Dell PowerVault MD3820f 3,000 user Mailbox Exchange 2013 Resiliency Storage Solution — Direct Attach FC using dual QLogic QLE2662 16Gb FC adapters

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 this document. 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 3,000 user mailbox Microsoft Exchange 2013 site, with one 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 MD3820f 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 databases 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 MD3820f 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 MD3820f array. The tested environment simulates up to 3,000 users with 2GB Mailbox size and 200 messages a day, or 0.12 IOPS for every user, including 20% headroom.

1.3 Solution description

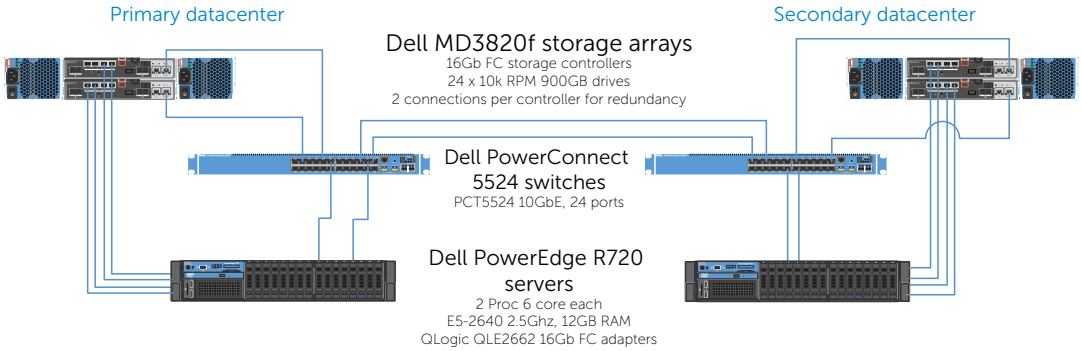
Testing was performed on a Dell R720 server, dual QLogic QLE2662 16Gb FC HBAs, and a Dell MD3820f storage array with redundant controller pair; front-end connections and back-end connections. Exchange is a critical application in most businesses today and the design of the system supporting Exchange 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 MD3820f is a 2U drive enclosure with 24 2.5" drive slots offering four 16Gb Fibre Channel and two 12Gb SAS host connections per controller. Fifteen 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 professionals 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?idItem=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.

Direct-attach Fibre Channel storage diagram

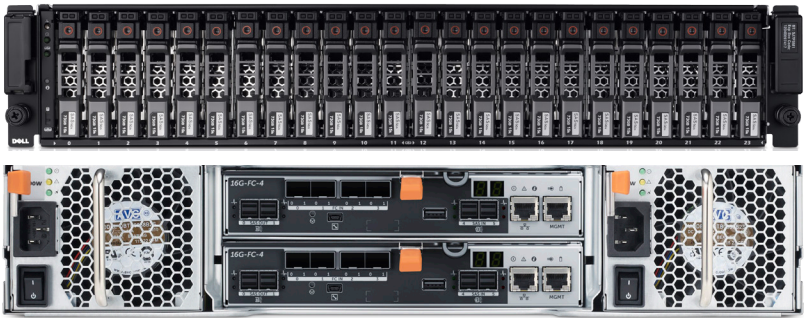


2 The Dell MD3820f solution for Microsoft ESRP

2.1 A modular hardware design

The PowerVault MD3820f enclosure is designed to scale the needs of applications requiring large amounts of data storage. The MD3820f is a 24-drive, 2U standard rack enclosure and can scale up to 192 drives using MD1220 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 MD3820f front and back view



The MD3820f 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 MD3820f. The features of Dell PowerVault MD3820f are detailed in Table 1.

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

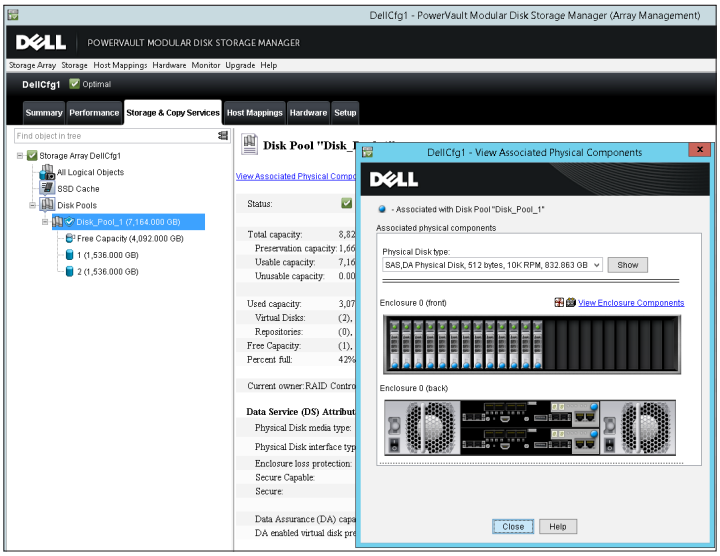


Figure 3 MDSM summary view

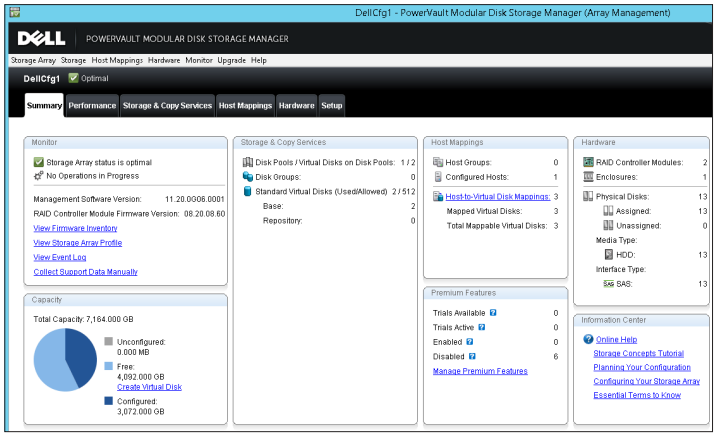


Table 1 Dell PowerVault MD3820f Features

Feature	Details
2U, 24 drive FC enclosure	Designed to fit standard 1,000mm 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 192 2.5-in SAS drives	• 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 eight 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	• 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	• 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	• 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 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 5 shows the Mailbox Calculator output for 3,000 users with 200 messages/day profile. The recommended IOPS per server is 360. 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

2.5 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 in a fully redundant configuration 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. Dynamic Disk Pooling was chosen for data protection of the database volumes and log volumes

2.6 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	3,000
Number of DAG	1
Number of servers/DAG	2
Number of active mailboxes/server	3,000
Number of databases/host	16
Number of copies/database	2
Number of mailboxes/database	187-188
Simulated profile: I/O per second per mailbox (IOPS, include 20% headroom)	0.12
Database/Log LUN size	1.732TB
Total database size for performance testing	6.93TB
% storage capacity used by Exchange database*	88.10%

* 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 MD3820f: 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	N/A
HBA model and firmware	QLogic QLE2662 16Gb FC HBA: 02.00.84
Number of HBA's/host	2
Host server type	Dell PowerEdge R720 Dual E5-2640 6-core CPU, 32GB RAM
Total number of disks tested in solution	15
Maximum number of spindles that can be hosted in the storage	24 drive bay + dual controllers in a 2U 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	15
Total raw storage capacity (TB)	7.68TB
Data protection	DDP
Total formatted capacity	837.863 GB
Storage capacity utilization	90.22%
Database capacity utilization	87.41%

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' 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

Planning for high availability and site resilience, see 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

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 de-fragmentation 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 one 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 destage 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 unreadable 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.

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	459.710
Disks Writes/sec sum	260.734
Disk Read Latency (ms) average	12.875
Disk Write Latency (ms) average	1.831
Transaction Log I/O	
Log Disks Writes/sec sum	63.587
Log Disk Write Latency (ms) average	0.468

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	58.84
MB read/sec total per server	941.41

5.3.2 Transaction log recovery/Replay performance

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

Performance item	Detail
Average time to play one Log file (sec)	0.425

6 Conclusion

This ESRP document presents a tested and validated Exchange solution for 3,000 mailboxes with 2GB mailbox size supporting up to 200 messages/day in a single DAG. The solution uses one Dell PowerEdge R720 servers attached to a PowerVault MD3820f 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 3,000 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

Test Summary

Overall Test Result	**Pass**
Machine Name	Server 1
Test Description	Machine Name: Dell Poweredge R720 (non-virtual) 3000 users Microsoft Exchange 2013 1 Dell Poweredge R720 server with Microsoft Server 2012 r2 installed 2GB Mailboxes, 3000 users per server, 0.12 IOPs 16 DB and LOG on 4 LUNs (combined) Dell MD3820f using Dynamic Disk Pool (15 drives) technology for data protection QLogic 16Gb FC HBA Queue Depth = 254 FC Direct Attach
Test Start Time	7/20/2015 2:52:37 PM
Test End Time	7/20/2015 5:02:01 PM
Collection Start Time	7/20/2015 3:01:08 PM
Collection End Time	7/20/2015 5:00:56 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_7_20_14_53_11.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	720.444
Target Transactional I/O per Second	360
Initial Database Size (bytes)	6472490549248
Final Database Size (bytes)	6474721918976
Database Files (Count)	16

Jetstress System Parameters

Thread Count	16
Minimum Database Cache	512.0 MB
Maximum Database Cache	4096.0 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
Instance3580.1  Log path: C:\Users\Administrator\Desktop\Volume2\log1
                Database: C:\Users\Administrator\Desktop\Vollume1\db1\Jetstress001001.edb

Instance3580.2  Log path: C:\Users\Administrator\Desktop\Volume2\log2
                Database: C:\Users\Administrator\Desktop\Vollume1\db2\Jetstress002001.edb

Instance3580.3  Log path: C:\Users\Administrator\Desktop\Volume2\log3
                Database: C:\Users\Administrator\Desktop\Vollume1\db3\Jetstress003001.edb

Instance3580.4  Log path: C:\Users\Administrator\Desktop\Volume2\log4
                Database: C:\Users\Administrator\Desktop\Vollume1\db4\Jetstress004001.edb

Instance3580.5  Log path: C:\Users\Administrator\Desktop\Vollume1\log5
                Database: C:\Users\Administrator\Desktop\Volume2\db5\Jetstress005001.edb

Instance3580.6  Log path: C:\Users\Administrator\Desktop\Vollume1\log6
                Database: C:\Users\Administrator\Desktop\Volume2\db6\Jetstress006001.edb

Instance3580.7  Log path: C:\Users\Administrator\Desktop\Vollume1\log7
                Database: C:\Users\Administrator\Desktop\Volume2\db7\Jetstress007001.edb

Instance3580.8  Log path: C:\Users\Administrator\Desktop\Vollume1\log8
                Database: C:\Users\Administrator\Desktop\Volume2\db8\Jetstress008001.edb

Instance3580.9  Log path: C:\Users\Administrator\Desktop\Volume4\log9
                Database: C:\Users\Administrator\Desktop\Volume3\db9\Jetstress009001.edb

Instance3580.10 Log path: C:\Users\Administrator\Desktop\Volume4\log10
                Database: C:\Users\Administrator\Desktop\Volume3\db10\Jetstress010001.edb

Instance3580.11 Log path: C:\Users\Administrator\Desktop\Volume4\log11
                Database: C:\Users\Administrator\Desktop\Volume3\db11\Jetstress011001.edb

Instance3580.12 Log path: C:\Users\Administrator\Desktop\Volume4\log12
                Database: C:\Users\Administrator\Desktop\Volume3\db12\Jetstress012001.edb

Instance3580.13 Log path: C:\Users\Administrator\Desktop\Volume3\log13
                Database: C:\Users\Administrator\Desktop\Volume4\db13\Jetstress013001.edb

Instance3580.14 Log path: C:\Users\Administrator\Desktop\Volume3\log14
                Database: C:\Users\Administrator\Desktop\Volume4\db14\Jetstress014001.edb

Instance3580.15 Log path: C:\Users\Administrator\Desktop\Volume3\log15
                Database: C:\Users\Administrator\Desktop\Volume4\db15\Jetstress015001.edb

Instance3580.16 Log path: C:\Users\Administrator\Desktop\Volume3\log16
                Database: C:\Users\Administrator\Desktop\Volume4\db16\Jetstress016001.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
Instance3580.1	13.921	1.874	28.696	16.224	33396.451	35671.050	0.000	0.462	0.000	3.977	0.000	20714.693
Instance3580.2	13.185	1.892	28.735	16.366	33401.923	35533.973	0.000	0.466	0.000	4.003	0.000	20436.656
Instance3580.3	12.699	1.905	28.773	16.316	33364.163	35681.593	0.000	0.462	0.000	3.968	0.000	20698.045
Instance3580.4	12.455	1.898	28.725	16.285	33496.878	35565.442	0.000	0.464	0.000	3.964	0.000	20587.401
Instance3580.5	12.225	1.938	28.912	16.541	33371.408	35605.669	0.000	0.467	0.000	4.081	0.000	20157.811
Instance3580.6	11.959	1.929	28.761	16.365	33417.818	35608.364	0.000	0.470	0.000	3.980	0.000	20547.330
Instance3580.7	11.928	1.934	28.831	16.351	33461.279	35611.933	0.000	0.464	0.000	3.981	0.000	20557.426
Instance3580.8	11.934	1.932	28.524	16.137	33431.791	35634.443	0.000	0.463	0.000	3.918	0.000	20937.110
Instance3580.9	12.113	1.688	28.528	16.154	33444.625	35625.938	0.000	0.471	0.000	3.945	0.000	20974.575
Instance3580.10	12.151	1.694	28.777	16.376	33428.037	35611.381	0.000	0.470	0.000	3.951	0.000	20820.929
Instance3580.11	12.281	1.714	28.684	16.325	33444.201	35631.125	0.000	0.473	0.000	3.993	0.000	20694.084
Instance3580.12	12.600	1.711	28.943	16.467	33437.443	35551.733	0.000	0.476	0.000	4.009	0.000	20360.326
Instance3580.13	13.358	1.811	28.676	16.136	33451.820	35647.611	0.000	0.473	0.000	3.946	0.000	20593.144
Instance3580.14	13.688	1.769	28.453	15.860	33466.457	35671.150	0.000	0.470	0.000	3.912	0.000	20851.480
Instance3580.15	14.304	1.811	28.782	16.372	33463.373	35589.686	0.000	0.468	0.000	3.961	0.000	20740.754
Instance3580.16	15.196	1.790	28.911	16.459	33380.413	35587.412	0.000	0.466	0.000	3.998	0.000	20637.477

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance3580.1	9.750	261140.009
Instance3580.2	9.754	261045.055
Instance3580.3	9.751	261100.922
Instance3580.4	9.754	261021.586
Instance3580.5	9.750	261175.849
Instance3580.6	9.752	261119.226
Instance3580.7	9.754	261056.002
Instance3580.8	9.752	261079.500
Instance3580.9	9.752	261143.102
Instance3580.10	9.752	261102.795
Instance3580.11	9.753	261066.004
Instance3580.12	9.748	261229.303
Instance3580.13	9.755	261018.924
Instance3580.14	9.751	261144.712
Instance3580.15	9.747	261273.163
Instance3580.16	9.754	261040.495

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance3580.1	0.348	135255.595
Instance3580.2	0.346	134282.533
Instance3580.3	0.348	135255.595
Instance3580.4	0.346	134282.533
Instance3580.5	0.347	134769.064
Instance3580.6	0.346	134282.533
Instance3580.7	0.347	134769.064
Instance3580.8	0.348	135255.595
Instance3580.9	0.351	136228.656
Instance3580.10	0.348	135255.595
Instance3580.11	0.351	136228.656
Instance3580.12	0.346	134282.533
Instance3580.13	0.345	133796.002
Instance3580.14	0.345	133796.002
Instance3580.15	0.348	135255.595
Instance3580.16	0.350	135742.126

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
Instance3580.1	13.921	1.874	38.447	16.224	91154.278	35671.050	0.599	0.462	0.348	3.977	135255.595	20714.693
Instance3580.2	13.185	1.892	38.489	16.366	91090.496	35533.973	0.581	0.466	0.346	4.003	134282.533	20436.656
Instance3580.3	12.699	1.905	38.524	16.316	91010.393	35681.593	0.546	0.462	0.348	3.968	135255.595	20698.045
Instance3580.4	12.455	1.898	38.478	16.285	91170.788	35565.442	0.572	0.464	0.346	3.964	134282.533	20587.401
Instance3580.5	12.225	1.938	38.661	16.541	90819.415	35605.669	0.652	0.467	0.347	4.081	134769.064	20157.811
Instance3580.6	11.959	1.929	38.512	16.365	91074.036	35608.364	0.605	0.470	0.346	3.980	134282.533	20547.330
Instance3580.7	11.928	1.934	38.585	16.351	90994.953	35611.933	0.568	0.464	0.347	3.981	134769.064	20557.426
Instance3580.8	11.934	1.932	38.276	16.137	91434.538	35634.443	0.607	0.463	0.348	3.918	135255.595	20937.110
Instance3580.9	12.113	1.688	38.280	16.154	91450.812	35625.938	0.453	0.471	0.351	3.945	136228.656	20974.575
Instance3580.10	12.151	1.694	38.529	16.376	91054.699	35611.381	0.455	0.470	0.348	3.951	135255.595	20820.929
Instance3580.11	12.281	1.714	38.437	16.325	91201.148	35631.125	0.476	0.473	0.351	3.993	136228.656	20694.084
Instance3580.12	12.600	1.711	38.691	16.467	90830.767	35551.733	0.529	0.476	0.346	4.009	134282.533	20360.326
Instance3580.13	13.358	1.811	38.431	16.136	91216.565	35647.611	0.778	0.473	0.345	3.946	133796.002	20593.144
Instance3580.14	13.688	1.769	38.205	15.860	91579.228	35671.150	0.830	0.470	0.345	3.912	133796.002	20851.480
Instance3580.15	14.304	1.811	38.529	16.372	91091.861	35589.686	0.792	0.468	0.348	3.961	135255.595	20740.754
Instance3580.16	15.196	1.790	38.666	16.459	90813.484	35587.412	0.705	0.466	0.350	3.998	135742.126	20637.477

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.280	0.131	0.741
Available MBytes	26323.061	26284.000	26612.000
Free System Page Table Entries	16608335.685	16607962.000	16608594.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	149222453.445	148037632.000	149487616.000
Pool Paged Bytes	91638012.259	91574272.000	91811840.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```
7/20/2015 2:52:37 PM -- Preparing for testing ...
7/20/2015 2:52:54 PM -- Attaching databases ...
7/20/2015 2:52:54 PM -- Preparations for testing are complete.
7/20/2015 2:52:54 PM -- Starting transaction dispatch ..
7/20/2015 2:52:54 PM -- Database cache settings: (minimum: 512.0 MB, maximum: 4.0 GB)
7/20/2015 2:52:54 PM -- Database flush thresholds: (start: 40.9 MB, stop: 81.9 MB)
7/20/2015 2:53:11 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
7/20/2015 2:53:11 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
7/20/2015 2:53:12 PM -- Operation mix: Sessions 16, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
7/20/2015 2:53:12 PM -- Performance logging started (interval: 15000 ms).
7/20/2015 2:53:12 PM -- Attaining prerequisites:
7/20/2015 3:01:08 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 3879473000.0 (lower bound: 3865470000.0, upper bound: none)
7/20/2015 5:01:09 PM -- Performance logging has ended.
7/20/2015 5:01:09 PM -- JetInterop batch transaction stats: 10000, 10000, 10000, 10000, 10000, 10000, 10000, 10000, 10000, 10000, 10000, 10000, 10000, 10000, 9999
and 9999.
7/20/2015 5:01:09 PM -- Dispatching transactions ends.
7/20/2015 5:01:09 PM -- Shutting down databases ...
7/20/2015 5:02:01 PM -- Instance3580.1 (complete), Instance3580.2 (complete), Instance3580.3 (complete), Instance3580.4 (complete), Instance3580.5 (complete),
Instance3580.6 (complete), Instance3580.7 (complete), Instance3580.8 (complete), Instance3580.9 (complete), Instance3580.10 (complete), Instance3580.11 (complete),
Instance3580.12 (complete), Instance3580.13 (complete), Instance3580.14 (complete), Instance3580.15 (complete) and Instance3580.16 (complete)
7/20/2015 5:02:01 PM -- C:\Program Files\Exchange Jetstress\Performance_2015_7_20_14_53_11.blg has 510 samples.
7/20/2015 5:02:01 PM -- Creating test report ...
7/20/2015 5:02:06 PM -- Instance3580.1 has 13.9 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.1 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.1 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.2 has 13.2 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.2 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.2 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.3 has 12.7 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.3 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.3 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.4 has 12.5 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.4 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.4 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.5 has 12.2 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.5 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.5 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.6 has 12.0 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.6 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.6 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.7 has 11.9 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.7 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.7 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.8 has 11.9 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.8 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.8 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.9 has 12.1 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.9 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.9 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.10 has 12.2 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.10 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.10 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.11 has 12.3 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.11 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.11 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.12 has 12.6 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.12 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.12 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.13 has 13.4 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.13 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.13 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.14 has 13.7 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.14 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.14 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.15 has 14.3 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.15 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.15 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.16 has 15.2 for I/O Database Reads Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.16 has 0.5 for I/O Log Writes Average Latency.
7/20/2015 5:02:06 PM -- Instance3580.16 has 0.5 for I/O Log Reads Average Latency.
7/20/2015 5:02:06 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
7/20/2015 5:02:06 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
7/20/2015 5:02:06 PM -- C:\Program Files\Exchange Jetstress\Performance_2015_7_20_14_53_11.xml has 478 samples queried.
```

B Stress testing

Test Summary

Overall Test Result	**Pass**
Machine Name	Server 1
Test Description	Machine Name: Dell Poweredge R720 (non-virtual) 3000 users Microsoft Exchange 2013 1 Dell Poweredge R720 server with Microsoft Server 2012 r2 installed 2GB Mailboxes, 3000 users per server, 0.12 IOPs 16 DB and LOG on 4 LUNs (combined) Dell MD3820f using Dynamic Disk Pool (15 drives) technology for data protection Dual QLogic 16Gb FC HBA Queue Depth = 254 FC Direct Attach
Test Start Time	7/21/2015 10:12:51 AM
Test End Time	7/22/2015 10:22:29 AM
Collection Start Time	7/21/2015 10:21:28 AM
Collection End Time	7/22/2015 10:21:22 AM
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\Stress_2015_7_21_10_13_24.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	715.006
Target Transactional I/O per Second	360
Initial Database Size (bytes)	6478521958400
Final Database Size (bytes)	6503285129216
Database Files (Count)	16

Jetstress System Parameters

Thread Count	16
Minimum Database Cache	512.0 MB
Maximum Database Cache	4096.0 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

Instance2272.1 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Vollume1\db1\Jetstress001001.edb

Instance2272.2 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Vollume1\db2\Jetstress002001.edb

Instance2272.3 Log path: C:\Users\Administrator\Desktop\Volume2\log3
Database: C:\Users\Administrator\Desktop\Vollume1\db3\Jetstress003001.edb

Instance2272.4 Log path: C:\Users\Administrator\Desktop\Volume2\log4
Database: C:\Users\Administrator\Desktop\Vollume1\db4\Jetstress004001.edb

Instance2272.5 Log path: C:\Users\Administrator\Desktop\Vollume1\log5
Database: C:\Users\Administrator\Desktop\Volume2\db5\Jetstress005001.edb

Instance2272.6 Log path: C:\Users\Administrator\Desktop\Vollume1\log6
Database: C:\Users\Administrator\Desktop\Volume2\db6\Jetstress006001.edb

Instance2272.7 Log path: C:\Users\Administrator\Desktop\Vollume1\log7
Database: C:\Users\Administrator\Desktop\Volume2\db7\Jetstress007001.edb

Instance2272.8 Log path: C:\Users\Administrator\Desktop\Vollume1\log8
Database: C:\Users\Administrator\Desktop\Volume2\db8\Jetstress008001.edb

Instance2272.9 Log path: C:\Users\Administrator\Desktop\Volume4\log9
Database: C:\Users\Administrator\Desktop\Volume3\db9\Jetstress009001.edb

Instance2272.10 Log path: C:\Users\Administrator\Desktop\Volume4\log10
Database: C:\Users\Administrator\Desktop\Volume3\db10\Jetstress010001.edb

Instance2272.11 Log path: C:\Users\Administrator\Desktop\Volume4\log11
Database: C:\Users\Administrator\Desktop\Volume3\db11\Jetstress011001.edb

Instance2272.12 Log path: C:\Users\Administrator\Desktop\Volume4\log12
Database: C:\Users\Administrator\Desktop\Volume3\db12\Jetstress012001.edb

Instance2272.13 Log path: C:\Users\Administrator\Desktop\Volume3\log13
Database: C:\Users\Administrator\Desktop\Volume4\db13\Jetstress013001.edb

Instance2272.14 Log path: C:\Users\Administrator\Desktop\Volume3\log14
Database: C:\Users\Administrator\Desktop\Volume4\db14\Jetstress014001.edb

Instance2272.15 Log path: C:\Users\Administrator\Desktop\Volume3\log15
Database: C:\Users\Administrator\Desktop\Volume4\db15\Jetstress015001.edb

Instance2272.16 Log path: C:\Users\Administrator\Desktop\Volume3\log16
Database: C:\Users\Administrator\Desktop\Volume4\db16\Jetstress016001.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
Instance2272.1	14.040	1.884	28.459	16.259	33445.981	35206.849	0.000	0.475	0.000	3.892	0.000	20654.964
Instance2272.2	13.310	1.883	28.527	16.311	33449.612	35185.172	0.000	0.474	0.000	3.896	0.000	20616.304
Instance2272.3	12.813	1.888	28.501	16.281	33425.611	35189.385	0.000	0.475	0.000	3.903	0.000	20568.763
Instance2272.4	12.501	1.888	28.533	16.284	33445.700	35189.967	0.000	0.476	0.000	3.889	0.000	20559.100
Instance2272.5	12.361	1.917	28.452	16.217	33451.512	35218.430	0.000	0.474	0.000	3.888	0.000	20657.502
Instance2272.6	12.072	1.916	28.462	16.187	33461.155	35206.401	0.000	0.470	0.000	3.873	0.000	20634.950
Instance2272.7	11.978	1.914	28.380	16.153	33439.744	35210.836	0.000	0.472	0.000	3.891	0.000	20700.129
Instance2272.8	12.018	1.921	28.487	16.205	33438.795	35186.888	0.000	0.471	0.000	3.870	0.000	20653.292
Instance2272.9	12.196	1.655	28.434	16.178	33444.508	35220.067	0.000	0.482	0.000	3.879	0.000	20687.387
Instance2272.10	12.224	1.678	28.446	16.209	33457.488	35212.671	0.000	0.478	0.000	3.878	0.000	20700.310
Instance2272.11	12.353	1.682	28.440	16.162	33463.734	35215.122	0.000	0.480	0.000	3.876	0.000	20638.066
Instance2272.12	12.593	1.672	28.406	16.170	33446.323	35217.783	0.000	0.481	0.000	3.877	0.000	20761.347
Instance2272.13	13.531	1.792	28.474	16.250	33443.651	35186.771	0.000	0.476	0.000	3.904	0.000	20585.846
Instance2272.14	13.833	1.785	28.484	16.212	33445.228	35204.188	0.000	0.477	0.000	3.876	0.000	20611.066
Instance2272.15	14.420	1.781	28.477	16.272	33435.264	35194.671	0.000	0.476	0.000	3.894	0.000	20601.185
Instance2272.16	15.232	1.787	28.444	16.248	33431.297	35217.660	0.000	0.478	0.000	3.902	0.000	20609.481

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2272.1	9.764	260835.761
Instance2272.2	9.763	260865.160
Instance2272.3	9.764	260847.467
Instance2272.4	9.763	260879.057
Instance2272.5	9.763	260822.378
Instance2272.6	9.764	260850.369
Instance2272.7	9.763	260898.822
Instance2272.8	9.764	260866.979
Instance2272.9	9.761	260913.226
Instance2272.10	9.764	260844.235
Instance2272.11	9.764	260883.441
Instance2272.12	9.766	260849.792
Instance2272.13	9.763	260829.843
Instance2272.14	9.762	260869.444
Instance2272.15	9.763	260863.525
Instance2272.16	9.763	260886.333

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2272.1	0.341	132265.852
Instance2272.2	0.340	132289.096
Instance2272.3	0.340	132100.592
Instance2272.4	0.339	131666.260
Instance2272.5	0.341	132345.556
Instance2272.6	0.338	131535.149
Instance2272.7	0.341	132624.136
Instance2272.8	0.338	131457.118
Instance2272.9	0.340	132055.224
Instance2272.10	0.340	132220.534
Instance2272.11	0.339	131658.958
Instance2272.12	0.341	132262.431
Instance2272.13	0.341	132300.460
Instance2272.14	0.338	131409.133
Instance2272.15	0.340	132259.506
Instance2272.16	0.341	132300.460

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
Instance2272.1	14.040	1.884	38.223	16.259	91529.895	35206.849	0.551	0.475	0.341	3.892	132265.852	20654.964
Instance2272.2	13.310	1.883	38.290	16.311	91434.954	35185.172	0.556	0.474	0.340	3.896	132289.096	20616.304
Instance2272.3	12.813	1.888	38.266	16.281	91456.544	35189.385	0.541	0.475	0.340	3.903	132100.592	20568.763
Instance2272.4	12.501	1.888	38.297	16.284	91428.263	35189.967	0.542	0.476	0.339	3.889	131666.260	20559.100
Instance2272.5	12.361	1.917	38.215	16.217	91542.034	35218.430	0.730	0.474	0.341	3.888	132345.556	20657.502
Instance2272.6	12.072	1.916	38.226	16.187	91540.733	35206.401	0.716	0.470	0.338	3.873	131535.149	20634.950
Instance2272.7	11.978	1.914	38.143	16.153	91660.414	35210.836	0.718	0.472	0.341	3.891	132624.136	20700.129
Instance2272.8	12.018	1.921	38.252	16.205	91493.030	35186.888	0.748	0.471	0.338	3.870	131457.118	20653.292
Instance2272.9	12.196	1.655	38.194	16.178	91575.527	35220.067	0.494	0.482	0.340	3.879	132055.224	20687.387
Instance2272.10	12.224	1.678	38.210	16.209	91563.362	35212.671	0.499	0.478	0.340	3.878	132220.534	20700.310
Instance2272.11	12.353	1.682	38.203	16.162	91585.876	35215.122	0.495	0.480	0.339	3.876	131658.958	20638.066
Instance2272.12	12.593	1.672	38.172	16.170	91622.869	35217.783	0.511	0.481	0.341	3.877	132262.431	20761.347
Instance2272.13	13.531	1.792	38.237	16.250	91503.188	35186.771	1.341	0.476	0.341	3.904	132300.460	20585.846
Instance2272.14	13.833	1.785	38.246	16.212	91493.605	35204.188	1.288	0.477	0.338	3.876	131409.133	20611.066
Instance2272.15	14.420	1.781	38.240	16.272	91500.108	35194.671	1.303	0.476	0.340	3.894	132259.506	20601.185
Instance2272.16	15.232	1.787	38.207	16.248	91552.712	35217.660	1.323	0.478	0.341	3.902	132300.460	20609.481

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.286	0.097	20.158
Available MBytes	26227.464	26122.000	26509.000
Free System Page Table Entries	16608273.654	16607187.000	16608553.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	159907902.698	154238976.000	167731200.000
Pool Paged Bytes	104486960.804	93220864.000	170893312.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```
7/21/2015 10:12:51 AM -- Preparing for testing ...
7/21/2015 10:13:07 AM -- Attaching databases ...
7/21/2015 10:13:07 AM -- Preparations for testing are complete.
7/21/2015 10:13:07 AM -- Starting transaction dispatch ..
7/21/2015 10:13:07 AM -- Database cache settings: (minimum: 512.0 MB, maximum: 4.0 GB)
7/21/2015 10:13:07 AM -- Database flush thresholds: (start: 40.9 MB, stop: 81.9 MB)
7/21/2015 10:13:24 AM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
7/21/2015 10:13:24 AM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
7/21/2015 10:13:25 AM -- Operation mix: Sessions 16, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
7/21/2015 10:13:25 AM -- Performance logging started (interval: 15000 ms).
7/21/2015 10:13:25 AM -- Attaining prerequisites:
7/21/2015 10:21:28 AM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 3872977000.0 (lower bound: 3865470000.0, upper bound: none)
7/22/2015 10:21:29 AM -- Performance logging has ended.
7/22/2015 10:21:29 AM -- JetInterop batch transaction stats: 110156, 110155, 110155, 110155, 110155, 110155, 110155, 110155, 110155, 110155, 110155, 110155,
110155, 110155, 110155 and 110155.
7/22/2015 10:21:29 AM -- Dispatching transactions ends.
7/22/2015 10:21:29 AM -- Shutting down databases ...
7/22/2015 10:22:29 AM -- Instance2272.1 (complete), Instance2272.2 (complete), Instance2272.3 (complete), Instance2272.4 (complete), Instance2272.5 (complete),
Instance2272.6 (complete), Instance2272.7 (complete), Instance2272.8 (complete), Instance2272.9 (complete), Instance2272.10 (complete), Instance2272.11 (complete),
Instance2272.12 (complete), Instance2272.13 (complete), Instance2272.14 (complete), Instance2272.15 (complete) and Instance2272.16 (complete)
7/22/2015 10:22:29 AM -- C:\Program Files\Exchange Jetstress\Stress_2015_7_21_10_13_24.blg has 5781 samples.
7/22/2015 10:22:29 AM -- Creating test report ...
7/22/2015 10:23:31 AM -- Instance2272.1 has 14.0 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.1 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.1 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.2 has 13.3 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.2 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.2 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.3 has 12.8 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.3 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.3 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.4 has 12.5 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.4 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.4 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.5 has 12.4 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.5 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.5 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.6 has 12.1 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.6 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.6 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.7 has 12.0 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.7 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.7 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.8 has 12.0 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.8 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.8 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.9 has 12.2 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.9 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.9 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.10 has 12.2 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.10 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.10 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.11 has 12.4 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.11 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.11 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.12 has 12.6 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.12 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.12 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.13 has 13.5 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.13 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.13 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.14 has 13.8 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.14 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.14 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.15 has 14.4 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.15 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.15 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.16 has 15.2 for I/O Database Reads Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.16 has 0.5 for I/O Log Writes Average Latency.
7/22/2015 10:23:31 AM -- Instance2272.16 has 0.5 for I/O Log Reads Average Latency.
7/22/2015 10:23:31 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
7/22/2015 10:23:31 AM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
7/22/2015 10:23:31 AM -- C:\Program Files\Exchange Jetstress\Stress_2015_7_21_10_13_24.xml has 5748 samples queried.
```

C Backup testing

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance892.1	386136.03	01:51:02	57.96
Instance892.2	386136.03	01:47:45	59.72
Instance892.3	386144.03	01:45:21	61.09
Instance892.4	386144.03	01:47:12	60.03
Instance892.5	386144.03	01:47:40	59.77
Instance892.6	386144.03	01:45:27	61.02
Instance892.7	386160.03	01:45:53	60.78
Instance892.8	386144.03	01:47:25	59.91
Instance892.9	386136.03	01:47:50	59.67
Instance892.10	386136.03	01:48:04	59.55
Instance892.11	386144.03	01:50:27	58.27
Instance892.12	386136.03	01:51:05	57.93
Instance892.13	386144.03	01:53:01	56.94
Instance892.14	386136.03	01:53:46	56.57
Instance892.15	386152.03	01:54:21	56.28
Instance892.16	386136.03	01:55:03	55.93
Avg			58.84
Sum			941.41

Jetstress System Parameters

Thread Count	16
Minimum Database Cache	512.0 MB
Maximum Database Cache	4096.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance892.1 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Vollume1\db1\Jetstress001001.edb

Instance892.2 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Vollume1\db2\Jetstress002001.edb

Instance892.3 Log path: C:\Users\Administrator\Desktop\Volume2\log3
Database: C:\Users\Administrator\Desktop\Vollume1\db3\Jetstress003001.edb

Instance892.4 Log path: C:\Users\Administrator\Desktop\Volume2\log4
Database: C:\Users\Administrator\Desktop\Vollume1\db4\Jetstress004001.edb

Instance892.5 Log path: C:\Users\Administrator\Desktop\Vollume1\log5
Database: C:\Users\Administrator\Desktop\Volume2\db5\Jetstress005001.edb

Instance892.6 Log path: C:\Users\Administrator\Desktop\Vollume1\log6
Database: C:\Users\Administrator\Desktop\Volume2\db6\Jetstress006001.edb

Instance892.7 Log path: C:\Users\Administrator\Desktop\Vollume1\log7
Database: C:\Users\Administrator\Desktop\Volume2\db7\Jetstress007001.edb

Instance892.8 Log path: C:\Users\Administrator\Desktop\Vollume1\log8
Database: C:\Users\Administrator\Desktop\Volume2\db8\Jetstress008001.edb

Instance892.9 Log path: C:\Users\Administrator\Desktop\Volume4\log9
Database: C:\Users\Administrator\Desktop\Volume3\db9\Jetstress009001.edb

Instance892.10 Log path: C:\Users\Administrator\Desktop\Volume4\log10
Database: C:\Users\Administrator\Desktop\Volume3\db10\Jetstress010001.edb

Instance892.11 Log path: C:\Users\Administrator\Desktop\Volume4\log11
Database: C:\Users\Administrator\Desktop\Volume3\db11\Jetstress011001.edb

Instance892.12 Log path: C:\Users\Administrator\Desktop\Volume4\log12
Database: C:\Users\Administrator\Desktop\Volume3\db12\Jetstress012001.edb

Instance892.13 Log path: C:\Users\Administrator\Desktop\Volume3\log13
Database: C:\Users\Administrator\Desktop\Volume4\db13\Jetstress013001.edb

Instance892.14 Log path: C:\Users\Administrator\Desktop\Volume3\log14
Database: C:\Users\Administrator\Desktop\Volume4\db14\Jetstress014001.edb

Instance892.15 Log path: C:\Users\Administrator\Desktop\Volume3\log15
Database: C:\Users\Administrator\Desktop\Volume4\db15\Jetstress015001.edb

Instance892.16 Log path: C:\Users\Administrator\Desktop\Volume3\log16
Database: C:\Users\Administrator\Desktop\Volume4\db16\Jetstress016001.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
Instance892.1	8.499	0.000	232.692	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.2	7.427	0.000	239.320	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.3	8.946	0.000	245.175	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.4	8.548	0.000	240.374	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.5	8.699	0.000	239.296	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.6	8.312	0.000	244.299	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.7	8.563	0.000	243.637	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.8	8.538	0.000	239.906	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.9	8.544	0.000	239.315	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.10	8.588	0.000	238.339	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.11	8.860	0.000	233.322	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.12	9.165	0.000	231.958	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.13	7.967	0.000	227.846	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.14	8.135	0.000	226.440	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.15	8.546	0.000	224.972	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance892.16	11.087	0.000	213.193	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	1.087	0.654	1.413
Available MBytes	30493.306	30456.000	30518.000
Free System Page Table Entries	16608654.721	16608235.000	16608887.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	153100663.616	153071616.000	153190400.000
Pool Paged Bytes	93152287.301	92979200.000	93331456.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

7/21/2015 8:04:56 AM -- Preparing for testing ...
7/21/2015 8:05:12 AM -- Attaching databases ...
7/21/2015 8:05:12 AM -- Preparations for testing are complete.
7/21/2015 8:05:29 AM -- Performance logging started (interval: 30000 ms).
7/21/2015 8:05:29 AM -- Backing up databases ...
7/21/2015 10:00:33 AM -- Performance logging has ended.
7/21/2015 10:00:33 AM -- Instance892.1 (100% processed), Instance892.2 (100% processed), Instance892.3 (100% processed), Instance892.4 (100% processed), Instance892.5 (100% processed), Instance892.6 (100% processed), Instance892.7 (100% processed), Instance892.8 (100% processed), Instance892.9 (100% processed), Instance892.10 (100% processed), Instance892.11 (100% processed), Instance892.12 (100% processed), Instance892.13 (100% processed), Instance892.14 (100% processed), Instance892.15 (100% processed) and Instance892.16 (100% processed)
7/21/2015 10:00:33 AM -- C:\Program Files\Exchange Jetstress\DatabaseBackup_2015_7_21_8_5_12.blg has 229 samples.
7/21/2015 10:00:33 AM -- Creating test report ...

D Recovery testing

Test Summary

Overall Test Result	**Pass**
Machine Name	Server 1
Test Description	Machine Name: Dell Poweredge R720 (non-virtual) 3000 users Microsoft Exchange 2013 1 Dell Poweredge R720 server with Microsoft Server 2012 r2 installed 2GB Mailboxes, 3000 users per server, 0.12 IOPs 16 DB and LOG on 4 LUNs (combined) Dell MD3820f using Dynamic Disk Pool (15 drives) technology for data protection QLogic 16Gb FC HBA Queue Depth = 254 FC Direct Attach
Test Start Time	7/20/2015 9:54:28 PM
Test End Time	7/21/2015 1:22:43 AM
Collection Start Time	7/20/2015 9:55:17 PM
Collection End Time	7/21/2015 1:21:44 AM
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_7_20_21_55_1.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	758.536
Target Transactional I/O per Second	360
Initial Database Size (bytes)	6474721918976
Final Database Size (bytes)	6478521958400
Database Files (Count)	16

Jetstress System Parameters

Thread Count	16
Minimum Database Cache	512.0 MB
Maximum Database Cache	4096.0 MB
Insert Operations	40%
Delete Operations	20%
Replace Operations	5%
Read Operations	35%
Lazy Commits	70%

Database Configuration

Instance460.1 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Vollume1\db1\Jetstress001001.edb

Instance460.2 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Vollume1\db2\Jetstress002001.edb

Instance460.3 Log path: C:\Users\Administrator\Desktop\Volume2\log3
Database: C:\Users\Administrator\Desktop\Vollume1\db3\Jetstress003001.edb

Instance460.4 Log path: C:\Users\Administrator\Desktop\Volume2\log4
Database: C:\Users\Administrator\Desktop\Vollume1\db4\Jetstress004001.edb

Instance460.5 Log path: C:\Users\Administrator\Desktop\Vollume1\log5
Database: C:\Users\Administrator\Desktop\Volume2\db5\Jetstress005001.edb

Instance460.6 Log path: C:\Users\Administrator\Desktop\Vollume1\log6
Database: C:\Users\Administrator\Desktop\Volume2\db6\Jetstress006001.edb

Instance460.7 Log path: C:\Users\Administrator\Desktop\Vollume1\log7
Database: C:\Users\Administrator\Desktop\Volume2\db7\Jetstress007001.edb

Instance460.8 Log path: C:\Users\Administrator\Desktop\Vollume1\log8
Database: C:\Users\Administrator\Desktop\Volume2\db8\Jetstress008001.edb

Instance460.9 Log path: C:\Users\Administrator\Desktop\Volume4\log9
Database: C:\Users\Administrator\Desktop\Volume3\db9\Jetstress009001.edb

Instance460.10 Log path: C:\Users\Administrator\Desktop\Volume4\log10
Database: C:\Users\Administrator\Desktop\Volume3\db10\Jetstress010001.edb

Instance460.11 Log path: C:\Users\Administrator\Desktop\Volume4\log11
Database: C:\Users\Administrator\Desktop\Volume3\db11\Jetstress011001.edb

Instance460.12 Log path: C:\Users\Administrator\Desktop\Volume4\log12
Database: C:\Users\Administrator\Desktop\Volume3\db12\Jetstress012001.edb

Instance460.13 Log path: C:\Users\Administrator\Desktop\Volume3\log13
Database: C:\Users\Administrator\Desktop\Volume4\db13\Jetstress013001.edb

Instance460.14 Log path: C:\Users\Administrator\Desktop\Volume3\log14
Database: C:\Users\Administrator\Desktop\Volume4\db14\Jetstress014001.edb

Instance460.15 Log path: C:\Users\Administrator\Desktop\Volume3\log15
Database: C:\Users\Administrator\Desktop\Volume4\db15\Jetstress015001.edb

Instance460.16 Log path: C:\Users\Administrator\Desktop\Volume3\log16
Database: C:\Users\Administrator\Desktop\Volume4\db16\Jetstress016001.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
Instance460.1	17.487	3.835	30.449	17.062	32768.000	35497.791	0.000	0.492	0.000	4.192	0.000	20427.264
Instance460.2	16.571	3.287	30.406	16.951	32768.000	35499.781	0.000	0.486	0.000	4.188	0.000	20584.360
Instance460.3	16.041	4.317	30.549	17.297	32768.000	35503.684	0.000	0.491	0.000	4.275	0.000	20356.570
Instance460.4	15.754	3.895	30.314	16.944	32768.000	35514.453	0.000	0.482	0.000	4.194	0.000	20690.259
Instance460.5	15.473	3.219	30.553	17.072	32768.000	35471.483	0.000	0.483	0.000	4.157	0.000	20588.739
Instance460.6	15.119	3.787	30.451	16.962	32768.000	35487.419	0.000	0.477	0.000	4.163	0.000	20481.306
Instance460.7	15.029	4.316	30.381	17.176	32768.000	35456.343	0.000	0.484	0.000	4.234	0.000	20523.886
Instance460.8	15.130	3.899	30.445	16.974	32768.000	35461.215	0.000	0.480	0.000	4.169	0.000	20720.384
Instance460.9	15.360	3.237	30.294	16.813	32768.000	35539.001	0.000	0.491	0.000	4.116	0.000	20792.166
Instance460.10	15.340	3.836	30.273	16.927	32768.000	35520.715	0.000	0.491	0.000	4.200	0.000	20579.693
Instance460.11	15.517	2.868	30.411	17.047	32768.000	35508.686	0.000	0.494	0.000	4.180	0.000	20531.699
Instance460.12	15.816	3.670	30.521	17.124	32768.000	35475.199	0.000	0.489	0.000	4.173	0.000	20675.960
Instance460.13	16.880	3.472	30.432	17.204	32768.000	35493.845	0.000	0.481	0.000	4.226	0.000	20522.373
Instance460.14	17.275	4.148	30.354	17.007	32768.000	35549.122	0.000	0.484	0.000	4.209	0.000	20447.824
Instance460.15	17.978	2.771	30.259	16.850	32768.000	35529.442	0.000	0.489	0.000	4.137	0.000	20863.209
Instance460.16	19.135	3.697	30.226	16.808	32768.000	35511.671	0.000	0.497	0.000	4.155	0.000	20675.253

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.333	0.185	2.073
Available MBytes	26407.212	26286.000	30080.000
Free System Page Table Entries	16608593.602	16608161.000	16608896.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	152971174.741	150724608.000	153337856.000
Pool Paged Bytes	92828471.167	92655616.000	92975104.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```
7/20/2015 9:54:28 PM -- Preparing for testing ...
7/20/2015 9:54:44 PM -- Attaching databases ...
7/20/2015 9:54:44 PM -- Preparations for testing are complete.
7/20/2015 9:54:44 PM -- Starting transaction dispatch ..
7/20/2015 9:54:44 PM -- Database cache settings: (minimum: 512.0 MB, maximum: 4.0 GB)
7/20/2015 9:54:44 PM -- Database flush thresholds: (start: 40.9 MB, stop: 81.9 MB)
7/20/2015 9:55:01 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
7/20/2015 9:55:01 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
7/20/2015 9:55:02 PM -- Operation mix: Sessions 16, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
7/20/2015 9:55:02 PM -- Performance logging started (interval: 15000 ms).
7/20/2015 9:55:02 PM -- Generating log files ...
7/21/2015 1:21:51 AM -- C:\Users\Administrator\Desktop\Volume2\log1 (100.6% generated), C:\Users\Administrator\Desktop\Volume2\log2 (100.8% generated),
C:\Users\Administrator\Desktop\Volume2\log3 (102.0% generated), C:\Users\Administrator\Desktop\Volume2\log4 (102.0% generated),
C:\Users\Administrator\Desktop\Vollume1\log5 (100.4% generated), C:\Users\Administrator\Desktop\Vollume1\log6 (100.2% generated),
C:\Users\Administrator\Desktop\Vollume1\log7 (102.2% generated), C:\Users\Administrator\Desktop\Vollume1\log8 (101.0% generated),
C:\Users\Administrator\Desktop\Volume4\log9 (100.2% generated), C:\Users\Administrator\Desktop\Volume4\log10 (101.4% generated),
C:\Users\Administrator\Desktop\Volume4\log11 (100.8% generated), C:\Users\Administrator\Desktop\Volume4\log12 (101.2% generated),
C:\Users\Administrator\Desktop\Volume3\log13 (101.8% generated), C:\Users\Administrator\Desktop\Volume3\log14 (101.2% generated),
C:\Users\Administrator\Desktop\Volume3\log15 (101.4% generated) and C:\Users\Administrator\Desktop\Volume3\log16 (100.8% generated)
7/21/2015 1:21:51 AM -- Performance logging has ended.
7/21/2015 1:21:51 AM -- JetInterop batch transaction stats: 16934, 16934, 16934, 16934, 16934, 16934, 16933, 16933, 16933, 16933, 16933, 16933, 16933, 16933, 16933
and 16933.
7/21/2015 1:21:51 AM -- Dispatching transactions ends.
7/21/2015 1:21:51 AM -- Shutting down databases ...
7/21/2015 1:22:43 AM -- Instance460.1 (complete), Instance460.2 (complete), Instance460.3 (complete), Instance460.4 (complete), Instance460.5 (complete),
Instance460.6 (complete), Instance460.7 (complete), Instance460.8 (complete), Instance460.9 (complete), Instance460.10 (complete), Instance460.11 (complete),
Instance460.12 (complete), Instance460.13 (complete), Instance460.14 (complete), Instance460.15 (complete) and Instance460.16 (complete)
7/21/2015 1:22:43 AM -- C:\Program Files\Exchange Jetstress\Performance_2015_7_20_21_55_1.blg has 826 samples.
7/21/2015 1:22:43 AM -- Creating test report ...
7/21/2015 1:22:46 AM -- Instance460.1 has 17.5 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.1 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.1 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.2 has 16.6 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.2 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.2 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.3 has 16.0 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.3 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.3 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.4 has 15.8 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.4 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.4 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.5 has 15.5 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.5 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.5 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.6 has 15.1 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.6 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.6 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.7 has 15.0 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.7 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.7 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.8 has 15.1 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.8 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.8 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.9 has 15.4 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.9 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.9 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.10 has 15.3 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.10 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.10 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.11 has 15.5 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.11 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.11 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.12 has 15.8 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.12 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.12 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.13 has 16.9 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.13 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.13 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.14 has 17.3 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.14 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.14 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.15 has 18.0 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.15 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.15 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.16 has 19.1 for I/O Database Reads Average Latency.
7/21/2015 1:22:46 AM -- Instance460.16 has 0.5 for I/O Log Writes Average Latency.
7/21/2015 1:22:46 AM -- Instance460.16 has 0.5 for I/O Log Reads Average Latency.
7/21/2015 1:22:46 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
7/21/2015 1:22:46 AM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
7/21/2015 1:22:46 AM -- C:\Program Files\Exchange Jetstress\Performance_2015_7_20_21_55_1.xml has 825 samples queried.
```