required	47 GB	47 GB	380 GB	760 GB
Database+Log Volume Space Required	2009 GB	2009 GB	16072 GB	32144 GB
Log Volume Space Required	0 GB	0 GB	0 GB	0 GB
Restore Volume Space Required	--	1449 GB	5797 GB	11594 GB
Host IO and Throughput Requirements				
	/ Database	/ Server	/ DAG	/ Environment
Total Database Required IOPS	20	20	80	161
Total Log Required IOPS	4	4	18	35
Database Read I/O Percentage	60%	--	--	--
Background Database Maintenance Throughput Requirements	1.0 MB/s	1 MB/s	4 MB/s	8 MB/s

2.6 Targeted customer profile

This solution is targeted for a medium-sized organization. Capacity can be dynamically scaled from 600GB to over a petabyte.

1. A Dell MD3 Series storage solution can be sized for any organization
2. Up to four servers can be directly connected to the storage array via Fibre Channel or iSCSI, two via SAS
3. User I/O profile (0.09 IOPs per user, 0.12 tested, giving 20% headroom).
4. User mailbox size (2GB 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. Dynamic Disk Pooling was chosen for data protection of the database volumes and log volumes.



2.7 Volume sizing

The volume size tested was just large enough to support the database size. Volumes on Dell MD3 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 Dynamic Volume Expansion and hot upgrades, additional disk capacity can be added as needed. If more spindles are required to accommodate growth, they can simply be 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 88% 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

Configuration Item	Detail
Number of Exchange mailboxes simulated	10,000
Number of DAG	1
Number of servers/DAG	2
Number of active mailboxes/server	5,000
Number of databases/host	8
Number of copies/database	2
Number of mailboxes/database	625
Simulated profile: I/O per second per mailbox (IOPS, include 20% headroom)	0.12
Database/Log LUN size	5.774TB
Total database size for performance testing	23.096TB
% storage capacity used by Exchange database*	97.08%

* 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 no data, will consume no disk space.



3.2 Primary storage hardware

Configuration Item	Detail
Storage Connectivity (Fibre Channel, SAS, SATA, iSCSI)	FC
Storage Model and OS/firmware revision	Dell MD3860f: 08.20.08.60
Storage Cache	16GB
Number of storage controllers	2
Number of storage ports	4 active FC port per controller
Maximum bandwidth of storage connectivity to host	64Gb/s (4x16Gb HBA)
Switch type/model/firmware revision	FC: Brocade 6505: 7.3.0a
HBA model and firmware	QLogic QLE2662 16Gb FC HBA: 02.00.84
Number of HBA's/host	2
Host server type	Dell PowerEdge R720
Total number of disks tested in solution	39
Maximum number of spindles that can be hosted in the storage	60 drive bay + dual controllers in a 4U chassis Scalable to 192 drives via modular expansion enclosures

3.3 Primary storage software

Configuration Item	Detail
HBA driver	9.1.11.3
Multi-Pathing (MPI/O)	Microsoft Windows Server 2012 R2 MPI/O Round-Robin (InBox DSM)
Host OS	Windows Server 2012 R2 Datacenter (6.3.9600)
ESE.dll file version	15.00.0847.030
Replication solution name/version	Microsoft Exchange Server 2013 DAG replication

3.4 Primary storage disk configuration (Mailbox store/Log disks)

Configuration Item	Detail
Disk Type, speed and firmware revision	SAS 10k 900GB, B556
Raw capacity per disk (GB)	838.363GB
Number of physical disks in test	39
Total raw storage capacity (TB)	23.232TB
Data protection	DDP
Total formatted capacity	837.363GB
Storage capacity utilization	99.41%
Database capacity utilization	87.05%



4 Best practices

- Ensure Multipath I/O is installed and configured on the server before installing MS Exchange. This feature provides alternate paths between storage devices and hosts in case the primary path fails. This feature also provides load balancing between paths.
- Configure the page file size to be 10MB larger than the physical RAM installed in the server.
- Assign an allocation unit size of 64KB when creating volumes in Windows Server 2012. This option increases the block size of the volume being created. This setting can result in increased performance because it uses the most efficient block size for data transfer on the system bus.
- Set the start demand cache flushing value to 80% in the Dell Modular Disk Storage Manager.
- When creating volumes in the Modular Disk Storage Manager, make sure read and write cache are both enabled. Also confirm that dynamic cache read pre-fetch is enabled. These three settings increase the performance of the storage system.
- Adjust IOPs per user to 0.12 to allow for 20% headroom.
- From a controller resource allocation perspective, there are two user-modifiable reconstruction priorities within DDP. It is recommended to set these as Low or Medium priority settings for NL-SAS drives, this will increase the drive reconstruction time but will also lessen the impact of I/O performance during rebuild.
 - Degraded reconstruction priority is assigned for instances where only a single D-Piece needs to be rebuilt for affected D-Stripes. The default is 'high' setting 1.
 - Critical reconstruction priority is assigned for instances where a D-Stripe has two missing D-Pieces which need to be rebuilt. The default is 'highest'.
- Given the self healing benefits of DDP consideration should be given to add additional HDDs to provide for a long term "no drive replacement" scenario. Adding 5% drive overhead to the drive pool provides for a predicted two years, or more, of no drive maintenance, based on typical drive failure rates.
- It is best to use SAS drives with Exchange 2013 when a moderate amount of storage capacity is needed with high performance and balanced power consumption. It is also important to disable physical disk-write caching when the drives are used without an un-interruptible power supply (UPS). The 900GB 10k RPM SAS drives used in the testing were chosen for their average storage capacity, excellent random I/O performance, and great sequential I/O performance and power utilization.

Best Practice Exchange 2013 storage configuration options

[https://technet.microsoft.com/en-us/library/ee832792\(v=exchg.150\).aspx](https://technet.microsoft.com/en-us/library/ee832792(v=exchg.150).aspx)

Planning for high availability and site resilience, see [https://technet.microsoft.com/library/dd638104\(EXCHG.150\)#StoreReq](https://technet.microsoft.com/library/dd638104(EXCHG.150)#StoreReq)

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

Exchange 2013 requirements that you need to know before you install Exchange 2013, see <https://technet.microsoft.com/en-us/library/aa996719.aspx>

Exchange 2013 Sizing and Configuration Recommendations, see <https://technet.microsoft.com/en-us/library/dn879075.aspx>



Drive Best Practices

When initializing disks in Windows Server 2012, the disks should be initialized as Basic Disks. Initializing a disk as dynamic increases processor overhead as the server also becomes responsible for managing volumes. This is the recommended disk configuration by Microsoft. When formatting drives, use the GUID partition table (GPT) scheme as opposed to MBR. GPT allows volumes to reach 256TB in size.

It is also important to disable automatic disk optimization and defragmentation on Windows Server 2012. When this feature is enabled, additional processor overhead will be incurred because the system will monitor and move data around to prevent fragmentation. Confirm that NTFS compression is not enabled. Do not use NTFS encrypting file system (EFS) or resilient file system (ReFS) as these will also increase processor overhead.

Dynamic Disk Pools

Dell MD3 Series Dynamic Disk Pools (DDP) is a data protection technology designed to deliver consistent storage system performance, data protection, and efficiency throughout the lifecycle of the system. DDP simplifies the setup process and reduces the ongoing maintenance requirements of data protection. With DDP, customers do not have to define RAID array sizes, hot spares, and drive maintenance schedules. DDP distributes data, parity information, and spare capacity across a pool of drives. Its intelligent algorithm defines which drives are used for segment placement, making sure data is fully protected.

DDP is able to utilize every drive in the pool for the intensive process of rebuilding a failed drive. This dynamic rebuild technology is the key to its exceptional performance under failure and returns the system to optimal conditions up to eight times more quickly than traditional RAID technology. With shorter rebuild times and patented prioritization reconstruction technology, DDP significantly reduces exposure to numerous cascading disk failures. Flexible disk pool sizing provides optimal utilization of any configuration for maximum performance, protection, and efficiency. DDP can easily be grown by adding up to 12 additional disk drives at a time.

In addition to superior data protection, Dynamic Disk Pools enable customers to structure their storage infrastructure in a way that can greatly reduce drive maintenance schedules. Designing a disk pool with additional drive capacity for growth at system installation leverages the technology's automatic self-healing capability and can extend drive maintenance schedules by years, driving operational costs down.

Configuration flexibility enables DDP to address wide-ranging requirements. Drives can be configured into one large disk pool to maximize simplicity and protection or into numerous smaller pools to maximize sequential performance. Different drive types can be used to create storage tiers, such as performance pools and capacity pools, and disk pools can reside in the same system with traditional RAID groups.

The following are the four key benefits of DDP technology:

- Reduce performance degradation following a drive (or multiple-drive) failure
- Eliminate complex RAID management without sacrificing data protection
- Eliminate deployment and management of idle hot spare drives
- Expand or contract the disk pool without reconfiguring RAID



Backup strategy

Other features of the MD3 Series that protect data include mirroring and backing up controller cache. If power is lost to the system during operation, onboard batteries are used to de-stage the data from cache memory to internal controller flash so that it will be available when power is restored. The DDP algorithms allow the system to recreate any lost data in the rare case of drive failure. Users also have the option of confirming data with RAID parity at all times and even continuing a rebuild when hitting an un-readable sector.

Behind the scenes, the system performs other tasks that protect data at all times. The optional media scan feature looks for inconsistencies even on sectors not currently being accessed by any host. All types of diagnostic data are constantly collected for later use by support if necessary.

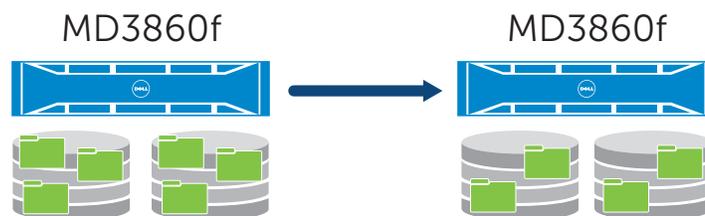
Not only does the MD3 Series offer the detailed reliability and availability features already described, but using the MDSM software features allows the possibility to maximize availability.

High-speed, high-efficiency Snapshot copies

- Robust disaster recovery protection
 - Synchronous mirroring for no-data-loss protection of content
 - Asynchronous mirroring for long-distance protection and compliance
- Flexible protection to maximize ROI
 - Recovery target can be flash, NL-SAS, or mixed based on cost/performance needs
 - Delivers speed without breaking budgets

Figure 5 illustrates a graphical representation of the HA possibilities using Snapshot copies and mirroring. For more information, refer to the Dell Support site Documentation library and the MDSM online help.

Figure 5: Snapshot copies



Additional information

For more information Dell MD3 Series storage solutions, visit our website at <http://www.dell.com/storage>.

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 Appendix later in this white-paper.

5.1 Reliability

Tests in this framework to check storage reliability are run over a 24 hour period. The goal of these "Stress tests" is to verify that 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/log corruption.

The following list provides an overview of reliability 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

5.2 Storage performance results

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

Multiple Server Metrics:

The sum of all transactional I/O performance across all mailbox databases and the average latency across all databases on a per server basis.

Database I/O	Value
Disks Reads/sec sum	1378.260
Disks Writes/sec sum	614.717
Disk Read Latency (ms) average	16.080
Disk Write Latency (ms) average	2.111
Transaction Log I/O	
Log Disks Writes/sec average	149.480
Log Disk Write Latency (ms) sum	0.536



5.3 Database backup/recovery performance

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

5.3.1 Database read-only performance

The test measures the maximum rate at which databases could be backed up via Volume Shadow Copy Service (VSS). The following table shows the average rate for a single database file.

Performance item	Detail
MB read/sec per database	103.375
MB read/sec total per server	827

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 10,000 log files played in a single database. Each log file is 1MB in size.

Performance item	Detail
Average time to play one Log file (sec)	0.751

6 Conclusion

This ESRP document presents a tested and validated Exchange solution for 10,000 mailboxes with 2GB mailbox size supporting up to 200 messages/day in a single DAG. The solution uses two Dell PowerEdge R720 servers attached to a PowerVault MD3860f storage array for Exchange mailbox databases and transactional logs.

Testing was carried out as part of the ESRP test framework using Microsoft Exchange Server 2013 Jetstress. The test results show that the proposed solution is more than capable of delivering the IOPs and meeting the capacity requirements to support 10,000 mailboxes with the set mailbox profile.

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



7 Additional resources

Microsoft ESRP Program Website: <http://technet.microsoft.com/en-us/exchange/ff182054.aspx>

Dell Storage Website: <http://www.dell.com/storage/>

Dell TechCenter storage page: <http://en.community.dell.com/techcenter/storage/>



8 Appendix

Test results for each particular mailbox size, users and connection

A Performance testing

Server 1

Test Summary

Overall Test Result	Pass
Machine Name	Servers
Test Description	Machine Name: Dell Poweredge R720 (non-virtual) 10000 users Microsoft Exchange 2013 2 Dell Poweredge R720 servers with Microsoft Server 2012 r2 installed 2GB Mailboxes, 5000 users per server, 0.12 IOPs 16 DB and LOG on 4 LUNs (combined) Dell MD3860f using Dynamic Disk Pool (39 drives) technology for data protection Dual QLogic QLE2662 16Gb FC HBAs per server Brocade 6505 16Gb FC Switch
Test Start Time	8/1/2015 8:54:50 PM
Test End Time	8/2/2015 8:05:35 AM
Collection Start Time	8/1/2015 8:57:56 PM
Collection End Time	8/1/2015 10:57:46 PM
Jetstress Version	15.00.0995.000
ESE Version	15.00.0847.030
Operating System	Windows Server 2012 R2 Datacenter (6.2.9200.0)
Performance Log	C:\Program Files\Exchange\Jetstress\Performance_2015_8_1_20_55_7.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1021.204
Target Transactional I/O per Second	600
Initial Database Size (bytes)	10749481058304
Final Database Size (bytes)	10763213209600
Database Files (Count)	8

Jetstress System Parameters

Thread Count	25
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2



Database Configuration

Instance3636.1 Log path: C:\Users\Administrator\Desktop\Volume1\log5
Database: C:\Users\Administrator\Desktop\Volume1\db1\Jetstress001001.edb

Instance3636.2 Log path: C:\Users\Administrator\Desktop\Volume1\log6
Database: C:\Users\Administrator\Desktop\Volume1\db2\Jetstress002001.edb

Instance3636.3 Log path: C:\Users\Administrator\Desktop\Volume1\log7
Database: C:\Users\Administrator\Desktop\Volume1\db3\Jetstress003001.edb

Instance3636.4 Log path: C:\Users\Administrator\Desktop\Volume1\log8
Database: C:\Users\Administrator\Desktop\Volume1\db4\Jetstress004001.edb

Instance3636.5 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Volume2\db5\Jetstress005001.edb

Instance3636.6 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Volume2\db6\Jetstress006001.edb

Instance3636.7 Log path: C:\Users\Administrator\Desktop\Volume2\log3
Database: C:\Users\Administrator\Desktop\Volume2\db7\Jetstress007001.edb

Instance3636.8 Log path: C:\Users\Administrator\Desktop\Volume2\log4
Database: C:\Users\Administrator\Desktop\Volume2\db8\Jetstress008001.edb

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
Instance3636.1	17.945	2.077	88.232	39.741	32926.694	35373.223	0.000	0.532	0.000	9.683	0.000	20358.675
Instance3636.2	17.021	2.099	88.459	39.761	32908.651	35350.735	0.000	0.533	0.000	9.618	0.000	20280.415
Instance3636.3	16.206	2.111	88.134	39.344	32916.366	35392.871	0.000	0.531	0.000	9.538	0.000	20462.248
Instance3636.4	15.522	2.088	88.019	39.376	32929.780	35370.805	0.000	0.534	0.000	9.519	0.000	20560.434
Instance3636.5	15.080	2.125	88.131	39.402	32909.555	35409.502	0.000	0.533	0.000	9.558	0.000	20372.951
Instance3636.6	14.821	2.143	87.964	39.232	32918.068	35407.902	0.000	0.532	0.000	9.519	0.000	20500.275
Instance3636.7	14.721	2.135	88.399	39.566	32909.325	35413.155	0.000	0.533	0.000	9.645	0.000	20212.804
Instance3636.8	14.614	2.124	88.302	39.143	32909.330	35346.745	0.000	0.537	0.000	9.475	0.000	20283.920

Background Database Maintenance I/O Performance

MSEXchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3636.1	9.727	261762.151
Instance3636.2	9.724	261860.993
Instance3636.3	9.725	261836.568
Instance3636.4	9.725	261822.426
Instance3636.5	9.726	261838.106
Instance3636.6	9.727	261808.982
Instance3636.7	9.724	261873.424
Instance3636.8	9.728	261781.953

Log Replication I/O Performance

MSEXchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3636.1	0.841	232078.198
Instance3636.2	0.835	231586.093
Instance3636.3	0.833	232073.641
Instance3636.4	0.838	232560.172
Instance3636.5	0.833	232075.247
Instance3636.6	0.833	232075.247
Instance3636.7	0.834	232549.957
Instance3636.8	0.821	232565.051



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
Instance3636.1	17.945	2.077	97.959	39.741	55649.758	35373.223	2.206	0.532	0.841	9.683	232078.198	20358.675
Instance3636.2	17.021	2.099	98.183	39.761	55583.585	35350.735	2.077	0.533	0.835	9.618	231586.093	20280.415
Instance3636.3	16.206	2.111	97.859	39.344	55665.636	35392.871	1.902	0.531	0.833	9.538	232073.641	20462.248
Instance3636.4	15.522	2.088	97.744	39.376	55703.953	35370.805	1.835	0.534	0.838	9.519	232560.172	20560.434
Instance3636.5	15.080	2.125	97.857	39.402	55663.326	35409.502	1.414	0.533	0.833	9.558	232075.247	20372.951
Instance3636.6	14.821	2.143	97.691	39.232	55708.245	35407.902	1.244	0.532	0.833	9.519	232075.247	20500.275
Instance3636.7	14.721	2.135	98.124	39.566	55600.516	35413.155	1.335	0.533	0.834	9.645	232549.957	20212.804
Instance3636.8	14.614	2.124	98.030	39.143	55620.907	35346.745	1.447	0.537	0.821	9.475	232565.051	20283.920

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.373	0.164	0.649
Available MBytes	28295.096	28285.000	28358.000
Free System Page Table Entries	16603712.192	1660394.000	16603944.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	220778803.841	220606464.000	220876800.000
Pool Paged Bytes	100394832.701	100327424.000	100474880.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

8/1/2015 8:54:51 PM -- Preparing for testing ...
8/1/2015 8:54:59 PM -- Attaching databases ...
8/1/2015 8:54:59 PM -- Preparations for testing are complete.
8/1/2015 8:54:59 PM -- Starting transaction dispatch ...
8/1/2015 8:54:59 PM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
8/1/2015 8:54:59 PM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
8/1/2015 8:55:07 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
8/1/2015 8:55:07 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
8/1/2015 8:55:08 PM -- Operation mix: Sessions 25, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
8/1/2015 8:55:08 PM -- Performance logging started (interval: 15000 ms).
8/1/2015 8:55:08 PM -- Attaining prerequisites.
8/1/2015 8:57:56 PM -- (MSExchange Database\JetstressWin)\Database Cache Size, Last: 1941467000.0 (lower bound: 1932735000.0, upper bound: none)
8/1/2015 10:57:58 PM -- Performance logging has ended.
8/2/2015 8:05:27 AM -- JetInterop batch transaction stats: 122441, 122441, 122441, 122441, 122440, 122440, 122440 and 122440.
8/2/2015 8:05:27 AM -- Dispatching transactions ends.
8/2/2015 8:05:28 AM -- Shutting down databases ...
8/2/2015 8:05:35 AM -- Instance3636.1 (complete), Instance3636.2 (complete), Instance3636.3 (complete), Instance3636.4 (complete), Instance3636.5 (complete), Instance3636.6 (complete), Instance3636.7 (complete) and Instance3636.8 (complete)
8/2/2015 8:05:35 AM -- Creating test report ...
8/2/2015 8:05:39 AM -- C:\Program Files\Exchange\Jetstress\Performance_2015_8_1_20_55_7.big has 490 samples.
8/2/2015 8:05:39 AM -- Instance3636.1 has 17.9 for I/O Database Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.1 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.1 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.2 has 17.0 for I/O Database Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.2 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.2 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.3 has 16.2 for I/O Database Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.3 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.3 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.4 has 15.5 for I/O Database Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.4 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.4 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.5 has 15.1 for I/O Database Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.5 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.5 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.6 has 14.8 for I/O Database Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.6 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.6 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.7 has 14.7 for I/O Database Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.7 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.7 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.8 has 14.6 for I/O Database Reads Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.8 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:39 AM -- Instance3636.8 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:39 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
8/2/2015 8:05:39 AM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
8/2/2015 8:05:39 AM -- C:\Program Files\Exchange\Jetstress\Performance_2015_8_1_20_55_7.xml has 478 samples queried.

```



Server 2

Test Summary

Overall Test Result	Pass
Machine Name	Servers
Test Description	Machine Name: Dell Poweredge R720 (non-virtual) 10000 users Microsoft Exchange 2013 2 Dell Poweredge R720 servers with Microsoft Server 2012 r2 installed 2GB Mailboxes, 5000 users per server, 0.12 IOPs 16 DB and LOG on 4 LUNs (combined) Dell MD3860f using Dynamic Disk Pool (39 drives) technology for data protection Dual QLogic QLE2662 16Gb FC HBAs per server Brocade 6505 16Gb FC Switch
Test Start Time	8/1/2015 8:54:50 PM
Test End Time	8/2/2015 8:05:35 AM
Collection Start Time	8/1/2015 8:57:56 PM
Collection End Time	8/1/2015 10:57:46 PM
Jetstress Version	15.00.0995.000
ESE Version	15.00.0847.030
Operating System	Windows Server 2012 R2 Datacenter (6.2.9200.0)
Performance Log	C:\Program Files\Exchange Jetstress\Performance_2015_8_1_20_55_7.big

Database Sizing and Throughput

Achieved Transactional I/O per Second	971.774
Target Transactional I/O per Second	600
Initial Database Size (bytes)	10748986130432
Final Database Size (bytes)	10762038804480
Database Files (Count)	8

Jetstress System Parameters

Thread Count	25
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2



Database Configuration

Instance3576.1 Log path: C:\Users\Administrator\Desktop\Volume4\log9
Database: C:\Users\Administrator\Desktop\Volume3\db9\Jetstress001001.edb

Instance3576.2 Log path: C:\Users\Administrator\Desktop\Volume4\log10
Database: C:\Users\Administrator\Desktop\Volume3\db10\Jetstress002001.edb

Instance3576.3 Log path: C:\Users\Administrator\Desktop\Volume4\log11
Database: C:\Users\Administrator\Desktop\Volume3\db11\Jetstress003001.edb

Instance3576.4 Log path: C:\Users\Administrator\Desktop\Volume4\log12
Database: C:\Users\Administrator\Desktop\Volume3\db12\Jetstress004001.edb

Instance3576.5 Log path: C:\Users\Administrator\Desktop\Volume3\log13
Database: C:\Users\Administrator\Desktop\Volume4\db13\Jetstress005001.edb

Instance3576.6 Log path: C:\Users\Administrator\Desktop\Volume3\log14
Database: C:\Users\Administrator\Desktop\Volume4\db14\Jetstress006001.edb

Instance3576.7 Log path: C:\Users\Administrator\Desktop\Volume3\log15
Database: C:\Users\Administrator\Desktop\Volume4\db15\Jetstress007001.edb

Instance3576.8 Log path: C:\Users\Administrator\Desktop\Volume3\log16
Database: C:\Users\Administrator\Desktop\Volume4\db16\Jetstress008001.edb

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
Instance3576.1	14.978	2.138	84.205	37.763	32954.192	35397.630	0.000	0.534	0.000	9.242	0.000	20254.391
Instance3576.2	14.952	2.130	84.436	37.812	32953.753	35375.694	0.000	0.537	0.000	9.225	0.000	20098.387
Instance3576.3	15.082	2.119	84.183	37.356	32966.754	35449.300	0.000	0.536	0.000	9.109	0.000	20369.784
Instance3576.4	15.273	2.123	83.709	36.873	32973.286	35484.114	0.000	0.537	0.000	8.999	0.000	20447.051
Instance3576.5	16.363	2.073	84.017	37.514	32970.762	35420.437	0.000	0.536	0.000	9.168	0.000	20250.085
Instance3576.6	17.162	2.106	84.185	37.515	32938.693	35450.518	0.000	0.543	0.000	9.126	0.000	20230.467
Instance3576.7	18.073	2.115	83.867	37.071	32962.443	35436.045	0.000	0.541	0.000	9.003	0.000	20372.771
Instance3576.8	19.463	2.071	84.018	37.248	32951.056	35419.786	0.000	0.544	0.000	9.066	0.000	20312.428

Background Database Maintenance I/O Performance

MSEXchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3576.1	9.635	261812.563
Instance3576.2	9.636	261793.417
Instance3576.3	9.636	261803.677
Instance3576.4	9.635	261821.734
Instance3576.5	9.635	261836.402
Instance3576.6	9.634	261857.548
Instance3576.7	9.637	261763.218
Instance3576.8	9.633	261884.645

Log Replication I/O Performance

MSEXchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3576.1	0.800	231589.145
Instance3576.2	0.792	231590.747
Instance3576.3	0.792	230619.717
Instance3576.4	0.786	232079.529
Instance3576.5	0.793	231589.145
Instance3576.6	0.790	230134.202
Instance3576.7	0.785	231103.630
Instance3576.8	0.788	230619.717



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
Instance3576.1	14.978	2.138	93.840	37.763	56451.793	35397.630	2.636	0.534	0.800	9.242	231589.145	20254.391
Instance3576.2	14.952	2.130	94.072	37.812	56394.430	35375.694	2.685	0.537	0.792	9.225	231590.747	20098.387
Instance3576.3	15.082	2.119	93.819	37.356	56469.496	35449.300	2.722	0.536	0.792	9.109	230619.717	20369.784
Instance3576.4	15.273	2.123	93.344	36.873	56595.296	35484.114	2.678	0.537	0.786	8.999	232079.529	20447.051
Instance3576.5	16.363	2.073	93.652	37.514	56516.540	35420.437	2.024	0.536	0.793	9.168	231589.145	20250.085
Instance3576.6	17.162	2.106	93.819	37.515	56445.772	35450.518	1.751	0.543	0.790	9.126	230134.202	20230.467
Instance3576.7	18.073	2.115	93.504	37.071	56543.671	35436.045	1.793	0.541	0.785	9.003	231103.630	20372.771
Instance3576.8	19.463	2.071	93.651	37.248	56499.970	35419.786	1.793	0.544	0.788	9.066	230619.717	20312.428

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.336	0.143	0.525
Available MBytes	28336.204	28319.000	28506.000
Free System Page Table Entries	16603719.573	16603386.000	16603920.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	176444561.067	176369664.000	176590848.000
Pool Paged Bytes	95570798.933	95563776.000	95600640.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

8/1/2015 8:55:04 PM -- Preparing for testing ...
8/1/2015 8:55:13 PM -- Attaching databases ...
8/1/2015 8:55:13 PM -- Preparations for testing are complete.
8/1/2015 8:55:13 PM -- Starting transaction dispatch ...
8/1/2015 8:55:13 PM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
8/1/2015 8:55:13 PM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
8/1/2015 8:55:21 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
8/1/2015 8:55:21 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
8/1/2015 8:55:22 PM -- Operation mix: Sessions 25, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
8/1/2015 8:55:22 PM -- Performance logging started (interval: 15000 ms).
8/1/2015 8:55:22 PM -- Attaining prerequisites:
8/1/2015 8:58:20 PM -- (MSExchange Database(JetstressWin)\Database Cache Size, Last: 1932960000.0 (lower bound: 1932735000.0, upper bound: none)
8/1/2015 10:58:20 PM -- Performance logging has ended.
8/2/2015 8:05:33 AM -- JetInterop batch transaction stats: 116717, 116717, 116717, 116717, 116716, 116716, 116716 and 116716.
8/2/2015 8:05:33 AM -- Dispatching transactions ends.
8/2/2015 8:05:34 AM -- Shutting down databases ...
8/2/2015 8:05:41 AM -- Instance3576.1 (complete), Instance3576.2 (complete), Instance3576.3 (complete), Instance3576.4 (complete), Instance3576.5 (complete), Instance3576.6 (complete), Instance3576.7 (complete) and Instance3576.8 (complete)
8/2/2015 8:05:41 AM -- C:\Program Files\Exchange Jetstress\Performance_2015_8_1_20_55_21.blg has 491 samples.
8/2/2015 8:05:41 AM -- Creating test report ...
8/2/2015 8:05:43 AM -- Instance3576.1 has 15.0 for I/O Database Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.1 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.1 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.2 has 15.0 for I/O Database Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.2 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.2 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.3 has 15.1 for I/O Database Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.3 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.3 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.4 has 15.3 for I/O Database Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.4 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.4 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.5 has 16.4 for I/O Database Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.5 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.5 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.6 has 17.2 for I/O Database Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.6 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.6 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.7 has 18.1 for I/O Database Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.7 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.7 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.8 has 19.5 for I/O Database Reads Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.8 has 0.5 for I/O Log Writes Average Latency.
8/2/2015 8:05:43 AM -- Instance3576.8 has 0.5 for I/O Log Reads Average Latency.
8/2/2015 8:05:43 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
8/2/2015 8:05:43 AM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
8/2/2015 8:05:43 AM -- C:\Program Files\Exchange Jetstress\Performance_2015_8_1_20_55_21.xml has 479 samples queried.

```



B Stress testing

Server 1

Database Sizing and Throughput

Achieved Transactional I/O per Second	945.362
Target Transactional I/O per Second	600
Initial Database Size (bytes)	10767642394624
Final Database Size (bytes)	10795022811136
Database Files (Count)	8

Jetstress System Parameters

Thread Count	25
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2



Database Configuration

Instance1592.1 Log path: C:\Users\Administrator\Desktop\Volume1\log5
Database: C:\Users\Administrator\Desktop\Volume1\db1\Jetstress001001.edb

Instance1592.2 Log path: C:\Users\Administrator\Desktop\Volume1\log6
Database: C:\Users\Administrator\Desktop\Volume1\db2\Jetstress002001.edb

Instance1592.3 Log path: C:\Users\Administrator\Desktop\Volume1\log7
Database: C:\Users\Administrator\Desktop\Volume1\db3\Jetstress003001.edb

Instance1592.4 Log path: C:\Users\Administrator\Desktop\Volume1\log8
Database: C:\Users\Administrator\Desktop\Volume1\db4\Jetstress004001.edb

Instance1592.5 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Volume2\db5\Jetstress005001.edb

Instance1592.6 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Volume2\db6\Jetstress006001.edb

Instance1592.7 Log path: C:\Users\Administrator\Desktop\Volume2\log3
Database: C:\Users\Administrator\Desktop\Volume2\db7\Jetstress007001.edb

Instance1592.8 Log path: C:\Users\Administrator\Desktop\Volume2\log4
Database: C:\Users\Administrator\Desktop\Volume2\db8\Jetstress008001.edb

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
Instance1592.1	18.823	2.098	81.438	36.860	33402.393	34486.593	0.000	0.578	0.000	8.635	0.000	20270.126
Instance1592.2	17.731	2.118	81.406	36.833	33402.150	34491.372	0.000	0.576	0.000	8.650	0.000	20275.151
Instance1592.3	17.055	2.117	81.448	36.778	33409.433	34486.965	0.000	0.580	0.000	8.625	0.000	20265.868
Instance1592.4	16.489	2.107	81.478	36.785	33402.292	34488.480	0.000	0.577	0.000	8.622	0.000	20247.797
Instance1592.5	16.071	2.067	81.381	36.753	33397.867	34494.058	0.000	0.587	0.000	8.629	0.000	20294.968
Instance1592.6	15.780	2.079	81.412	36.733	33415.887	34489.415	0.000	0.580	0.000	8.611	0.000	20303.294
Instance1592.7	15.586	2.088	81.290	36.601	33413.469	34498.292	0.000	0.584	0.000	8.601	0.000	20335.971
Instance1592.8	15.395	2.062	81.357	36.809	33410.040	34491.482	0.000	0.581	0.000	8.638	0.000	20341.255

Background Database Maintenance I/O Performance

MSEXchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance1592.1	9.701	261807.488
Instance1592.2	9.700	261827.415
Instance1592.3	9.701	261810.992
Instance1592.4	9.700	261845.277
Instance1592.5	9.703	261821.930
Instance1592.6	9.702	261835.029
Instance1592.7	9.703	261822.651
Instance1592.8	9.702	261830.632

Log Replication I/O Performance

MSEXchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance1592.1	0.748	227424.544
Instance1592.2	0.749	226726.247
Instance1592.3	0.747	226462.540
Instance1592.4	0.745	226982.432
Instance1592.5	0.748	226864.677
Instance1592.6	0.746	226667.212
Instance1592.7	0.747	226494.063
Instance1592.8	0.750	227386.960



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
Instance1592.1	18.823	2.098	91.139	36.860	57715.079	34486.593	2.878	0.578	0.748	8.635	227424.544	20270.126
Instance1592.2	17.731	2.118	91.107	36.833	57723.464	34491.372	2.860	0.576	0.749	8.650	226726.247	20275.151
Instance1592.3	17.055	2.117	91.149	36.778	57718.680	34486.965	2.850	0.580	0.747	8.625	226462.540	20265.868
Instance1592.4	16.489	2.107	91.179	36.785	57705.718	34488.480	2.816	0.577	0.745	8.622	226982.432	20247.797
Instance1592.5	16.071	2.067	91.083	36.753	57730.817	34494.058	1.083	0.587	0.748	8.629	226864.677	20294.968
Instance1592.6	15.780	2.079	91.114	36.733	57738.949	34489.415	1.074	0.580	0.746	8.611	226667.212	20303.294
Instance1592.7	15.586	2.088	90.993	36.601	57769.172	34498.292	1.114	0.584	0.747	8.601	226494.063	20335.971
Instance1592.8	15.395	2.062	91.060	36.809	57748.084	34491.482	1.093	0.581	0.750	8.638	227386.960	20341.255

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.337	0.089	2.134
Available MBytes	28127.768	28049.000	28242.000
Free System Page Table Entries	16603534.923	16602698.000	16603895.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	227507364.794	226471936.000	228728832.000
Pool Paged Bytes	102187374.604	101982208.000	107655168.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

8/3/2015 1:25:37 PM -- Preparing for testing ...
8/3/2015 1:25:45 PM -- Attaching databases ...
8/3/2015 1:25:45 PM -- Preparations for testing are complete.
8/3/2015 1:25:45 PM -- Starting transaction dispatch ..
8/3/2015 1:25:45 PM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
8/3/2015 1:25:45 PM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
8/3/2015 1:25:54 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
8/3/2015 1:25:54 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
8/3/2015 1:25:54 PM -- Operation mix: Sessions 25, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
8/3/2015 1:25:54 PM -- Performance logging started (Interval: 15000 ms).
8/3/2015 1:25:54 PM -- Attaining prerequisites:
8/3/2015 1:29:42 PM -- \\MSExchange Database(JetstressWin)\Database Cache Size, Last: 1941168000.0 (lower bound: 1932735000.0, upper bound: none)
8/4/2015 1:29:42 PM -- Performance logging has ended.
8/4/2015 1:29:42 PM -- JetInterop batch transaction stats: 243695, 243695, 243695, 243695, 243694, 243694, 243694 and 243694.
8/4/2015 1:29:42 PM -- Dispatching transactions ends.
8/4/2015 1:29:42 PM -- Shutting down databases ...
8/4/2015 1:29:48 PM -- Instance1592.1 (complete), Instance1592.2 (complete), Instance1592.3 (complete), Instance1592.4 (complete), Instance1592.5 (complete), Instance1592.6 (complete), Instance1592.7 (complete) and Instance1592.8 (complete)
8/4/2015 1:29:48 PM -- C:\Program Files\Exchange\Jetstress\Stress_2015_8_3_13_25_54.blg has 5769 samples.
8/4/2015 1:29:48 PM -- Creating test report ....
8/4/2015 1:30:10 PM -- Instance1592.1 has 18.8 for I/O Database Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.1 has 0.6 for I/O Log Writes Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.1 has 0.6 for I/O Log Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.2 has 17.7 for I/O Database Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.2 has 0.6 for I/O Log Writes Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.2 has 0.6 for I/O Log Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.3 has 17.1 for I/O Database Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.3 has 0.6 for I/O Log Writes Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.3 has 0.6 for I/O Log Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.4 has 16.5 for I/O Database Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.4 has 0.6 for I/O Log Writes Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.4 has 0.6 for I/O Log Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.5 has 16.1 for I/O Database Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.5 has 0.6 for I/O Log Writes Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.5 has 0.6 for I/O Log Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.6 has 15.8 for I/O Database Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.6 has 0.6 for I/O Log Writes Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.6 has 0.6 for I/O Log Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.7 has 15.6 for I/O Database Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.7 has 0.6 for I/O Log Writes Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.7 has 0.6 for I/O Log Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.8 has 15.4 for I/O Database Reads Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.8 has 0.6 for I/O Log Writes Average Latency.
8/4/2015 1:30:10 PM -- Instance1592.8 has 0.6 for I/O Log Reads Average Latency.
8/4/2015 1:30:10 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
8/4/2015 1:30:10 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
8/4/2015 1:30:10 PM -- C:\Program Files\Exchange\Jetstress\Stress_2015_8_3_13_25_54.xml has 5753 samples queried.

```



Server 2

Database Sizing and Throughput

Achieved Transactional I/O per Second	920.889
Target Transactional I/O per Second	600
Initial Database Size (bytes)	10766451212288
Final Database Size (bytes)	10793034711040
Database Files (Count)	8

Jetstress System Parameters

Thread Count	25
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%
Run Background Database Maintenance	True
Number of Copies per Database	2



Database Configuration

Instance3880.1 Log path: C:\Users\Administrator\Desktop\Volume4\log9
Database: C:\Users\Administrator\Desktop\Volume3\db9\Jetstress001001.edb

Instance3880.2 Log path: C:\Users\Administrator\Desktop\Volume4\log10
Database: C:\Users\Administrator\Desktop\Volume3\db10\Jetstress002001.edb

Instance3880.3 Log path: C:\Users\Administrator\Desktop\Volume4\log11
Database: C:\Users\Administrator\Desktop\Volume3\db11\Jetstress003001.edb

Instance3880.4 Log path: C:\Users\Administrator\Desktop\Volume4\log12
Database: C:\Users\Administrator\Desktop\Volume3\db12\Jetstress004001.edb

Instance3880.5 Log path: C:\Users\Administrator\Desktop\Volume3\log13
Database: C:\Users\Administrator\Desktop\Volume4\db13\Jetstress005001.edb

Instance3880.6 Log path: C:\Users\Administrator\Desktop\Volume3\log14
Database: C:\Users\Administrator\Desktop\Volume4\db14\Jetstress006001.edb

Instance3880.7 Log path: C:\Users\Administrator\Desktop\Volume3\log15
Database: C:\Users\Administrator\Desktop\Volume4\db15\Jetstress007001.edb

Instance3880.8 Log path: C:\Users\Administrator\Desktop\Volume3\log16
Database: C:\Users\Administrator\Desktop\Volume4\db16\Jetstress008001.edb

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
Instance3880.1	15.762	2.022	79.356	35.910	33336.835	34511.535	0.000	0.583	0.000	8.426	0.000	20231.945
Instance3880.2	15.719	2.015	79.274	35.866	33325.392	34512.689	0.000	0.584	0.000	8.418	0.000	20245.820
Instance3880.3	15.818	2.020	79.276	35.862	33325.588	34520.739	0.000	0.583	0.000	8.407	0.000	20295.952
Instance3880.4	16.024	1.996	79.268	35.835	33326.846	34517.858	0.000	0.586	0.000	8.407	0.000	20269.450
Instance3880.5	17.401	2.048	79.236	35.814	33329.476	34517.865	0.000	0.613	0.000	8.401	0.000	20278.109
Instance3880.6	17.921	2.058	79.324	35.901	33330.950	34505.542	0.000	0.611	0.000	8.398	0.000	20288.627
Instance3880.7	18.749	2.059	79.152	35.651	33329.074	34525.889	0.000	0.608	0.000	8.367	0.000	20286.101
Instance3880.8	19.851	2.073	79.302	35.861	33317.951	34517.686	0.000	0.611	0.000	8.407	0.000	20225.877

Background Database Maintenance I/O Performance

MSEXchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3880.1	9.903	261823.852
Instance3880.2	9.905	261792.329
Instance3880.3	9.904	261808.712
Instance3880.4	9.902	261854.957
Instance3880.5	9.906	261828.780
Instance3880.6	9.905	261824.023
Instance3880.7	9.905	261832.378
Instance3880.8	9.905	261803.341

Log Replication I/O Performance

MSEXchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3880.1	0.728	227098.724
Instance3880.2	0.728	226370.087
Instance3880.3	0.728	226418.774
Instance3880.4	0.728	227304.838
Instance3880.5	0.727	226535.596
Instance3880.6	0.727	227140.089
Instance3880.7	0.725	226985.431
Instance3880.8	0.727	226463.113



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
Instance3880.1	15.762	2.022	89.259	35.910	58687.204	34511.535	1.832	0.583	0.728	8.426	227098.724	20231.945
Instance3880.2	15.719	2.015	89.179	35.866	58699.996	34512.689	1.811	0.584	0.728	8.418	226370.087	20245.820
Instance3880.3	15.818	2.020	89.180	35.862	58699.328	34520.739	1.786	0.583	0.728	8.407	226418.774	20295.952
Instance3880.4	16.024	1.996	89.170	35.835	58703.967	34517.858	1.838	0.586	0.728	8.407	227304.838	20269.450
Instance3880.5	17.401	2.048	89.142	35.814	58720.529	34517.865	1.953	0.613	0.727	8.401	226535.596	20278.109
Instance3880.6	17.921	2.058	89.229	35.901	58695.379	34505.542	1.999	0.611	0.727	8.398	227140.089	20288.627
Instance3880.7	18.749	2.059	89.056	35.651	58742.774	34525.889	1.952	0.608	0.725	8.367	226985.431	20286.101
Instance3880.8	19.851	2.073	89.208	35.861	58688.072	34517.686	1.930	0.611	0.727	8.407	226463.113	20225.877

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.431	0.188	3.025
Available MBytes	27985.710	27924.000	28209.000
Free System Page Table Entries	16603060.952	16602195.000	16603509.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	184840723.042	184102912.000	186646528.000
Pool Paged Bytes	99201946.561	98869248.000	104546304.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```

6/8/2015 11:38:25 AM -- Preparing for testing ...
6/8/2015 11:38:25 AM -- Creating C:\Users\Administrator\Desktop\Volume1\Jetstress001001.eb.
6/8/2015 11:38:25 AM -- Database cache settings: (minimum: 32.0 MB, maximum: 256.0 MB)
6/8/2015 11:38:25 AM -- Database flush thresholds: (start: 2.5 MB, stop: 5.1 MB)
6/8/2015 12:43:32 PM -- 100.0% of 500.0 GB complete (170874985 records inserted).
6/8/2015 12:43:33 PM -- 100.0% of 500.0 GB complete (170874988 records inserted).
6/8/2015 12:43:33 PM -- Duplicating 1 databases:
6/8/2015 1:39:14 PM -- 100.0% of 500.0 GB complete (500.0 GB duplicated).
6/8/2015 1:39:16 PM -- Attaching databases ...
6/8/2015 1:39:16 PM -- Preparations for testing are complete.
6/8/2015 1:39:16 PM -- Starting transaction dispatch ..
6/8/2015 1:39:16 PM -- Database cache settings: (minimum: 64.0 MB, maximum: 512.0 MB)
6/8/2015 1:39:16 PM -- Database flush thresholds: (start: 5.1 MB, stop: 10.2 MB)
6/8/2015 1:39:18 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
6/8/2015 1:39:18 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
6/8/2015 1:39:19 PM -- Operation mix: Sessions 20, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
6/8/2015 1:39:19 PM -- Performance logging started (interval: 15000 ms).
6/8/2015 1:39:19 PM -- Attaining prerequisites:
6/8/2015 1:41:04 PM -- \MSEXchange Database(JetstressWin)\Database Cache Size, Last: 487563300.0 (lower bound: 483183800.0, upper bound: none)
6/9/2015 1:41:04 PM -- Performance logging has ended.
6/9/2015 1:41:04 PM -- JetInterop batch transaction stats: 1162698 and 1162698.
6/9/2015 1:41:04 PM -- Dispatching transactions ends.
6/9/2015 1:41:04 PM -- Shutting down databases ...
6/9/2015 1:41:05 PM -- Instance3636.1 (complete) and Instance3636.2 (complete)
6/9/2015 1:41:05 PM -- C:\Program Files\Exchange Jetstress\Stress_2015_6_8_13_39_18.blg has 5763 samples.
6/9/2015 1:41:05 PM -- Creating test report ...
6/9/2015 1:41:10 PM -- Instance3636.1 has 9.4 for I/O Database Reads Average Latency.
6/9/2015 1:41:10 PM -- Instance3636.1 has 0.4 for I/O Log Writes Average Latency.
6/9/2015 1:41:10 PM -- Instance3636.1 has 0.4 for I/O Log Reads Average Latency.
6/9/2015 1:41:10 PM -- Instance3636.2 has 9.3 for I/O Database Reads Average Latency.
6/9/2015 1:41:10 PM -- Instance3636.2 has 0.5 for I/O Log Writes Average Latency.
6/9/2015 1:41:10 PM -- Instance3636.2 has 0.5 for I/O Log Reads Average Latency.
6/9/2015 1:41:10 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
6/9/2015 1:41:10 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
6/9/2015 1:41:10 PM -- C:\Program Files\Exchange Jetstress\Stress_2015_6_8_13_39_18.xml has 5755 samples queried.
    
```



C Backup testing

Server 1

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance1392.1	1283080.03	03:45:21	94.89
Instance1392.2	1283072.03	03:34:56	99.49
Instance1392.3	1283080.03	03:33:00	100.39
Instance1392.4	1283064.03	03:19:35	107.14
Instance1392.5	1283056.03	03:23:04	105.30
Instance1392.6	1283056.03	03:15:43	109.26
Instance1392.7	1283056.03	03:15:43	109.26
Instance1392.8	1283072.03	03:12:44	110.95
Avg			104.59
Sum			836.69

Jetstress System Parameters

Thread Count	25
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance1392.1	Log path: C:\Users\Administrator\Desktop\Volume1\log5 Database: C:\Users\Administrator\Desktop\Volume1\db1\Jetstress001001.edb
Instance1392.2	Log path: C:\Users\Administrator\Desktop\Volume1\log6 Database: C:\Users\Administrator\Desktop\Volume1\db2\Jetstress002001.edb
Instance1392.3	Log path: C:\Users\Administrator\Desktop\Volume1\log7 Database: C:\Users\Administrator\Desktop\Volume1\db3\Jetstress003001.edb
Instance1392.4	Log path: C:\Users\Administrator\Desktop\Volume1\log8 Database: C:\Users\Administrator\Desktop\Volume1\db4\Jetstress004001.edb
Instance1392.5	Log path: C:\Users\Administrator\Desktop\Volume2\log1 Database: C:\Users\Administrator\Desktop\Volume2\db5\Jetstress005001.edb
Instance1392.6	Log path: C:\Users\Administrator\Desktop\Volume2\log2 Database: C:\Users\Administrator\Desktop\Volume2\db6\Jetstress006001.edb
Instance1392.7	Log path: C:\Users\Administrator\Desktop\Volume2\log3 Database: C:\Users\Administrator\Desktop\Volume2\db7\Jetstress007001.edb
Instance1392.8	Log path: C:\Users\Administrator\Desktop\Volume2\log4 Database: C:\Users\Administrator\Desktop\Volume2\db8\Jetstress008001.edb

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
Instance1392.1	3.327	0.000	379.952	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance1392.2	3.152	0.000	398.522	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance1392.3	3.191	0.000	402.235	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance1392.4	3.009	0.000	429.434	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance1392.5	5.024	0.000	421.463	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance1392.6	4.855	0.000	436.960	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance1392.7	4.426	0.000	437.236	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance1392.8	4.736	0.000	443.990	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.997	0.027	1.380
Available MBytes	30460.009	30428.000	30468.000
Free System Page Table Entries	16604043.087	16603437.000	16604239.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	220951711.289	220925952.000	220995584.000
Pool Paged Bytes	100503124.196	100397056.000	100564992.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

8/2/2015 3:19:57 PM -- Preparing for testing ...
8/2/2015 3:20:06 PM -- Attaching databases ...
8/2/2015 3:20:06 PM -- Preparations for testing are complete.
8/2/2015 3:20:14 PM -- Performance logging started (interval: 30000 ms).
8/2/2015 3:20:14 PM -- Backing up databases ...
8/2/2015 7:05:36 PM -- Performance logging has ended.
8/2/2015 7:05:36 PM -- Instance1392.1 (100% processed), Instance1392.2 (100% processed), Instance1392.3 (100% processed), Instance1392.4 (100% processed), Instance1392.5 (100% processed), Instance1392.6 (100% processed), Instance1392.7 (100% processed) and Instance1392.8 (100% processed)
8/2/2015 7:05:36 PM -- C:\Program Files\Exchange\Jetstress\DatabaseBackup_2015_8_2_15_20_6.blg has 450 samples.
8/2/2015 7:05:36 PM -- Creating test report ...



Server 2

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance896.1	1282928.03	03:11:02	111.92
Instance896.2	1282936.03	03:14:48	109.76
Instance896.3	1282920.03	03:17:55	108.03
Instance896.4	1282912.03	03:29:50	101.89
Instance896.5	1282936.03	03:36:38	98.70
Instance896.6	1282936.03	03:39:25	97.45
Instance896.7	1282920.03	03:44:13	95.36
Instance896.8	1282928.03	03:46:58	94.20
Avg			102.16
Sum			817.31

Jetstress System Parameters

Thread Count	25
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance896.1	Log path: C:\Users\Administrator\Desktop\Volume4\log9 Database: C:\Users\Administrator\Desktop\Volume3\db9\Jetstress001001.edb
Instance896.2	Log path: C:\Users\Administrator\Desktop\Volume4\log10 Database: C:\Users\Administrator\Desktop\Volume3\db10\Jetstress002001.edb
Instance896.3	Log path: C:\Users\Administrator\Desktop\Volume4\log11 Database: C:\Users\Administrator\Desktop\Volume3\db11\Jetstress003001.edb
Instance896.4	Log path: C:\Users\Administrator\Desktop\Volume4\log12 Database: C:\Users\Administrator\Desktop\Volume3\db12\Jetstress004001.edb
Instance896.5	Log path: C:\Users\Administrator\Desktop\Volume3\log13 Database: C:\Users\Administrator\Desktop\Volume4\db13\Jetstress005001.edb
Instance896.6	Log path: C:\Users\Administrator\Desktop\Volume3\log14 Database: C:\Users\Administrator\Desktop\Volume4\db14\Jetstress006001.edb
Instance896.7	Log path: C:\Users\Administrator\Desktop\Volume3\log15 Database: C:\Users\Administrator\Desktop\Volume4\db15\Jetstress007001.edb
Instance896.8	Log path: C:\Users\Administrator\Desktop\Volume3\log16 Database: C:\Users\Administrator\Desktop\Volume4\db16\Jetstress008001.edb

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
Instance896.1	3.109	0.000	448.636	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance896.2	2.898	0.000	439.344	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance896.3	2.963	0.000	432.453	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance896.4	3.052	0.000	407.576	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance896.5	3.183	0.000	394.777	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance896.6	3.827	0.000	389.842	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance896.7	3.484	0.000	381.599	0.000	262144.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance896.8	3.831	0.000	373.624	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.979	0.665	1.750
Available MBytes	30507.035	30460.000	30515.000
Free System Page Table Entries	16604063.318	16603618.000	16604303.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	176832647.629	176783360.000	176873472.000
Pool Paged Bytes	95725925.157	95592448.000	95793152.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

8/2/2015 3:20:03 PM -- Preparing for testing ...
8/2/2015 3:20:12 PM -- Attaching databases ...
8/2/2015 3:20:12 PM -- Preparations for testing are complete.
8/2/2015 3:20:20 PM -- Performance logging started (interval: 30000 ms).
8/2/2015 3:20:20 PM -- Backing up databases ...
8/2/2015 7:07:19 PM -- Performance logging has ended.
8/2/2015 7:07:19 PM -- Instance896.1 (100% processed), Instance896.2 (100% processed), Instance896.3 (100% processed), Instance896.4 (100% processed), Instance896.5 (100% processed), Instance896.6 (100% processed), Instance896.7 (100% processed) and Instance896.8 (100% processed)
8/2/2015 7:07:19 PM -- [C:\Program Files\Exchange\Jetstress\DatabaseBackup_2015_8_2_15_20_12.blq](#) has 453 samples.
8/2/2015 7:07:19 PM -- Creating test report ...



D Recovery testing

Server 1

Database Sizing and Throughput

Achieved Transactional I/O per Second	935.406
Target Transactional I/O per Second	600
Initial Database Size (bytes)	10763213209600
Final Database Size (bytes)	10765100646400
Database Files (Count)	8

Jetstress System Parameters

Thread Count	20
Minimum Database Cache	256.0 MB
Maximum Database Cache	2048.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance2952.1	Log path: C:\Users\Administrator\Desktop\Volume1\log5 Database: C:\Users\Administrator\Desktop\Volume1\db1\Jetstress001001.edb
Instance2952.2	Log path: C:\Users\Administrator\Desktop\Volume1\log6 Database: C:\Users\Administrator\Desktop\Volume1\db2\Jetstress002001.edb
Instance2952.3	Log path: C:\Users\Administrator\Desktop\Volume1\log7 Database: C:\Users\Administrator\Desktop\Volume1\db3\Jetstress003001.edb
Instance2952.4	Log path: C:\Users\Administrator\Desktop\Volume1\log8 Database: C:\Users\Administrator\Desktop\Volume1\db4\Jetstress004001.edb
Instance2952.5	Log path: C:\Users\Administrator\Desktop\Volume2\log1 Database: C:\Users\Administrator\Desktop\Volume2\db5\Jetstress005001.edb
Instance2952.6	Log path: C:\Users\Administrator\Desktop\Volume2\log2 Database: C:\Users\Administrator\Desktop\Volume2\db6\Jetstress006001.edb
Instance2952.7	Log path: C:\Users\Administrator\Desktop\Volume2\log3 Database: C:\Users\Administrator\Desktop\Volume2\db7\Jetstress007001.edb
Instance2952.8	Log path: C:\Users\Administrator\Desktop\Volume2\log4 Database: C:\Users\Administrator\Desktop\Volume2\db8\Jetstress008001.edb

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
Instance2952.1	16.822	3.013	80.790	35.505	32768.000	34752.583	0.000	0.521	0.000	8.546	0.000	20341.993
Instance2952.2	16.013	2.937	80.788	35.740	32768.000	34744.124	0.000	0.523	0.000	8.610	0.000	20173.720
Instance2952.3	15.422	2.810	80.822	35.685	32768.000	34731.051	0.000	0.521	0.000	8.535	0.000	20285.696
Instance2952.4	14.928	2.882	80.850	35.950	32768.000	34730.986	0.000	0.527	0.000	8.641	0.000	20264.883
Instance2952.5	14.421	2.807	81.162	36.212	32768.000	34704.804	0.000	0.528	0.000	8.648	0.000	20107.294
Instance2952.6	14.234	2.921	80.901	36.143	32768.000	34736.467	0.000	0.526	0.000	8.635	0.000	20351.112
Instance2952.7	14.097	2.934	80.880	35.799	32768.000	34740.232	0.000	0.523	0.000	8.583	0.000	20325.708
Instance2952.8	13.975	2.842	81.440	36.742	32768.000	34694.681	0.000	0.528	0.000	8.717	0.000	20151.416

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.345	0.125	0.564
Available MBytes	28280.605	28236.000	30057.000
Free System Page Table Entries	16603784.988	16603473.000	16604044.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	222247953.787	221184000.000	222535680.000
Pool Paged Bytes	101162194.898	100634624.000	101294080.000
Database Page Fault Stalls/sec	0.000	0.000	0.000



Test Log

8/3/2015 12:42:12 AM -- Preparing for testing ...
8/3/2015 12:42:20 AM -- Attaching databases ...
8/3/2015 12:42:20 AM -- Preparations for testing are complete.
8/3/2015 12:42:20 AM -- Starting transaction dispatch ...
8/3/2015 12:42:20 AM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
8/3/2015 12:42:20 AM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
8/3/2015 12:42:28 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
8/3/2015 12:42:28 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
8/3/2015 12:42:29 AM -- Operation mix: Sessions 20, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
8/3/2015 12:42:29 AM -- Performance logging started (interval: 15000 ms).
8/3/2015 12:42:29 AM -- Generating log files ...
8/3/2015 2:23:27 AM -- C:\Users\Administrator\Desktop\Volume1\log5 (100.4% generated), C:\Users\Administrator\Desktop\Volume1\log6 (100.2% generated), C:\Users\Administrator\Desktop\Volume1\log7 (100.2% generated), C:\Users\Administrator\Desktop\Volume1\log8 (101.2% generated), C:\Users\Administrator\Desktop\Volume2\log1 (100.4% generated), C:\Users\Administrator\Desktop\Volume2\log2 (101.2% generated), C:\Users\Administrator\Desktop\Volume2\log3 (100.6% generated) and C:\Users\Administrator\Desktop\Volume2\log4 (101.4% generated)
8/3/2015 2:23:28 AM -- Performance logging has ended.
8/3/2015 2:23:28 AM -- JetInterop batch transaction stats: 17045, 17044, 17044, 17044, 17044, 17044, 17044 and 17044.
8/3/2015 2:23:28 AM -- Dispatching transactions ends.
8/3/2015 2:23:28 AM -- Shutting down databases ...
8/3/2015 2:23:33 AM -- Instance2952.1 (complete), Instance2952.2 (complete), Instance2952.3 (complete), Instance2952.4 (complete), Instance2952.5 (complete), Instance2952.6 (complete), Instance2952.7 (complete) and Instance2952.8 (complete)
8/3/2015 2:23:33 AM -- C:\Program Files\Exchange\Jetstress\Performance_2015_8_3_0_42_28.blg has 403 samples.
8/3/2015 2:23:33 AM -- Creating test report ...
8/3/2015 2:23:34 AM -- Instance2952.1 has 16.8 for I/O Database Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.1 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.1 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.2 has 16.0 for I/O Database Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.2 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.2 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.3 has 15.4 for I/O Database Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.3 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.3 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.4 has 14.9 for I/O Database Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.4 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.4 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.5 has 14.4 for I/O Database Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.5 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.5 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.6 has 14.2 for I/O Database Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.6 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.6 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.7 has 14.1 for I/O Database Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.7 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.7 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.8 has 14.0 for I/O Database Reads Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.8 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:23:34 AM -- Instance2952.8 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:23:34 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
8/3/2015 2:23:34 AM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
8/3/2015 2:23:34 AM -- C:\Program Files\Exchange\Jetstress\Performance_2015_8_3_0_42_28.xml has 402 samples queried.



Server 2

Database Sizing and Throughput

Achieved Transactional I/O per Second 913.969
Target Transactional I/O per Second 600
Initial Database Size (bytes) 10762038804480
Final Database Size (bytes) 10763968184320
Database Files (Count) 8

Jetstress System Parameters

Thread Count 20
Minimum Database Cache 256.0 MB
Maximum Database Cache 2048.0 MB
Insert Operations 40%
Delete Operations 20%
Replace Operations 5%
Read Operations 35%
Lazy Commits 70%

Database Configuration

Instance2092.1 Log path: C:\Users\Administrator\Desktop\Volume4\log9
 Database: C:\Users\Administrator\Desktop\Volume3\db9\Jetstress001001.edb
Instance2092.2 Log path: C:\Users\Administrator\Desktop\Volume4\log10
 Database: C:\Users\Administrator\Desktop\Volume3\db10\Jetstress002001.edb
Instance2092.3 Log path: C:\Users\Administrator\Desktop\Volume4\log11
 Database: C:\Users\Administrator\Desktop\Volume3\db11\Jetstress003001.edb
Instance2092.4 Log path: C:\Users\Administrator\Desktop\Volume4\log12
 Database: C:\Users\Administrator\Desktop\Volume3\db12\Jetstress004001.edb
Instance2092.5 Log path: C:\Users\Administrator\Desktop\Volume3\log13
 Database: C:\Users\Administrator\Desktop\Volume4\db13\Jetstress005001.edb
Instance2092.6 Log path: C:\Users\Administrator\Desktop\Volume3\log14
 Database: C:\Users\Administrator\Desktop\Volume4\db14\Jetstress006001.edb
Instance2092.7 Log path: C:\Users\Administrator\Desktop\Volume3\log15
 Database: C:\Users\Administrator\Desktop\Volume4\db15\Jetstress007001.edb
Instance2092.8 Log path: C:\Users\Administrator\Desktop\Volume3\log16
 Database: C:\Users\Administrator\Desktop\Volume4\db16\Jetstress008001.edb

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
Instance2092.1	14.276	2.794	79.206	35.323	32768.000	34726.517	0.000	0.532	0.000	8.493	0.000	20030.120
Instance2092.2	14.259	2.848	78.967	35.288	32768.000	34746.400	0.000	0.543	0.000	8.424	0.000	20356.996
Instance2092.3	14.399	2.863	78.945	35.114	32768.000	34767.754	0.000	0.531	0.000	8.384	0.000	20348.532
Instance2092.4	14.515	2.779	78.878	35.054	32768.000	34783.451	0.000	0.563	0.000	8.387	0.000	20460.353
Instance2092.5	15.474	2.812	78.963	34.930	32768.000	34748.335	0.000	0.527	0.000	8.313	0.000	20277.368
Instance2092.6	16.049	2.904	79.026	35.264	32768.000	34757.981	0.000	0.535	0.000	8.418	0.000	20326.928
Instance2092.7	16.776	2.878	79.133	35.148	32768.000	34748.279	0.000	0.524	0.000	8.389	0.000	20151.127
Instance2092.8	17.709	2.782	79.195	35.534	32768.000	34748.182	0.000	0.531	0.000	8.480	0.000	20270.426

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.319	0.130	0.622
Available MBytes	28328.554	28282.000	30142.000
Free System Page Table Entries	16603839.694	16603511.000	16604086.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	178775526.092	177479680.000	178929664.000
Pool Paged Bytes	97603376.733	97140736.000	97701888.000
Database Page Fault Stalls/sec	0.000	0.000	0.000



Test Log

```

8/3/2015 12:42:26 AM -- Preparing for testing ...
8/3/2015 12:42:34 AM -- Attaching databases ...
8/3/2015 12:42:34 AM -- Preparations for testing are complete.
8/3/2015 12:42:34 AM -- Starting transaction dispatch ..
8/3/2015 12:42:34 AM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
8/3/2015 12:42:34 AM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
8/3/2015 12:42:42 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
8/3/2015 12:42:42 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
8/3/2015 12:42:43 AM -- Operation mix: Sessions 20, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
8/3/2015 12:42:43 AM -- Performance logging started (interval: 15000 ms).
8/3/2015 12:42:43 AM -- Generating log files ...
8/3/2015 2:26:33 AM -- C:\Users\Administrator\Desktop\Volume4\log9 (101.2% generated), C:\Users\Administrator\Desktop\Volume4\log10 (101.8% generated),
C:\Users\Administrator\Desktop\Volume4\log11 (101.4% generated), C:\Users\Administrator\Desktop\Volume4\log12 (101.6% generated),
C:\Users\Administrator\Desktop\Volume3\log13 (100.2% generated), C:\Users\Administrator\Desktop\Volume3\log14 (101.4% generated),
C:\Users\Administrator\Desktop\Volume3\log15 (100.4% generated) and C:\Users\Administrator\Desktop\Volume3\log16 (102.0% generated)
8/3/2015 2:26:33 AM -- Performance logging has ended.
8/3/2015 2:26:33 AM -- JetInterop batch transaction stats: 17074, 17074, 17074, 17073, 17073, 17073, 17073 and 17073.
8/3/2015 2:26:33 AM -- Dispatching transactions ends.
8/3/2015 2:26:33 AM -- Shutting down databases ...
8/3/2015 2:26:38 AM -- Instance2092.1 (complete), Instance2092.2 (complete), Instance2092.3 (complete), Instance2092.4 (complete), Instance2092.5 (complete),
Instance2092.6 (complete), Instance2092.7 (complete) and Instance2092.8 (complete)
8/3/2015 2:26:38 AM -- C:\Program Files\Exchange\Jetstress\Performance_2015_8_3_0_42_42.blg has 415 samples.
8/3/2015 2:26:38 AM -- Creating test report ...
8/3/2015 2:26:39 AM -- Instance2092.1 has 14.3 for I/O Database Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.1 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.1 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.2 has 14.3 for I/O Database Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.2 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.2 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.3 has 14.4 for I/O Database Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.3 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.3 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.4 has 14.5 for I/O Database Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.4 has 0.6 for I/O Log Writes Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.4 has 0.6 for I/O Log Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.5 has 15.5 for I/O Database Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.5 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.5 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.6 has 16.0 for I/O Database Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.6 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.6 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.7 has 16.8 for I/O Database Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.7 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.7 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.8 has 17.7 for I/O Database Reads Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.8 has 0.5 for I/O Log Writes Average Latency.
8/3/2015 2:26:39 AM -- Instance2092.8 has 0.5 for I/O Log Reads Average Latency.
8/3/2015 2:26:39 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
8/3/2015 2:26:39 AM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
8/3/2015 2:26:39 AM -- C:\Program Files\Exchange\Jetstress\Performance_2015_8_3_0_42_42.xml has 414 samples queried.

```

