

VMMARK 2.5.2 VIRTUALIZATION PERFORMANCE OF THE DELL EQUALLOGIC PS6210XS STORAGE ARRAY

Dell™ EqualLogic™ PS6210XS

achieved a VMware® VMmark® score of **14.80@12 tiles**



SSD performance without sacrificing capacity, in mixed virtualized workloads including vMotion®



vmware®

Many modern data centers are using virtual machines (VMs) to consolidate physical servers to increase operational efficiency. As multi-core processors become more commonplace, underutilization of physical servers has become an increasing problem. Without virtualization, it is very difficult to fully utilize the power of a modern server. In a virtualized environment, a software layer lets users create multiple independent VMs on a single physical server, taking full advantage of the hardware resources. The storage solution, which is just as important as the servers and processors, should be flexible to accommodate the demands on real-world applications and operations that virtualization brings to the table.

In all virtualized environments where the underlying storage resources are shared among VMs, storage performance can deteriorate due to a phenomenon called the input/output (I/O) blender effect. Multiple VMs send their I/O streams to a hypervisor for processing. Unfortunately, if you are using more than one type of workload, I/O profiles are no longer consistent. This randomization of I/O workload profiles, which can occur with all virtualization platforms, renders prior workload optimizations ineffective, which can increase latency, or response time.

Because the performance requirements of storage in a completely virtualized environment differ from those in a physical or only partially virtualized environment, it is important to use a benchmark designed with these differences in mind, such as



A PRINCIPLED TECHNOLOGIES TEST REPORT

NOVEMBER 2014

Commissioned by Dell

VMware VMmark 2.5.2. VMmark incorporates a variety of platform-level workloads such as vMotion® and Storage vMotion® in addition to executing diverse workloads on a collection of virtual machines. VMmark expresses scores in terms of tiles; a tile consists of eight VMs that include database servers, Web servers, mail servers, as well as standby servers.

In the Principled Technologies labs, the Dell EqualLogic PS6210XS array, paired with a cluster of Dell PowerEdge M620 servers, supported 12 VMmark tiles for a total of 96 running VMs, and achieved a score of 14.80@12 tiles. This score indicates that the Dell EqualLogic PS6210XS array can simultaneously handle multiple virtualized applications and hypervisor operations while maintaining a strong level of performance, making it an excellent choice for small to medium enterprise customers who want to take advantage of the benefits that virtualization has to offer.

WHAT WE TESTED

Dell EqualLogic PS6210XS 10GbE iSCSI storage array paired with Dell PowerEdge M620 servers

The Dell EqualLogic PS6210XS is a hybrid storage solution that combines SSD speed and HDD capacity within one array. It uses a combination of 7 SSDs and 17 10K SAS HDDs with a raw capacity of up to 26TB per array. According to Dell, it is ideal for VDI deployments, important databases, and other mixed workloads.

To learn more about the EqualLogic PS6210XS, visit www.dell.com/us/business/p/equallogic-ps6210-series/pd.

As our goal was to discover the capabilities of the storage, we used multiple Dell PowerEdge M620 servers in a cluster and split the workload responsibilities among the servers. We found that with four M620 servers, we reached saturation on the storage before performance bottlenecked on the servers.

VMmark 2.5.2

We selected VMmark 2.5.2 to measure the performance of the Dell EqualLogic PS6210XS array. To compare platforms for virtualization, users need meaningful and accurate metrics. Benchmarks developed to measure performance in non-virtualized environments work by pushing one or more of the underlying hardware resources to saturation. They don't help you understand how virtual environments supporting multiple simultaneous workloads can scale.

Some multi-workload server consolidation benchmarks, such as VMware VMmark 1.1, measure single-host performance in virtualized environments. However, typical server usage is evolving as technological advances enable easier virtualization of bursty and heavy workloads, dynamic virtual machine relocation, dynamic datastore relocation, and the automation of many provisioning and administrative tasks across large-scale multi-host environments. Now, much of the stress on CPU, network, disk,

and memory subsystems is generated by the underlying infrastructure operations. Application performance also depends on effectively balancing load across multiple hosts. To be useful in this environment, a benchmark needs to look at both user-centric application performance and overall platform performance.

VMware VMmark 2.5.2, which has become an industry standard, meets these criteria. In addition to using this unique benchmark approach, VMware maintains very strict standards for execution and publication.

VMWARE + DELL EQUALLOGIC STORAGE = INTEGRATION

Until recently, only basic storage protocols were available to integrate storage area networks (SANs) and virtualization platforms. Lack of integration between the hypervisor and the underlying storage infrastructure prevented virtualized servers from taking full advantage of the data protection and performance features of enterprise-class storage.

Thanks to VMware vSphere Storage APIs (VAAI), this is no longer the case. Dell EqualLogic PS Series Internet SCSI (iSCSI) SAN arrays are compatible with VAAI, and as such all of their capabilities are transparently integrated into the VMware Infrastructure environment.

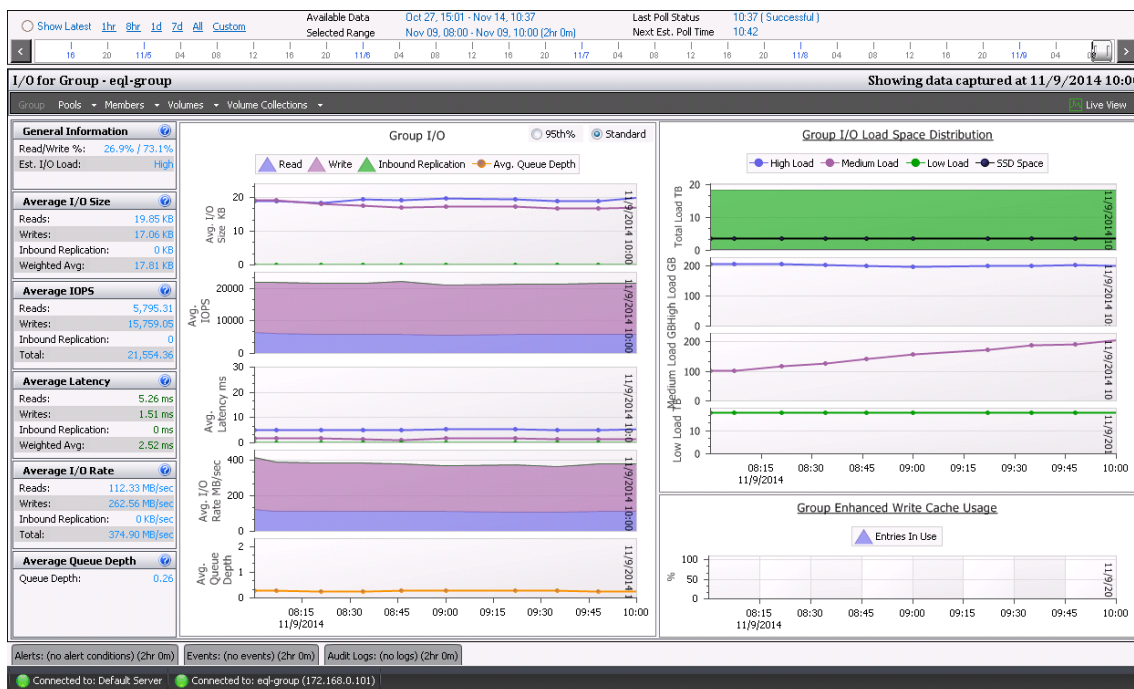
Dell's Virtual Storage Manager (VSM) makes managing the Dell EqualLogic PS6210XS array a simple and straightforward experience using tools that many IT administrators are already familiar with and use every day such as VMware vCenter and vSphere Web Client. Because VSM fully supports vSphere Storage APIs for Storage Awareness (VASA), it allows administrators to centralize the management of storage groups and assist in the creation, cloning, replication, configuration, and management of datastores using a graphical user interface through VMware vCenter.

EASE OF MANAGEMENT

Dell EqualLogic SAN HeadQuarters (SAN HQ) provides tools for administrators to keep a high-level view of the storage system, while providing the flexibility to make granular changes as needed.¹ Figure 1 illustrates using SAN HQ to manage the SAN and to monitor it for any issues.

¹ For more information on Dell EqualLogic SAN HQ, see www.dell.com/downloads/global/products/pvaul/en/equallogic-san-headquarters2.0.pdf

Figure 1: Monitoring the SAN using EqualLogic SAN HQ.



OUR TESTING

VMmark measures the performance and scalability of real-world applications running in virtualized environments. It is designed to measure virtual datacenter performance accurately and reliably using predefined tiles, and it is used to compare the performance of different hardware and virtualization configurations. To successfully support a tile, acceptable QoS levels must be met, and scores are given based on the number of operations or transactions the multiple applications are able to complete during the test.

A VMmark tile is composed of the following:

- A virtual Microsoft Exchange Server 2007 with 1,000 heavy profile users
- Two Olio virtual machines (Olio Web and Olio Database) that simulate a Web 2.0 application focused and social networking and events
- Four DVD Store Version 2 (DS2) virtual machines (three DS2 Web servers and one DS2 database) that simulate an E-commerce application
- One virtual Windows Server 2003 that serves as a standby machine

In addition to running the virtualized applications, VMmark also performs the following tasks during a test:

- Virtual machine cloning and deployment
- Dynamic virtual machine relocation using vMotion
- Dynamic Storage Relocation using Storage vMotion
- Automated virtual machine load balancing

To carry out the VMmark testing, we downloaded the benchmark from www.vmware.com/products/vmmark/. We followed the test directions in the VMware VMmark Benchmarking Guide (VMmark_Benchmarking_Guide_2.5.2.pdf), included with the download of VMmark 2.5.2 made publicly available on February 12, 2014. We used the guide's instructions to build the mail server, standby, and deploy template VMs from scratch. For the Oliodb, OlioWeb, DS2DB, and DS2Web VMs, we used the VMmark prebuilt templates.

Learn more about VMmark at

www.vmware.com/products/vmmark/overview.html.

ANALYZING THE RESULTS

As Figure 2 shows, the EqualLogic 6210XS array offered consistent operations per second throughout the run, averaging 21,727 IOPS. VMmark provided a persistent load on the storage, and as Figure 2 shows, the storage was able to handle it well.

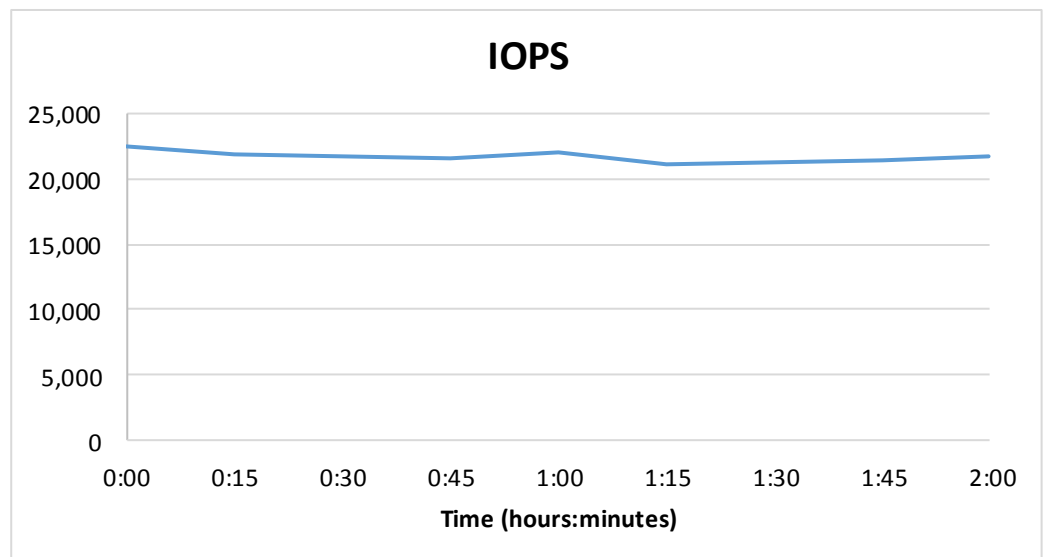


Figure 2: I/O operations per second during the VMmark run.

In addition to consistent level of IOPS, the EqualLogic 6210XS array demonstrated acceptably low latencies, averaging around 5 ms through the test run with occasional spikes during large groups of VM migrations (observed maximum latency ~55 ms). Thanks to write caching from the SSDs as well as data tiering between the SSDs and HDDs in the hybrid array, applications have much shorter wait times for retrieving data than they would in a purely HDD array. For a detailed look at our hardware configuration, see [Appendix A](#). See [Appendix B](#) for our test bed diagram and [Appendix C](#) for detailed VMmark 2.5.2 results.

CONCLUSION

Virtualization is a critical part of data center computing. For your virtualization solution to succeed, it is essential that you have a storage platform capable of delivering the performance and capacity needed for a virtualized environment in a cost effective way. The Dell EqualLogic PS6210XS array, paired with a cluster of Dell PowerEdge M620 servers, ran 12 VMmark tiles for a total of 96 running VMs, and achieved a score of 14.80@12. This performance, along with its value and ease of management, make the Dell EqualLogic PS6210XS array an excellent investment.

APPENDIX A – STORAGE DISCLOSURE AND SYSTEM CONFIGURATION

Figure 3 presents detailed configuration information about the servers we used in testing.

System	Dell PowerEdge M620 (servers under test)	Dell PowerEdge R620 (virtual client hosts)
Enclosure /chassis		
Blade enclosure/chassis	Dell PowerEdge M1000e Blade Enclosure with 2x MXL 10/40Gbe and 4x Force 10 XML 10/40GbE switch	N/A
General		
Number of processor packages	2	2
Number of cores per processor	8	12
Number of hardware threads per core	2	2
CPU		
Vendor	Intel®	Intel
Name	Xeon®	Xeon
Model number	E5-2680	E5-2695 v2
Socket type	LGA2011	LGA2011
Core frequency (GHz)	2.70	2.40
Bus frequency	8.0 GT/s	8.0 GT/s
L1 cache	32 KB + 32 KB	32 KB + 32 KB
L2 cache	256 KB (per core)	256 KB (per core)
L3 cache	20 MB	30 MB
Platform		
Vendor and model	Dell PowerEdge M620	Dell PowerEdge R620
BIOS name and version	Dell 2.2.7	Dell 2.2.2
BIOS settings	Default	Default
Memory module(s)		
Total RAM in system (GB)	256	384
Vendor and model number	Hynix® HMT42GR7MFR4C-PB	Hynix HMT42GR7MFR4C-PB
Type	PC3-12800R	PC3-12800R
Speed (MHz)	1,600	1,600
Speed running in the system (MHz)	1,600	1,600
Size (GB)	16	16
Number of RAM module(s)	16	24
Rank	Dual	Dual
OS/hypervisor		
Name	VMware ESXi 5.5.0	VMware ESXi 5.5.0
Build number	1881737	1881737
File system	VMFS	VMFS
Language	English	English
RAID controller		
Vendor and model number	PERC H310 Mini	PERC H710P Mini

System	Dell PowerEdge M620 (servers under test)	Dell PowerEdge R620 (virtual client hosts)
Hard drives		
Vendor and model number	Dell MBF2600RC	Dell MBF2600RC
Number of drives	2	2
Size (GB)	600	600
Type	SAS	SAS
Network adapter		
Vendor and model number	Broadcom® NetXtreme® II BCM57810 10GB	Broadcom NetXtreme II BCM57800 10GB
Number of ports	2	2
Type	Integrated	Integrated
Ethernet adapter B		
Vendor and model number	Intel 82599EB 10GB	N/A
Number of ports	2	N/A
Type	Mezzanine card	N/A
Ethernet adapter C		
Vendor and model number	Intel 82599EB 10GB	N/A
Number of ports	2	N/A
Type	Mezzanine card	N/A

Figure 3: System configuration information for our test servers.

Figure 4 provides configuration information about the Dell EqualLogic PS6210XS array we used in our tests.

Storage array	Dell EqualLogic PS6210XS
Number of storage shelves	1 x 24 disks enclosure
Number of storage controllers	2
Firmware revision	V7.0.4
Disk model number	7 x LB806M
Disk size (GB)	800
Disk type	SAS SSD
Disk model number	17 x HUC101212CSS600
Disk size (TB)	1.2
Disk type	SAS HDD

Figure 4: Detailed configuration information for the storage arrays.

APPENDIX B – TEST BED CONFIGURATION

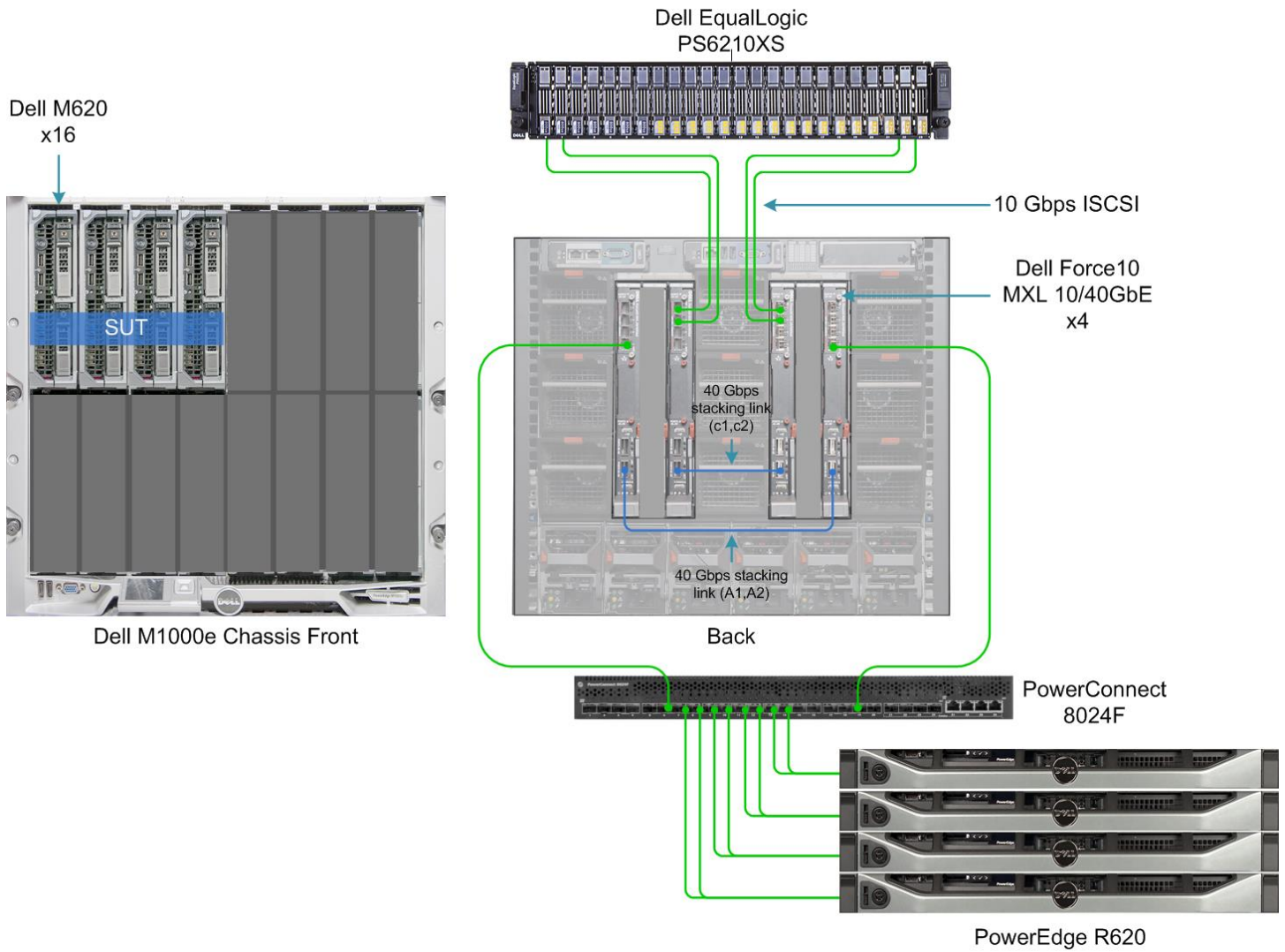


Figure 5: Configuration of our test bed.

APPENDIX C – VMMARK 2.5.2 DETAILED RESULTS

VMware® VMmark® V2.5.2 Results																
Vendor and Hardware Platform: Dell PowerEdge M620 Virtualization Platform: VMware ESXi 5.5.0 Update 1 Build 1881737 VMware vCenter Server 5.5.0 Build 1750787										VMmark V2.5.2 Score = 14.80 @ 12 Tiles						
Number of Hosts: 4					Uniform Hosts [yes/no]: yes					Total sockets/cores/threads in test: 8/64/128						
Tested By: Principled Technologies										Test Date: [11-09-2014]						
Performance Section Performance					Configuration Section Configuration					Notes Section Notes for Workload						

Performance

	mailserver			olio			dvdstoreA			dvdstoreB			dvdstoreC			
TILE_0	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	328.40	0.99	173.00	4787.82	1.03	63.59	3026.97	1.38	113.49	2456.43	1.62	127.11	1865.20	1.76	131.63	1.32
p1	324.98	0.98	234.97	4789.07	1.03	57.28	3575.25	1.63	73.84	2861.47	1.88	80.88	2034.62	1.92	84.80	1.43
p2	324.77	0.98	272.75	4766.25	1.03	60.80	3592.93	1.63	73.40	2969.80	1.96	80.76	2171.00	2.05	83.22	1.46
TILE_1	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	329.05	1.00	183.97	4784.50	1.03	54.78	3376.47	1.54	113.17	2357.97	1.55	126.72	1743.65	1.65	138.01	1.32
p1	328.18	0.99	252.65	4778.32	1.03	54.50	4025.25	1.83	73.58	2898.07	1.91	80.94	2073.07	1.96	85.00	1.48
p2	328.12	0.99	276.25	4755.93	1.02	58.97	4049.10	1.84	71.69	3146.20	2.07	76.68	2299.78	2.17	82.92	1.53
TILE_2	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	326.80	0.99	186.60	4774.05	1.03	54.02	3351.80	1.52	114.95	2361.32	1.55	128.84	1683.72	1.59	133.89	1.31
p1	329.40	1.00	259.77	4779.88	1.03	57.67	4006.60	1.82	73.08	3009.50	1.98	78.69	2193.65	2.07	81.63	1.50
p2	328.70	1.00	289.68	4772.15	1.03	61.46	3948.47	1.80	75.05	2963.40	1.95	80.54	2267.60	2.14	85.55	1.50
TILE_3	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	326.38	0.99	171.97	4785.05	1.03	52.78	3452.10	1.57	104.87	2454.50	1.62	115.90	1735.67	1.64	125.37	1.34
p1	325.98	0.99	227.85	4775.00	1.03	56.34	4198.43	1.91	64.89	3275.82	2.16	69.90	2428.50	2.30	72.08	1.57
p2	331.88	1.00	265.93	4757.93	1.03	60.76	4090.72	1.86	70.33	2941.88	1.94	78.28	2209.30	2.09	82.80	1.51
TILE_4	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	325.95	0.99	208.30	4781.07	1.03	53.68	3376.75	1.54	109.14	2508.72	1.65	118.37	1837.33	1.74	119.86	1.35

p1	326.40	0.99	273.55	4797.60	1.03	57.27	4156.18	1.89	66.28	3123.70	2.06	72.47	2353.28	2.22	77.32	1.55
p2	323.50	0.98	307.23	4777.93	1.03	60.64	4035.78	1.84	71.39	2933.55	1.93	76.92	2047.60	1.94	85.34	1.47
TILE_5	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	330.60	1.00	190.68	4778.90	1.03	53.67	3580.40	1.63	100.06	2724.25	1.79	109.48	1992.17	1.88	111.79	1.41
p1	328.32	0.99	246.72	4778.98	1.03	55.57	4244.95	1.93	63.85	3075.30	2.03	69.52	2279.00	2.15	75.78	1.54
p2	324.85	0.98	272.50	4775.32	1.03	59.63	4040.22	1.84	72.58	2918.45	1.92	78.49	2111.57	2.00	81.65	1.48
TILE_6	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	326.95	0.99	220.95	4771.80	1.03	53.52	3644.32	1.66	97.78	2698.15	1.78	107.26	1938.28	1.83	115.17	1.41
p1	330.43	1.00	290.85	4795.02	1.03	56.82	4225.70	1.92	63.41	3065.45	2.02	68.43	2269.70	2.15	74.09	1.54
p2	323.75	0.98	308.90	4759.52	1.03	77.15	4006.35	1.82	73.75	2982.57	1.96	81.11	2145.07	2.03	86.94	1.49
TILE_7	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	324.43	0.98	183.12	4798.23	1.03	53.15	3580.12	1.63	102.67	2597.22	1.71	116.74	1870.45	1.77	121.63	1.38
p1	326.55	0.99	234.50	4783.12	1.03	57.18	4151.77	1.89	66.36	3005.93	1.98	71.80	2168.88	2.05	73.27	1.51
p2	328.50	0.99	271.25	4781.52	1.03	60.15	4035.38	1.83	72.81	3002.88	1.98	79.25	2286.65	2.16	82.78	1.52
TILE_8	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	327.18	0.99	204.62	4770.43	1.03	53.73	3792.75	1.72	86.49	2830.28	1.86	93.32	2015.97	1.91	102.59	1.44
p1	328.40	0.99	253.68	4778.27	1.03	55.41	4161.20	1.89	66.51	3127.88	2.06	71.42	2281.65	2.16	75.51	1.54
p2	326.45	0.99	277.05	4795.48	1.03	59.76	4006.05	1.82	74.20	2844.95	1.87	82.97	2126.20	2.01	87.86	1.48
TILE_9	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	328.38	0.99	195.10	4781.10	1.03	53.54	3802.95	1.73	85.41	2861.28	1.88	89.95	2137.68	2.02	87.46	1.46
p1	329.27	1.00	267.57	4770.05	1.03	55.06	4225.55	1.92	63.94	3159.72	2.08	70.32	2428.20	2.29	71.74	1.57
p2	323.38	0.98	289.00	4762.38	1.03	58.85	4068.45	1.85	70.80	2958.47	1.95	75.59	2120.50	2.00	80.71	1.49
TILE_10	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	321.50	0.97	192.45	4795.65	1.03	52.79	3686.97	1.68	94.28	2816.30	1.85	103.11	2076.12	1.96	104.38	1.44
p1	326.98	0.99	256.62	4787.00	1.03	55.94	4119.45	1.87	68.23	2978.47	1.96	74.18	2230.03	2.11	79.33	1.51
p2	332.15	1.01	282.02	4778.23	1.03	60.18	3947.72	1.80	75.04	2847.62	1.88	81.27	2060.72	1.95	82.97	1.47
TILE_11	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	Actual	Ratio	QoS	GM
p0	326.45	0.99	181.85	4781.55	1.03	52.47	3957.97	1.80	80.80	2935.80	1.93	89.84	2223.25	2.10	95.31	1.49
p1	324.12	0.98	225.50	4771.43	1.03	54.46	4204.10	1.91	63.45	3100.00	2.04	65.35	2230.28	2.11	68.67	1.53
p2	329.68	1.00	261.93	4775.20	1.03	57.66	4136.25	1.88	67.45	3123.88	2.06	71.55	2293.47	2.17	74.04	1.54
p0_score:	16.67															
p1_score:	18.25															
p2_score:	17.93															

Infrastructure_Operations_Scores:										vmotion			svmotion			deploy		
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Completed_Ops_PerHour	35.00	20.00	10.00
Avg_Seconds_To_Complete	22.03	58.86	351.60
Failures	0.00	0.00	0.00
Ratio	2.19	2.22	2.50
Number_Of_Threads	2	2	2

Summary	Run_Is_Compliant	Turbo_Setting:0
	Number_Of_Compliance_Issues(0)*	Median_Phase(p2)
Unreviewed_VMmark2_Applications_Score	17.93	
Unreviewed_VMmark2_Infrastructure_Score	2.30	
Unreviewed_VMmark2_Score	14.80	

Configuration

Virtualization Software	
Hypervisor Vendor, Product, Version, and Build / Availability Date (MM-DD-YYYY)	VMware ESXi 5.5.0 Update 1 Build 1881737 / 06-10-2014
Datacenter Management Software Vendor, Product, Version, and Build / Availability Date (MM-DD-YYYY)	VMware vCenter Server 5.5.0 Build 1750787 / 04-19-2014
Supplemental Software	None
Servers	
Quantity	4
Server Manufacturer and Model	Dell PowerEdge M620
Processor Vendor and Model	Intel Xeon E5-2680
Processor Speed (GHz)	2.7
Total Sockets/Total Cores/Total Threads	2 Sockets / 16 Cores / 32 Threads
Primary Cache	32 KB I + 32 KB D on chip per core
Secondary Cache	256KB I+D on chip per core

Other Cache	20MB I+D on chip per core
BIOS Version	2.2.7
Memory Size (in GB, Number of DIMMs)	256, 16 DIMMs
Memory Type and Speed	16GB DIMMs 2Rx4 DDR3-1600MHz Registered ECC
Disk Subsystem Type	iSCSI SAN
Number of Disk Controllers	1
Disk Controller Vendors and Models	Dell PERC H310
Number of Host Bus Adapters	None
Host Bus Adapter Vendors and Models	None
Number of Network Controllers	2
Network Controller Vendors and Models	Broadcom® 10Gbps dual-port NetXtreme® II BCM57810 adapter, 10Gbps dual-port Intel 82599EB adapter
Other Hardware	Dell PowerEdge M1000e Blade Enclosure
Other Software	The following drivers were installed as part of the Dell-customized image for ESXi 5.5: tg3 - 3.133d.v55.1, bnx2 - 2.2.3t.v55.7, bnx2x - 1.78.28.v55.2, cnic - 1.78.12.v55.6, cnic-register - 1.78.1.v55.7, bnx2fc - 1.78.16.v55.4, bnx2i - 2.78.11.v55.4, qlnativefc - 1.1.7.0 - 10EM.550.0.0.1198610, qla4xxx - 634.55.20.0-1vmw, qlcnic - 5.5.164, qlge - v3.00.00.57, igb - 4.2.16.8, ixgbe - 3.18.7iov, lpfc - 10.0.575.8-10EM.550.0.0.1198611, elxnet - 10.0.575.7-10EM-550.0.0.1198611, be2iscsi - 4.6.261.0, mpt2sas - 16.00.01.00.1vmw
Hardware Availability Date (MM-DD-YYYY)	01-21-2014
Software Availability Date (MM-DD-YYYY)	06-10-2014
Network	
Network Switch Vendors and Models	4 x Dell Networking MXL 10/40GbE blade switches
Network Speed	10Gbps for all traffic
Storage	
Array Vendors, Models, and Firmware Versions	Dell EqualLogic PS6210XS, Firmware version V7.0.4
Fibre Channel Switch Vendors and Models	None
Disk Space Used	3,532.6 GB

Array Cache Size	16 GB
Total Number of Physical Disks Used	24
Total Number of Enclosures/Pods/Shelves Used	1
Number of Physical Disks Used per Enclosure/Pod/Shelf	24
Total Number of Storage Groups Used	1
Number of LUNs Used	10
LUN Size and Number of Disks Per LUN	Details in section Storage Notes
RAID Type	Details in section Storage Notes
Number of Members per RAID Set	Details in section Storage Notes
Disk Vendors, Models, and Speeds	<ul style="list-style-type: none"> 7 x SanDisk LB806M, 800GB SSD 17 x HGST HUC101212CSS600, 1.2TB 10k RPM SAS

Datacenter Management Server

System Model	Dell PowerEdge M620
Processor Vendor and Model	Intel Xeon E5-2660
Processor Speed (GHz)	2.2 GHz
Total Sockets/Total Cores/Total Threads	2 Sockets / 16 Cores / 32 Threads
Memory	32 GB
Network Controller(s) Vendors and Models	Broadcom® 10Gbps dual-port NetXtreme® II BCM57810 adapter, 10Gbps dual-port Intel 82599EB adapter
Operating System, Version, Bitness, and Service Pack	<ul style="list-style-type: none"> Microsoft Windows Server 2008 R2 Enterprise 64-bit (prime client) VMware ESXi 5.5.0 Update 1 Build 1881737 (virtual client hosts) Microsoft Windows Server 2008 R2 Enterprise 64-bit (virtual client)
Other Hardware	None
Other Software	None

Clients

Total Number of Clients / Total Physical Clients / Total Virtual Client Hosts	13 / 1 / 4
System Model(s)	Dell PowerEdge R620
Processor Vendor(s) and Model(s)	Intel Xeon E5-2695 v2
Processor Speed(s) (GHz)	2.4

Total Sockets/Total Cores/Total Threads	2 Sockets / 12 Cores / 24 Threads
Memory per Physical Client	32 GB (prime client), 64 GB (virtual client hosts)
Network Controller(s) Vendors and Models	Broadcom® 10Gbps dual-port NetXtreme® II BCM57810 adapter, 2 x 10Gbps dual-port Intel 82599EB adapter
Operating System, Version, Bitness, and Service Pack	<ul style="list-style-type: none"> • Microsoft Windows Server 2008 R2 Enterprise 64-bit (prime client) • VMware ESXi 5.5.0 Update 1 Build 1881737 (virtual client hosts) • Microsoft Windows Server 2008 R2 Enterprise 64-bit (virtual client)
Number of Virtual Clients	12
Number of vCPUs Per Virtual Client	4
Number of vMem (GB) Per Virtual Client	4
Virtual Client Networking Notes	None
Virtual Client Storage Notes	All clients stored on Dell Storage SC4020 storage array in a single LUN.
Other Hardware	Brocade 6505 fabric switch for connectivity to Dell Storage SC4020.
Other Software	None

Notes for Workload

Virtualization Software Notes

- Virtual hardware for all VMs was set to V10
- Ethernet adapter type set to vmxnet3 for all VMs (default vmxnet2)
- CD and floppy were removed from all VMs (default attached)
- Logging was disabled for all VMs (default enabled)
- All VMs except standby configured as single virtual socket with multiple cores (default one core per multiple virtual sockets)
- SCSI adapter type PVSCSI used for all Standby VMs (default LSI Logic parallel)
- SCSI adapter type PVSCSI used for all MailServer and Linux VMs (default LSI Logic SAS)
- VMware tools were version 9344 on all VMs except standby VMs which used version 9227
- vSphere DRS Migration Threshold set to Fully Automated Level 2
- /adv/Cpu/CoschedCrossCall = 0 (default 1)
- /adv/Cpu/HTWholeCoreThreshold = 0 (default 200)
- /adv/DataMover/HardwareAcceleratedInit = 0 (default 1)
- /adv/DataMover/HardwareAcceleratedMove = 0 (default 1)
- /adv/Mem/BalancePeriod = 0 (default 15)
- /adv/Mem/SamplePeriod = 0 (default 60)
- /adv/Mem/ShareScanGHz = 0 (default 4)
- /adv/Misc/TimerMaxHardPeriod = 4000 (default 100000)
- /adv/Net/MaxNetifRxQueueLen = 500 (default 100)
- /adv/Net/MaxNetifTxQueueLen = 1000 (default 500)

- /adv/Net/NetTxCompletionWorldlet = 0 (default 1)
- /adv/Irq/IRQRebalancePeriod = 20000 (default 50)
- /adv/Irq/BestVcpuRouting = 1 (default 0)
- /adv/Numa/LTermFairnessInterval = 0 (default 5)
- /adv/Numa/PreferHT = 1 (default 0)
- /adv/Numa/MonMigEnable = 0 (default 1)
- /adv/Numa/PageMigEnable = 0 (default 1)
- /adv/Numa/RebalancePeriod = 60000 (default 2000)
- /adv/Numa/SwapLoadEnable = 0 (default 1)
- /adv/Numa/SwapLocalityEnable = 0 (default 1)

Server Notes

- CPU C6 Report disabled (default enabled)
- Package C state limit set to C0 (default no limit)
- Intel Turbo Boost Enabled (frequency boost to 3.6 GHz) (default Enabled)
- System Profile set to Performance in BIOS (default Performance Per Watt Optimized (DAPC))

Networking Notes

vSwitch Configuration:

- vSwitch0 on vmnic0 (10Gb) for Service Console, all Standby, Mail, Olio, DS2, and Deploy VMs
- vSwitch1 on vmnic2 (10Gb) for iSCSI traffic
- vSwitch2 on vmnic1 (10Gb) for VMotion
- vSwitch1 and vSwitch2 MTU size was modified to 9000 (default 1500)

Storage Notes

- ESX was installed on a two-disk RAID 1 volume from the internal 85GB SAS hard drives in each system under test
- The EqualLogic storage array was configured into one RAID 6 storage pool with a hotspare 10K RPM disk.
- The storage pool was mapped to all servers.
- Storage pool layout:
 - 1 LUN at 1.5TB, as the transfer volume
 - 1 LUN at 1TB, containing the DS2 DB VMs
 - 1 LUN at 800GB, containing the DS Web VMs
 - 1 LUN at 1.65TB, containing the Mailserver VMs
 - 1 LUN at 350GB, containing the Olio DB VMs
 - 1 LUN at 1.8TB, containing the Olio Web VMs
 - 1 LUN at 120GB, containing the standby VMs
 - 2 LUNs at 75GB, containing the Standby source targets
 - 1 LUN at 30GB, containing the Deploy cloning target location
 - 1 LUN at 30GB, containing the Deploy template VMs

Datacenter Management Server Notes

The Datacenter Management Server was a virtual machine configured with 4 vCPU and 12GB RAM on a separate ESXi host.

Operating System Notes

All Mailservers ran Microsoft Windows Server 2008 R2 Enterprise 64-bit

Software Notes

None

Client Notes

- Microsoft Windows Server 2008 R2 Enterprise 64-bit installed on client virtual machines and updated through Windows Update
- Prime client was running Microsoft Windows Server 2008 R2 Enterprise 64-bit and VMware vSphere PowerCLI 5.5 Release 2 build 1671586
- Prime client ran as a physical client
- All other clients ran as virtual machines that were each defined with 4 virtual CPUs, 4GB of memory, 1 vmxnet3 network, and 36GB of disk space
- All virtual clients were hosted on a 4 virtual client host cluster.
- Clients ran with default ESX settings

Other Notes

- VMMARK2.CONFIG was modified with RMQ_PowerCLI_Delay=20

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