Dell PowerVault MD3820f 5,000 user Mailbox Exchange 2013 Resiliency Storage Solution — Direct Attach SAS using dual LSI 9300-8e 12Gb SAS 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 for 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 5,000 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 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 storage series. 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 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 5,000 users with 2GB Mailbox size and 200 messages a day, or 0.12 IOPS for every user, including 20% headroom.

1.3 Solution description

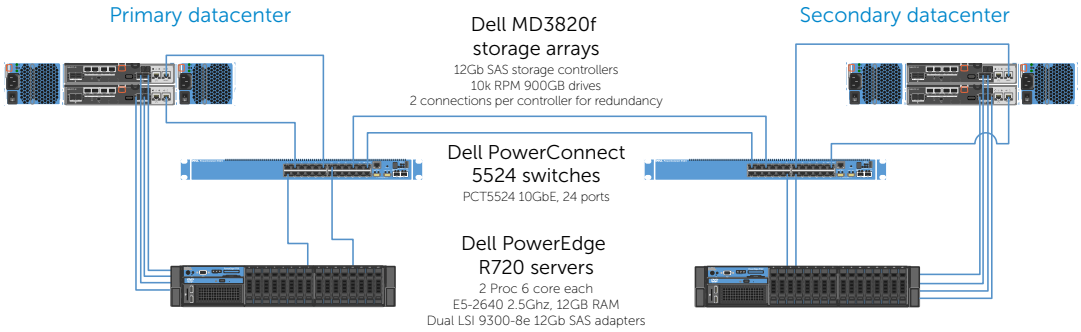
Testing was performed on a Dell R720 server, dual LSI 9300-8e 12Gb SAS adapters and a Dell MD3820f storage array with redundant controller pair; front-end connections and back-end connections. Exchange is a critical application in most businesses today and the design of the system supporting Exchange 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. Twenty 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.

SAS direct-attach storage diagram

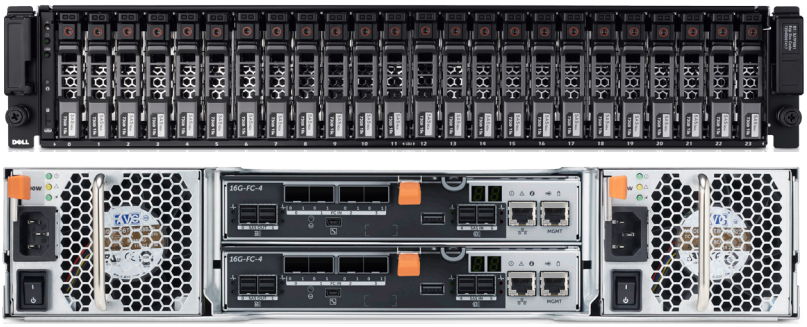


2 The Dell MD3820f solution for Microsoft ESRP

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 12Gb SAS 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

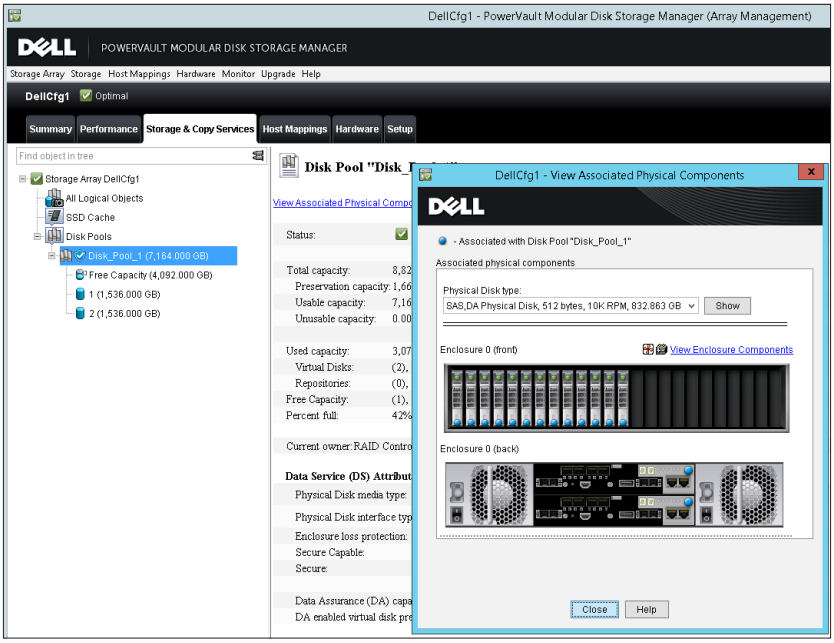


Figure 3 MDSM summary view

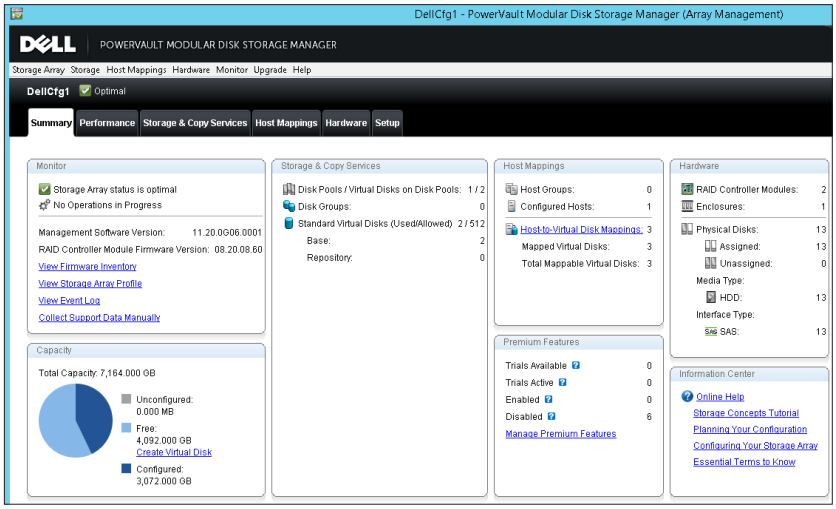


Table 1 Dell PowerVault MD3820f Features

Feature	Details
2U, 24 drive FC enclosure	Designed to fit standard 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	Four 12Gb/s SAS ports (2 per each 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 768GB 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 LSI 12Gb SAS adapter

The LSI SAS 9300 8 and 4-port, 12Gb/s SAS host bus adapter family provides increased connectivity and maximum performance for high-end servers and appliances within internal storage, or connecting to large scale storage enclosures.

- Four/eight ports of 12Gb/s SAS + SATA ports
- Eight lanes of PCI Express 3.0
- Low-profile form factor
- Mini-SAS HD connectors
- SAS 3008 12Gb/s SAS+SATA controller
- Supports SSDs, HDDs, and tape drives

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 4 shows the Mailbox Calculator output for 5,000 users with 200 messages/day profile. The recommended IOPS per server is 600. 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	5,000
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	2.897TB
Total database size for performance testing	11.587TB
% storage capacity used by Exchange database*	97.52%

* 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)	SAS
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 SAS port per controller
Maximum bandwidth of storage connectivity to host	192Gb/s (4x48Gb HBA) *
Switch type/model/firmware revision	NA
HBA model and firmware	LSI 9300-8e 12Gb SAS HBA: 3.00.08.00
Number of HBA's/host	2
Host server type	Dell PowerEdge R720
Total number of disks tested in solution	20
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

* - Each 12Gb SAS port has 4 lanes that each support 12Gb. Therefore a single 12Gb port can support up to 48Gb of throughput.

3.3 Primary storage software

Configuration Item	Detail
HBA driver	10.4.246.0
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	20
Total raw storage capacity (TB)	11.603TB
Data protection	DDP
Total formatted capacity	837.363GB
Storage capacity utilization	99.86%
Database capacity utilization	86.56%

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 uninterruptible 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 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 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 whitepaper.

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	725.335
Disks Writes/sec sum	323.805
Disk Read Latency (ms) average	15.145
Disk Write Latency (ms) average	1.519
Transaction Log I/O	
Log Disks Writes/sec sum	78.580
Log Disk Write Latency (ms) average	0.336

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 VSS. The following table shows the average rate for a single database file.

Performance item	Detail
MB read/sec per database	120.16
MB read/sec total per server	961.27

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)	0.863

6 Conclusion

This ESRP document presents a tested and validated Exchange solution for 5,000 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 5,000 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) 5000 users Microsoft Exchange 2013 1 Dell Poweredge R720 server with Microsoft Server 2012 r2 installed 2GB Mailboxes, 5000 users per server, 0.12 IOPs 8 DB and LOG on 4 LUNs (combined) Dell MD3820f using Dynamic Disk Pool (20 drives) technology for data protection SAS Direct Attach
Test Start Time	7/28/2015 10:15:18 PM
Test End Time	7/29/2015 12:18:29 AM
Collection Start Time	7/28/2015 10:18:18 PM
Collection End Time	7/29/2015 12:18:13 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_28_22_15_34.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1049.14
Target Transactional I/O per Second	600
Initial Database Size (bytes)	10748583477248
Final Database Size (bytes)	10751217500160
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

Instance2464.1 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Volume1\db1\Jetstress001001.edb

Instance2464.2 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Volume1\db2\Jetstress002001.edb

Instance2464.3 Log path: C:\Users\Administrator\Desktop\Volume1\log3
Database: C:\Users\Administrator\Desktop\Volume2\db3\Jetstress003001.edb

Instance2464.4 Log path: C:\Users\Administrator\Desktop\Volume1\log4
Database: C:\Users\Administrator\Desktop\Volume2\db4\Jetstress004001.edb

Instance2464.5 Log path: C:\Users\Administrator\Desktop\Volume4\log5
Database: C:\Users\Administrator\Desktop\Volume3\db5\Jetstress005001.edb

Instance2464.6 Log path: C:\Users\Administrator\Desktop\Volume4\log6
Database: C:\Users\Administrator\Desktop\Volume3\db6\Jetstress006001.edb

Instance2464.7 Log path: C:\Users\Administrator\Desktop\Volume3\log7
Database: C:\Users\Administrator\Desktop\Volume4\db7\Jetstress007001.edb

Instance2464.8 Log path: C:\Users\Administrator\Desktop\Volume3\log8
Database: C:\Users\Administrator\Desktop\Volume4\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
Instance2464.1	16.203	1.537	90.590	40.538	32898.813	35431.006	0.000	0.329	0.000	9.880	0.000	20260.735
Instance2464.2	14.912	1.552	90.879	40.499	32898.226	35429.019	0.000	0.329	0.000	9.817	0.000	20191.679
Instance2464.3	14.105	1.480	90.788	40.555	32895.535	35451.867	0.000	0.340	0.000	9.797	0.000	20372.369
Instance2464.4	13.785	1.464	90.896	40.588	32889.966	35408.839	0.000	0.339	0.000	9.854	0.000	20185.285
Instance2464.5	13.944	1.509	90.557	40.563	32891.004	35413.415	0.000	0.331	0.000	9.784	0.000	20471.246
Instance2464.6	14.450	1.520	90.684	40.391	32895.280	35448.286	0.000	0.340	0.000	9.815	0.000	20296.777
Instance2464.7	15.813	1.530	90.605	40.232	32880.848	35455.096	0.000	0.337	0.000	9.739	0.000	20389.161
Instance2464.8	17.951	1.562	90.336	40.439	32889.189	35447.472	0.000	0.340	0.000	9.894	0.000	20387.576

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance2464.1	9.746	261761.664
Instance2464.2	9.742	261880.606
Instance2464.3	9.745	261792.289
Instance2464.4	9.744	261802.592
Instance2464.5	9.743	261857.467
Instance2464.6	9.741	261907.585
Instance2464.7	9.745	261809.852
Instance2464.8	9.743	261830.623

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance2464.1	0.856	232561.778
Instance2464.2	0.848	232561.778
Instance2464.3	0.855	231105.232
Instance2464.4	0.850	232056.623
Instance2464.5	0.856	232561.778
Instance2464.6	0.851	232561.778
Instance2464.7	0.850	232561.778
Instance2464.8	0.862	232560.175

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
Instance2464.1	16.203	1.537	100.336	40.538	55128.772	35431.006	0.588	0.329	0.856	9.880	232561.778	20260.735
Instance2464.2	14.912	1.552	100.621	40.499	55068.037	35429.019	0.637	0.329	0.848	9.817	232561.778	20191.679
Instance2464.3	14.105	1.480	100.533	40.555	55082.645	35451.867	1.184	0.340	0.855	9.797	231105.232	20372.369
Instance2464.4	13.785	1.464	100.641	40.588	55053.664	35408.839	1.192	0.339	0.850	9.854	232056.623	20185.285
Instance2464.5	13.944	1.509	100.300	40.563	55133.303	35413.415	0.654	0.331	0.856	9.784	232561.778	20471.246
Instance2464.6	14.450	1.520	100.425	40.391	55108.607	35448.286	0.645	0.340	0.851	9.815	232561.778	20296.777
Instance2464.7	15.813	1.530	100.350	40.232	55111.263	35455.096	0.516	0.337	0.850	9.739	232561.778	20389.161
Instance2464.8	17.951	1.562	100.079	40.439	55176.681	35447.472	0.549	0.340	0.862	9.894	232560.175	20387.576

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.362	0.197	2.176
Available MBytes	28314.308	28284.000	28498.000
Free System Page Table Entries	16603605.392	16603033.000	16603864.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	197010722.133	196784128.000	197275648.000
Pool Paged Bytes	101710216.533	101613568.000	101851136.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```
7/28/2015 10:15:18 PM -- Preparing for testing ...
7/28/2015 10:15:26 PM -- Attaching databases ...
7/28/2015 10:15:26 PM -- Preparations for testing are complete.
7/28/2015 10:15:26 PM -- Starting transaction dispatch ..
7/28/2015 10:15:26 PM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
7/28/2015 10:15:26 PM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
7/28/2015 10:15:34 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
7/28/2015 10:15:34 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
7/28/2015 10:15:35 PM -- Operation mix: Sessions 25, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
7/28/2015 10:15:35 PM -- Performance logging started (interval: 15000 ms).
7/28/2015 10:15:35 PM -- Attaining prerequisites:
7/28/2015 10:18:18 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1949209000.0 (lower bound: 1932735000.0, upper bound: none)
7/29/2015 12:18:19 AM -- Performance logging has ended.
7/29/2015 12:18:19 AM -- JetInterop batch transaction stats: 23603, 23603, 23603, 23603, 23603, 23603, 23603 and 23603.
7/29/2015 12:18:19 AM -- Dispatching transactions ends.
7/29/2015 12:18:19 AM -- Shutting down databases ...
7/29/2015 12:18:29 AM -- Instance2464.1 (complete), Instance2464.2 (complete), Instance2464.3 (complete), Instance2464.4 (complete), Instance2464.5 (complete),
Instance2464.6 (complete), Instance2464.7 (complete) and Instance2464.8 (complete)
7/29/2015 12:18:29 AM -- C:\Program Files\Exchange Jetstress\Performance_2015_7_28_22_15_34.blg has 490 samples.
7/29/2015 12:18:29 AM -- Creating test report ...
7/29/2015 12:18:31 AM -- Instance2464.1 has 16.2 for I/O Database Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.1 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.1 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.2 has 14.9 for I/O Database Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.2 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.2 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.3 has 14.1 for I/O Database Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.3 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.3 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.4 has 13.8 for I/O Database Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.4 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.4 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.5 has 13.9 for I/O Database Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.5 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.5 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.6 has 14.5 for I/O Database Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.6 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.6 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.7 has 15.8 for I/O Database Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.7 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.7 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.8 has 18.0 for I/O Database Reads Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.8 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 12:18:31 AM -- Instance2464.8 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 12:18:31 AM -- Test has 0 Maximum Database Page Fault Stalls/sec.
7/29/2015 12:18:31 AM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
7/29/2015 12:18:31 AM -- C:\Program Files\Exchange Jetstress\Performance_2015_7_28_22_15_34.xml has 479 samples queried.
```

B Stress testing

Test Summary

Overall Test Result	**Pass**
Machine Name	Server 1
Test Description	Machine Name: Dell Poweredge R720 (non-virtual) 5000 users Microsoft Exchange 2013 1 Dell Poweredge R720 server with Microsoft Server 2012 r2 installed 2GB Mailboxes, 5000 users per server, 0.12 IOPs 8 DB and LOG on 4 LUNs (combined) Dell MD3820f using Dynamic Disk Pool (20 drives) technology for data protection SAS Direct Attach
Test Start Time	7/29/2015 10:40:45 PM
Test End Time	7/30/2015 10:43:52 PM
Collection Start Time	7/29/2015 10:43:40 PM
Collection End Time	7/30/2015 10:43:32 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\Stress_2015_7_29_22_41_1.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1031.033
Target Transactional I/O per Second	600
Initial Database Size (bytes)	10739397951488
Final Database Size (bytes)	10769949261824
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

Instance520.1 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Volume1\db1\Jetstress001001.edb

Instance520.2 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Volume1\db2\Jetstress002001.edb

Instance520.3 Log path: C:\Users\Administrator\Desktop\Volume1\log3
Database: C:\Users\Administrator\Desktop\Volume2\db3\Jetstress003001.edb

Instance520.4 Log path: C:\Users\Administrator\Desktop\Volume1\log4
Database: C:\Users\Administrator\Desktop\Volume2\db4\Jetstress004001.edb

Instance520.5 Log path: C:\Users\Administrator\Desktop\Volume4\log5
Database: C:\Users\Administrator\Desktop\Volume3\db5\Jetstress005001.edb

Instance520.6 Log path: C:\Users\Administrator\Desktop\Volume4\log6
Database: C:\Users\Administrator\Desktop\Volume3\db6\Jetstress006001.edb

Instance520.7 Log path: C:\Users\Administrator\Desktop\Volume3\log7
Database: C:\Users\Administrator\Desktop\Volume4\db7\Jetstress007001.edb

Instance520.8 Log path: C:\Users\Administrator\Desktop\Volume3\log8
Database: C:\Users\Administrator\Desktop\Volume4\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
Instance520.1	16.114	1.494	89.082	39.982	32962.099	35313.386	0.000	0.323	0.000	9.682	0.000	20323.341
Instance520.2	14.603	1.486	89.050	39.833	32966.120	35325.675	0.000	0.324	0.000	9.645	0.000	20348.434
Instance520.3	13.889	1.419	89.085	39.872	32977.941	35319.914	0.000	0.328	0.000	9.664	0.000	20323.983
Instance520.4	13.671	1.419	89.037	39.807	32968.691	35316.901	0.000	0.330	0.000	9.664	0.000	20314.380
Instance520.5	13.800	1.478	89.009	39.787	32963.730	35319.814	0.000	0.322	0.000	9.654	0.000	20319.325
Instance520.6	14.319	1.474	89.051	39.790	32969.604	35324.989	0.000	0.321	0.000	9.641	0.000	20310.276
Instance520.7	15.701	1.502	88.996	39.808	32975.043	35325.768	0.000	0.326	0.000	9.661	0.000	20319.712
Instance520.8	17.788	1.496	89.069	39.775	32968.096	35333.660	0.000	0.329	0.000	9.624	0.000	20293.700

Background Database Maintenance I/O Performance

MSExchange Database ==> Instances	Database Maintenance IO Reads/sec	Database Maintenance IO Reads Average Bytes
Instance520.1	9.710	261823.986
Instance520.2	9.710	261812.622
Instance520.3	9.710	261830.306
Instance520.4	9.710	261833.794
Instance520.5	9.711	261806.935
Instance520.6	9.710	261825.797
Instance520.7	9.711	261820.153
Instance520.8	9.710	261829.667

Log Replication I/O Performance

MSExchange Database ==> Instances	I/O Log Reads/sec	I/O Log Reads Average Bytes
Instance520.1	0.841	232035.860
Instance520.2	0.839	231873.348
Instance520.3	0.839	231912.104
Instance520.4	0.840	231834.138
Instance520.5	0.839	232035.954
Instance520.6	0.837	232035.993
Instance520.7	0.839	231712.731
Instance520.8	0.835	231953.785

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
Instance520.1	16.114	1.494	98.792	39.982	55455.884	35313.386	0.634	0.323	0.841	9.682	232035.860	20323.341
Instance520.2	14.603	1.486	98.761	39.833	55467.099	35325.675	0.638	0.324	0.839	9.645	231873.348	20348.434
Instance520.3	13.889	1.419	98.795	39.872	55470.860	35319.914	0.542	0.328	0.839	9.664	231912.104	20323.983
Instance520.4	13.671	1.419	98.746	39.807	55473.380	35316.901	0.550	0.330	0.840	9.664	231834.138	20314.380
Instance520.5	13.800	1.478	98.719	39.787	55474.698	35319.814	0.858	0.322	0.839	9.654	232035.954	20319.325
Instance520.6	14.319	1.474	98.761	39.790	55470.546	35324.989	0.818	0.321	0.837	9.641	232035.993	20310.276
Instance520.7	15.701	1.502	98.707	39.808	55488.616	35325.768	0.544	0.326	0.839	9.661	231712.731	20319.712
Instance520.8	17.788	1.496	98.779	39.775	55465.145	35333.660	0.537	0.329	0.835	9.624	231953.785	20293.700

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.358	0.144	6.969
Available MBytes	28266.910	28139.000	28351.000
Free System Page Table Entries	16603668.411	16602879.000	16603992.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	208172984.815	206000128.000	210362368.000
Pool Paged Bytes	103082765.614	102531072.000	104034304.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```
7/29/2015 10:40:45 PM -- Preparing for testing ...
7/29/2015 10:40:53 PM -- Attaching databases ...
7/29/2015 10:40:53 PM -- Preparations for testing are complete.
7/29/2015 10:40:53 PM -- Starting transaction dispatch ..
7/29/2015 10:40:53 PM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
7/29/2015 10:40:53 PM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
7/29/2015 10:41:01 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 200 msec/read).
7/29/2015 10:41:01 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 200 msec/write).
7/29/2015 10:41:02 PM -- Operation mix: Sessions 25, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
7/29/2015 10:41:02 PM -- Performance logging started (interval: 15000 ms).
7/29/2015 10:41:02 PM -- Attaining prerequisites:
7/29/2015 10:43:40 PM -- \MSExchange Database(JetstressWin)\Database Cache Size, Last: 1936978000.0 (lower bound: 1932735000.0, upper bound: none)
7/30/2015 10:43:41 PM -- Performance logging has ended.
7/30/2015 10:43:41 PM -- JetInterop batch transaction stats: 272646, 272646, 272646, 272646, 272646, 272646, 272645 and 272645.
7/30/2015 10:43:41 PM -- Dispatching transactions ends.
7/30/2015 10:43:41 PM -- Shutting down databases ...
7/30/2015 10:43:52 PM -- Instance520.1 (complete), Instance520.2 (complete), Instance520.3 (complete), Instance520.4 (complete), Instance520.5 (complete), Instance520.6
(complete), Instance520.7 (complete) and Instance520.8 (complete)
7/30/2015 10:43:52 PM -- C:\Program Files\Exchange Jetstress\Stress_2015_7_29_22_41_1.blg has 5764 samples.
7/30/2015 10:43:52 PM -- Creating test report ...
7/30/2015 10:44:14 PM -- Instance520.1 has 16.1 for I/O Database Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.1 has 0.3 for I/O Log Writes Average Latency.
7/30/2015 10:44:14 PM -- Instance520.1 has 0.3 for I/O Log Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.2 has 14.6 for I/O Database Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.2 has 0.3 for I/O Log Writes Average Latency.
7/30/2015 10:44:14 PM -- Instance520.2 has 0.3 for I/O Log Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.3 has 13.9 for I/O Database Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.3 has 0.3 for I/O Log Writes Average Latency.
7/30/2015 10:44:14 PM -- Instance520.3 has 0.3 for I/O Log Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.4 has 13.7 for I/O Database Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.4 has 0.3 for I/O Log Writes Average Latency.
7/30/2015 10:44:14 PM -- Instance520.4 has 0.3 for I/O Log Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.5 has 13.8 for I/O Database Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.5 has 0.3 for I/O Log Writes Average Latency.
7/30/2015 10:44:14 PM -- Instance520.5 has 0.3 for I/O Log Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.6 has 14.3 for I/O Database Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.6 has 0.3 for I/O Log Writes Average Latency.
7/30/2015 10:44:14 PM -- Instance520.6 has 0.3 for I/O Log Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.7 has 15.7 for I/O Database Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.7 has 0.3 for I/O Log Writes Average Latency.
7/30/2015 10:44:14 PM -- Instance520.7 has 0.3 for I/O Log Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.8 has 17.8 for I/O Database Reads Average Latency.
7/30/2015 10:44:14 PM -- Instance520.8 has 0.3 for I/O Log Writes Average Latency.
7/30/2015 10:44:14 PM -- Instance520.8 has 0.3 for I/O Log Reads Average Latency.
7/30/2015 10:44:14 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
7/30/2015 10:44:14 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
7/30/2015 10:44:14 PM -- C:\Program Files\Exchange Jetstress\Stress_2015_7_29_22_41_1.xml has 5753 samples queried.
```

C Backup testing

Database Backup Statistics - All

Database Instance	Database Size (MBytes)	Elapsed Backup Time	MBytes Transferred/sec
Instance716.1	1280232.03	03:04:42	115.52
Instance716.2	1280232.03	02:52:46	123.49
Instance716.3	1280224.03	02:59:25	118.92
Instance716.4	1280232.03	02:47:25	127.45
Instance716.5	1280224.03	02:43:29	130.50
Instance716.6	1280232.03	02:57:06	120.47
Instance716.7	1280224.03	03:07:35	113.75
Instance716.8	1280224.03	03:11:56	111.16
Avg			120.16
Sum			961.27

Jetstress System Parameters

Thread Count	32
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

Instance716.1 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Volume1\db1\Jetstress001001.edb

Instance716.2 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Volume1\db2\Jetstress002001.edb

Instance716.3 Log path: C:\Users\Administrator\Desktop\Volume1\log3
Database: C:\Users\Administrator\Desktop\Volume2\db3\Jetstress003001.edb

Instance716.4 Log path: C:\Users\Administrator\Desktop\Volume1\log4
Database: C:\Users\Administrator\Desktop\Volume2\db4\Jetstress004001.edb

Instance716.5 Log path: C:\Users\Administrator\Desktop\Volume4\log5
Database: C:\Users\Administrator\Desktop\Volume3\db5\Jetstress005001.edb

Instance716.6 Log path: C:\Users\Administrator\Desktop\Volume4\log6
Database: C:\Users\Administrator\Desktop\Volume3\db6\Jetstress006001.edb

Instance716.7 Log path: C:\Users\Administrator\Desktop\Volume3\log7
Database: C:\Users\Administrator\Desktop\Volume4\db7\Jetstress007001.edb

Instance716.8 Log path: C:\Users\Administrator\Desktop\Volume3\log8
Database: C:\Users\Administrator\Desktop\Volume4\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
Instance716.1	2.988	0.000	462.612	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance716.2	2.241	0.000	494.089	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance716.3	3.893	0.000	476.005	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance716.4	4.040	0.000	509.670	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance716.5	3.865	0.000	522.729	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance716.6	4.057	0.000	482.053	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance716.7	4.489	0.000	455.181	0.000	262144.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instance716.8	5.472	0.000	440.265	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	0.876	0.605	1.165
Available MBytes	30415.736	30391.000	30444.000
Free System Page Table Entries	16603788.407	16603160.000	16604000.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	205541023.081	205447168.000	205910016.000
Pool Paged Bytes	102685511.520	102604800.000	102801408.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

7/29/2015 7:15:52 PM -- Preparing for testing ...
7/29/2015 7:16:00 PM -- Attaching databases ...
7/29/2015 7:16:00 PM -- Preparations for testing are complete.
7/29/2015 7:16:09 PM -- Performance logging started (interval: 30000 ms).
7/29/2015 7:16:09 PM -- Backing up databases ...
7/29/2015 10:28:06 PM -- Performance logging has ended.
7/29/2015 10:28:06 PM -- Instance716.1 (100% processed), Instance716.2 (100% processed), Instance716.3 (100% processed), Instance716.4 (100% processed), Instance716.5 (100% processed), Instance716.6 (100% processed), Instance716.7 (100% processed) and Instance716.8 (100% processed)
7/29/2015 10:28:06 PM -- C:\Program Files\Exchange Jetstress\DatabaseBackup_2015_7_29_19_16_0.blg has 383 samples.
7/29/2015 10:28:06 PM -- 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) 5000 users Microsoft Exchange 2013 1 Dell Poweredge R720 server with Microsoft Server 2012 r2 installed 2GB Mailboxes, 5000 users per server, 0.12 IOPs 8 DB and LOG on 4 LUNs (combined) Dell MD3820f using Dynamic Disk Pool (20 drives) technology for data protection SAS Direct Attach
Test Start Time	7/29/2015 4:17:15 PM
Test End Time	7/29/2015 5:31:28 PM
Collection Start Time	7/29/2015 4:17:50 PM
Collection End Time	7/29/2015 5:31:08 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_29_16_17_34.blg

Database Sizing and Throughput

Achieved Transactional I/O per Second	1156.308
Target Transactional I/O per Second	600
Initial Database Size (bytes)	10737485348864
Final Database Size (bytes)	10739397951488
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%

Database Configuration

Instance760.1 Log path: C:\Users\Administrator\Desktop\Volume2\log1
Database: C:\Users\Administrator\Desktop\Volume1\db1\Jetstress001001.edb

Instance760.2 Log path: C:\Users\Administrator\Desktop\Volume2\log2
Database: C:\Users\Administrator\Desktop\Volume1\db2\Jetstress002001.edb

Instance760.3 Log path: C:\Users\Administrator\Desktop\Volume1\log3
Database: C:\Users\Administrator\Desktop\Volume2\db3\Jetstress003001.edb

Instance760.4 Log path: C:\Users\Administrator\Desktop\Volume1\log4
Database: C:\Users\Administrator\Desktop\Volume2\db4\Jetstress004001.edb

Instance760.5 Log path: C:\Users\Administrator\Desktop\Volume4\log5
Database: C:\Users\Administrator\Desktop\Volume3\db5\Jetstress005001.edb

Instance760.6 Log path: C:\Users\Administrator\Desktop\Volume4\log6
Database: C:\Users\Administrator\Desktop\Volume3\db6\Jetstress006001.edb

Instance760.7 Log path: C:\Users\Administrator\Desktop\Volume3\log7
Database: C:\Users\Administrator\Desktop\Volume4\db7\Jetstress007001.edb

Instance760.8 Log path: C:\Users\Administrator\Desktop\Volume3\log8
Database: C:\Users\Administrator\Desktop\Volume4\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
Instance760.1	16.210	2.166	100.178	44.359	32768.000	35630.036	0.000	0.328	0.000	11.882	0.000	20422.753
Instance760.2	14.985	2.148	100.316	44.076	32768.000	35648.130	0.000	0.328	0.000	11.837	0.000	20295.635
Instance760.3	14.200	2.054	100.586	43.855	32768.000	35624.868	0.000	0.331	0.000	11.799	0.000	20081.431
Instance760.4	14.034	2.037	100.529	44.725	32768.150	35567.201	0.000	0.332	0.000	12.020	0.000	20193.824
Instance760.5	14.176	2.212	100.409	44.156	32768.235	35551.000	0.000	0.326	0.000	11.747	0.000	20401.673
Instance760.6	14.621	2.230	100.134	44.211	32768.000	35628.719	0.000	0.328	0.000	11.862	0.000	20357.391
Instance760.7	15.930	2.183	99.930	43.579	32768.000	35713.538	0.000	0.332	0.000	11.720	0.000	20480.857
Instance760.8	17.809	2.191	100.735	44.531	32768.000	35514.668	0.000	0.333	0.000	11.875	0.000	20172.606

Host System Performance

Counter	Average	Minimum	Maximum
% Processor Time	0.411	0.261	0.629
Available MBytes	28355.153	28305.000	30146.000
Free System Page Table Entries	16603741.003	16603466.000	16603925.000
Transition Pages RePurposed/sec	0.000	0.000	0.000
Pool Nonpaged Bytes	205583004.735	204656640.000	205713408.000
Pool Paged Bytes	102516986.776	102510592.000	102572032.000
Database Page Fault Stalls/sec	0.000	0.000	0.000

Test Log

```
7/29/2015 4:17:15 PM -- Preparing for testing ...
7/29/2015 4:17:26 PM -- Attaching databases ...
7/29/2015 4:17:26 PM -- Preparations for testing are complete.
7/29/2015 4:17:26 PM -- Starting transaction dispatch ..
7/29/2015 4:17:26 PM -- Database cache settings: (minimum: 256.0 MB, maximum: 2.0 GB)
7/29/2015 4:17:26 PM -- Database flush thresholds: (start: 20.5 MB, stop: 40.9 MB)
7/29/2015 4:17:34 PM -- Database read latency thresholds: (average: 20 msec/read, maximum: 100 msec/read).
7/29/2015 4:17:34 PM -- Log write latency thresholds: (average: 10 msec/write, maximum: 100 msec/write).
7/29/2015 4:17:35 PM -- Operation mix: Sessions 25, Inserts 40%, Deletes 20%, Replaces 5%, Reads 35%, Lazy Commits 70%.
7/29/2015 4:17:35 PM -- Performance logging started (interval: 15000 ms).
7/29/2015 4:17:35 PM -- Generating log files ...
7/29/2015 5:31:18 PM -- C:\Users\Administrator\Desktop\Volume2\log1 (102.2% generated), C:\Users\Administrator\Desktop\Volume2\log2 (101.2% generated),
C:\Users\Administrator\Desktop\Volume1\log3 (100.2% generated), C:\Users\Administrator\Desktop\Volume1\log4 (102.4% generated),
C:\Users\Administrator\Desktop\Volume4\log5 (100.8% generated), C:\Users\Administrator\Desktop\Volume4\log6 (102.0% generated),
C:\Users\Administrator\Desktop\Volume3\log7 (101.2% generated) and C:\Users\Administrator\Desktop\Volume3\log8 (101.0% generated)
7/29/2015 5:31:18 PM -- Performance logging has ended.
7/29/2015 5:31:18 PM -- JetInterop batch transaction stats: 17111, 17111, 17111, 17111, 17111, 17111, 17110 and 17110.
7/29/2015 5:31:18 PM -- Dispatching transactions ends.
7/29/2015 5:31:19 PM -- Shutting down databases ...
7/29/2015 5:31:28 PM -- Instance760.1 (complete), Instance760.2 (complete), Instance760.3 (complete), Instance760.4 (complete), Instance760.5 (complete), Instance760.6
(complete), Instance760.7 (complete) and Instance760.8 (complete)
7/29/2015 5:31:28 PM -- C:\Program Files\Exchange Jetstress\Performance_2015_7_29_16_17_34.blg has 294 samples.
7/29/2015 5:31:28 PM -- Creating test report ...
7/29/2015 5:31:28 PM -- Instance760.1 has 16.2 for I/O Database Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.1 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 5:31:28 PM -- Instance760.1 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.2 has 15.0 for I/O Database Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.2 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 5:31:28 PM -- Instance760.2 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.3 has 14.2 for I/O Database Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.3 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 5:31:28 PM -- Instance760.3 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.4 has 14.0 for I/O Database Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.4 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 5:31:28 PM -- Instance760.4 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.5 has 14.2 for I/O Database Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.5 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 5:31:28 PM -- Instance760.5 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.6 has 14.6 for I/O Database Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.6 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 5:31:28 PM -- Instance760.6 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.7 has 15.9 for I/O Database Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.7 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 5:31:28 PM -- Instance760.7 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.8 has 17.8 for I/O Database Reads Average Latency.
7/29/2015 5:31:28 PM -- Instance760.8 has 0.3 for I/O Log Writes Average Latency.
7/29/2015 5:31:28 PM -- Instance760.8 has 0.3 for I/O Log Reads Average Latency.
7/29/2015 5:31:28 PM -- Test has 0 Maximum Database Page Fault Stalls/sec.
7/29/2015 5:31:28 PM -- The test has 0 Database Page Fault Stalls/sec samples higher than 0.
7/29/2015 5:31:28 PM -- C:\Program Files\Exchange Jetstress\Performance_2015_7_29_16_17_34.xml has 293 samples queried.
```