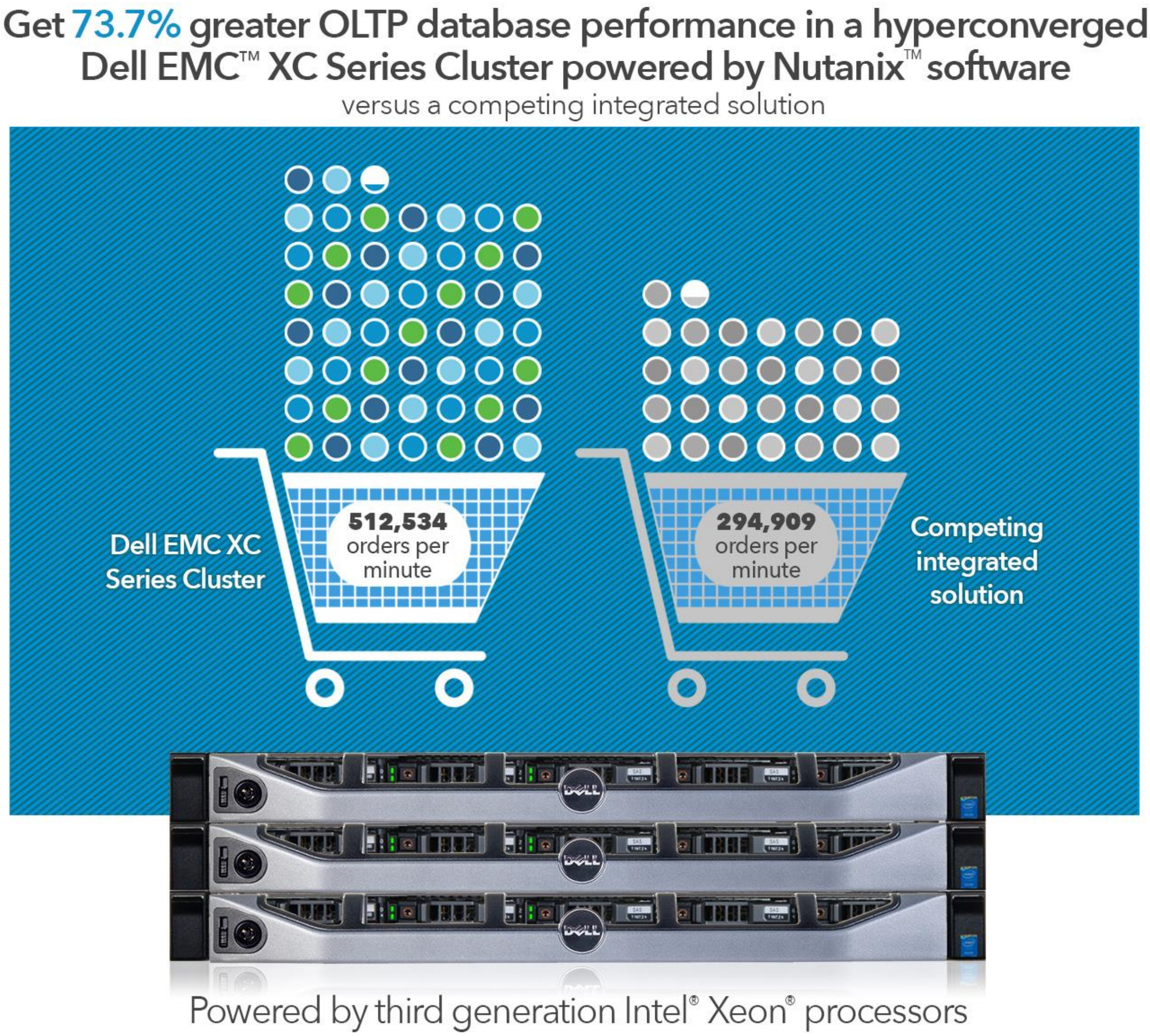
DELL EMC XC630 WEB-SCALE HYPERCONVERGED APPLIANCE: GREATER DATABASE PERFORMANCE THAN ALTERNATIVE INTEGRATED SOLUTION



If your business uses a three-tier architecture with disaggregated servers, storage, and SAN to run applications, you might be considering upgrading to an integrated solution to streamline your business. However, implementing a hyperconverged Dell EMC XC Series cluster powered by Nutanix software is an even more attractive option that can provide over 73 percent greater database performance—an advantage that translates to 50 percent greater database performance per dollar than a traditional integrated solution.[1]

In the Principled Technologies datacenter, we set up the Dell EMC XC630 hyperconverged compute/storage solution alongside a separate

[1] Based on the MSRP for the two solutions.

alternative integrated solution each running Microsoft® SQL Server® 2014 OLTP workloads along with simulated file/print and web server disk workloads.

The Dell EMC XC solution delivered 73.7 percent more database orders per minute (OPM) than the integrated solution. Taking into account the MSRP of both solutions, the Dell EMC XC solution output 2.71 OPM per dollar spent up front, while the integrated solution delivered only 1.80 OPM per dollar, making the Dell EMC XC solution a better value proposition.

In addition to superior performance, the hyperconverged Dell EMC XC solution also offers software-defined tiered storage, high availability, and a redundant network architecture. This makes it an excellent investment for businesses that are ready to take their computing and storage to the next level.

TRADITIONAL VS. INTEGRATED VS. HYPERCONVERGED

All datacenters deal with challenging complexities such as 3- to 5-year planning cycles, multiple vendors and toolkits, and ongoing maintenance. The computing approach that datacenter managers select—traditional, integrated, or hyperconverged—can have a great effect on these larger planning, implementation, and management challenges.

Traditional datacenters tend to separate compute and storage resources. Doing this correctly requires a bit of overhead, and the approach rarely yields optimal performance; in some cases, dual controller-based storage becomes the performance bottleneck.

An integrated infrastructure can improve upon the traditional approach by bringing servers, storage, networking, and software together into a single unified package; this can streamline some management challenges and reduce costs. That said, an integrated approach is largely a pre-validated packaging of traditional technologies rather than a fundamental shift in the underlying technology; as a result, some of the architecture pain points may remain.

This is not the case for a hyperconverged solution such as the cluster of Dell EMC XC630-10 appliances using Nutanix software. The Nutanix approach uses tiered software-defined storage technology that intelligently determines where to keep data based on frequency of access. In some configurations, this technology further improves performance and manageability over the integrated approach. The unique architecture of this hyperconverged solution combines a 1U form factor Dell EMC XC630-10 appliance, Intel processors,[2] onboard storage, and Nutanix software in a flexible and scalable building block.

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[2] The Dell EMC XC630-10 appliances in the configuration we tested were powered by Intel Xeon processors E5-2630 v3. These appliances are also available with other processors.

We set up the Dell EMC XC solution as a VMware® vSphere® cluster,[3] and ran a workload including Microsoft SQL Server, disk activity simulating file/print tasks, and a web server. We also set up a competing integrated solution from another vendor, whom we will call "Vendor A."[4] Figure 1 presents configuration information for the two solutions.

	Dell EMC XC solution	Competing integrated solution
Hardware		
CPU	Intel Xeon E5-2630 v3	Intel Xeon E5-2650 v3
Hardware threads available for workload processing	72*	80
Memory available	528 GB*	512 GB
Number of network ports	48 × 1 Gbps RJ-45 ports, 96 × 10 Gbps SFP+ ports, 12 × 40 Gbps QSFP+ ports	96 × 1/10 Gbps RJ-45 ports, 12 × 40 Gbps QSFP+ ports
Total rack space for servers/storage	3U	4U
Total rack space including network switches	5U	6U
SSDs	6 × 200 GB SATA 6 Gbps	–
Hard disk drives	24 × 1,000 GB SATA 6 Gbps	24 × 900 GB 10K SAS
Software		
Operating system	VMware ESXi™ 6.0.0	VMware ESXi 6.0.0
Software-defined storage software	AOS 4.5.0.2	N/A
Management software	Prism Central 4.5.0.2	Proprietary management software
Deduplication/compression	Yes	Yes
Compression	Yes	Yes
Snapshot granularity	Minute	Hour
Performance		
Total OPM	512,534	294,909
Price		
MSRP as of 12/10/2015	$188,922.00	$164,151.98

Figure 1: Hardware, software, and hardware-only pricing information for the two solutions we tested. *The hardware threads and memory available on the Dell EMC solution are less than the physical hardware present due to the CPU and memory resources required by the AOS Controller VMs (CVMs). One CVM runs on each node.

[3] The Dell EMC XC630-10 appliances can be configured with the free Acropolis hypervisor (AHV), which offers potential savings. We did not use this hypervisor in this study.

[4] End-user license agreements prohibit us from identifying the vendor and model of the integrated solution we tested. We present configuration and pricing information in Appendix A and details of our testing in Appendix B.

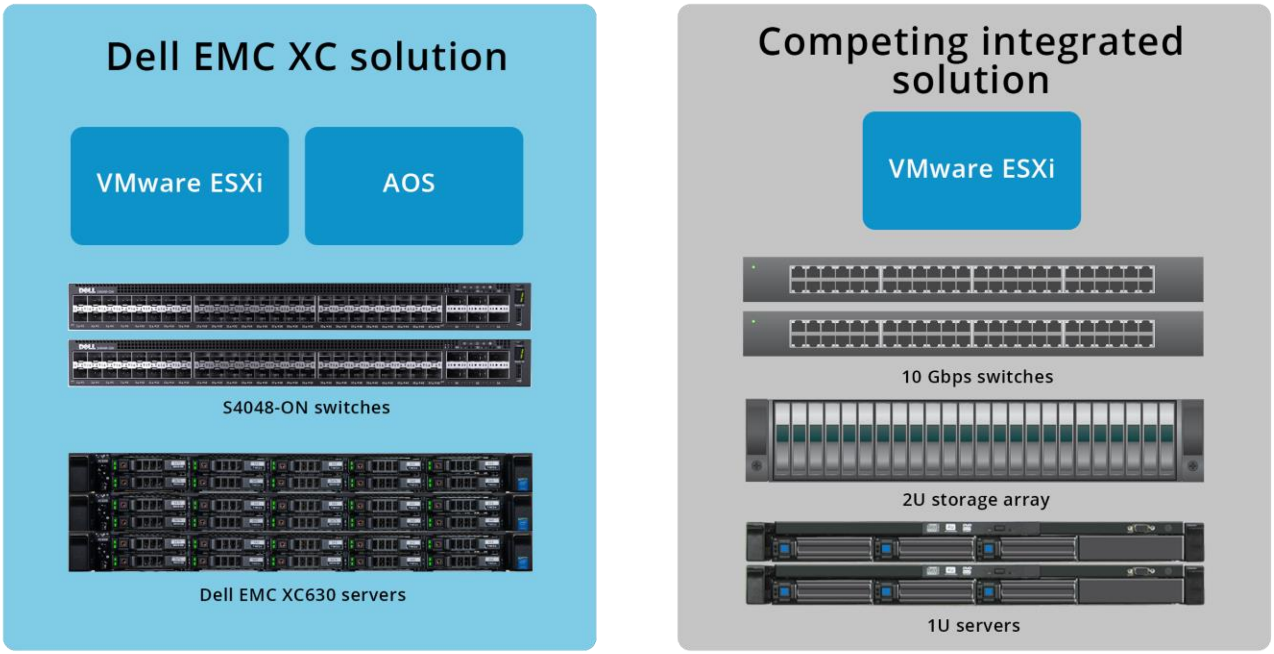
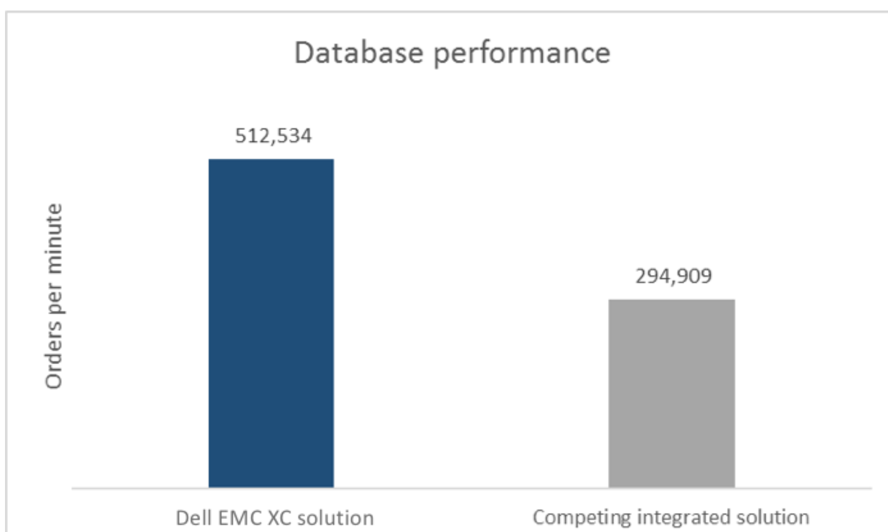


Figure 2: A comparison of the hardware and software stacks in each solution tested in this study.

We tested both solutions with an OLTP benchmarking tool to measure database performance, and concurrently exercised the IO subsystem in the background on both solutions, simulating file and print services and web hosting. We then measured the output of the database test (in orders per minute). As Figure 3 shows, the Dell EMC XC630 solution provided 73 percent better database performance than the competing integrated solution.

Figure 3: The Dell EMC XC630 solution powered by Intel processors and using AOS provided 73 percent more operations per minute in a database workload than the competing integrated solution we tested.



Next, we took the OPM each solution delivered and divided it by the manufacturer's suggested retail price of the solution. As Figure 4 shows, the Dell EMC XC630-10 solution is a significantly better value despite its higher MSRP, offering over 50 percent greater database performance per dollar.

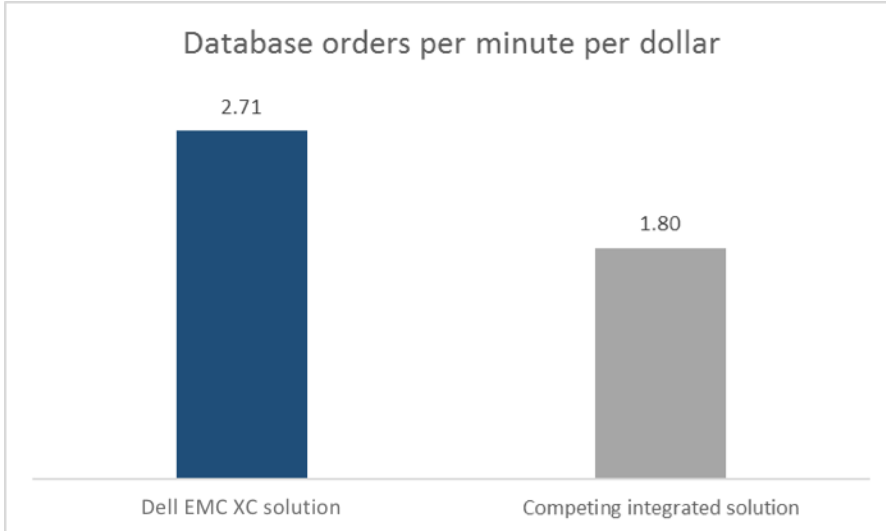


Figure 4: The Dell EMC XC630 solution powered by Intel processors and using AOS provided 50 percent greater value than the competing integrated solution in terms of performance per dollar value.

Our tests reported orders per minute measurements from the DVD Store benchmark, with the Dell EMC XC solution delivering 512,534 OPM and the integrated solution delivering only 294,909 OPM. We can attribute the Dell EMC XC solution's 73.7 percent advantage to the fact that the competing integrated solution's disk latency was much higher than that of the Dell EMC XC solution's storage.

VMware defines acceptable disk latency as sustained 20-millisecond latency or less. As Figure 5 illustrates, the Dell EMC XC solution managed to stay below this level for most of the test, with an average latency of 9.6 milliseconds.

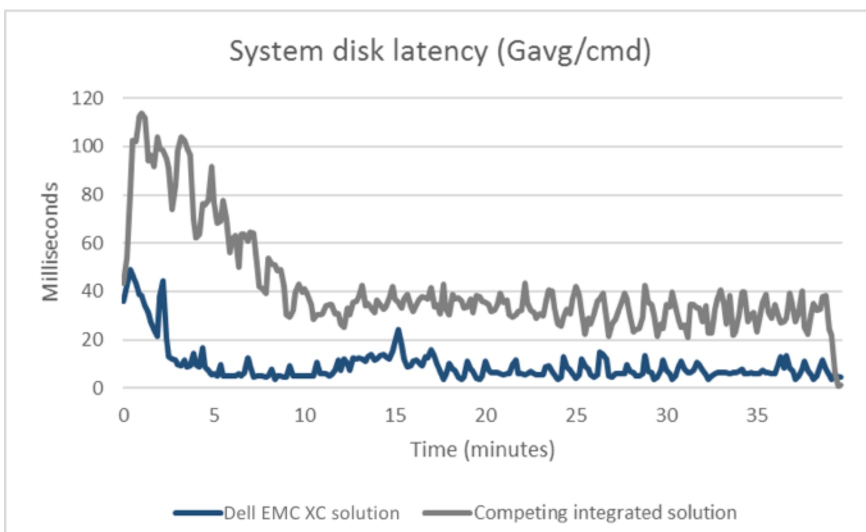


Figure 5: The system disk latency (Gavg/cmd) for the two solutions we tested.

In contrast, the competing integrated solution's average disk latency was 41.8 milliseconds, indicating a disk bottleneck. The high, sustained disk latency caused the competitor's processors to be severely underutilized, with only 32.7 percent active time on average (see Figure 6). This underutilization explains the low number of database orders per minute that the solution delivered. For comparison, the Dell EMC XC solution averaged 72.6 percent active time.

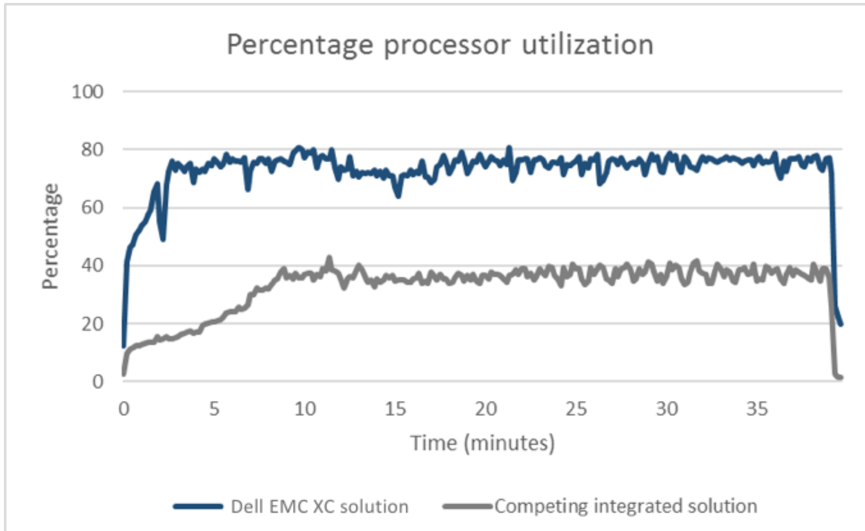


Figure 6: The percentage processor utilization for the two solutions we tested.

IN CONCLUSION

A scalable hyperconverged solution that combines CPU, storage, and hypervisor in each node can help your business simplify cluster management and reduce costs while boosting performance.

Running your company's application databases on an AOS-based cluster of Dell EMC XC630 appliances can give you 73 percent greater OLTP workload performance than running them on a competing integrated architecture with disparate storage and compute resources.

This performance advantage lets you serve more customers in the same amount of time and more than makes up for the higher price of the hyperconverged solution. The Dell EMC XC630 solution provides 50 percent greater database performance per dollar.

With software-defined tiered storage, high availability, and a redundant network architecture, the Dell EMC XC630 hyperconverged solution is a powerful, cost-effective alternative to a traditional integrated solution.

APPENDIX A – DETAILED SYSTEM CONFIGURATION AND PRICING

In September 2016, Dell EMC rebranded the Dell XC630 as the Dell EMC XC630. We completed our testing prior to that rebranding. On November 25, 2015, we finalized the hardware and software configurations we tested. Updates for current and recently released hardware and software appear often, so unavoidably these configurations may not represent the latest versions available when this report appears. For older systems, we chose configurations representative of typical purchases of those systems. We concluded hands-on testing on December 2, 2015.

Figures 7 and 8 show the configuration details of the Dell EMC XC solution system and network switch.

System	Dell EMC XC630-10
Power supplies	
Total number	2
Vendor and model number	Dell 0TFR9VA01
Wattage of each (W)	1100
General	
Number of processor packages	2
Number of cores per processor	8
Number of hardware threads per core	2
System power management policy	Performance per watt (OS)
CPU	
Vendor	Intel
Name	Xeon
Model number	E5-2630 v3
Socket type	FCLGA2011-3
Core frequency (GHz)	2.4
Bus frequency	8 GT/s
L1 cache	32 + 32 KB (per core)
L2 cache	256 KB (per core)
L3 cache	20 MB
Platform	
Vendor and model number	Dell EMC XC630-10
Motherboard model number	0CNCJW
BIOS name and version	1.3.6
BIOS settings	Defaults
Memory module(s)	
Total RAM in system (GB)	192
Vendor and model number	Micron® 36ASF2G72PZ-2G1A2
Type	PC4-2133
Speed (MHz)	1,866
Speed running in the system (MHz)	1,866
Size (GB)	16

System	Dell EMC XC630-10
Number of RAM module(s)	12
Chip organization	Double-sided
Rank	2Rx4
Operating system	
Name	VMware ESXi 6.0.0
Build number	3029578
Language	English
RAID controller	
Vendor and model number	PERC H730 Mini
Firmware version	25.3.0.0016
Cache size (GB)	1
RAID configuration	None
Hard disk types	
SSDs	
Vendor and model number	Intel SSDSC2BA200G3R
Number of disks	2
Size (GB)	200
RPM	N/A
Type	SATA 6 Gbps
HDDs	
Vendor and model number	Seagate® ST91000640SS
Number of disks	8
Size (GB)	1,000
RPM	7,200
Type	SATA 6 Gbps
Ethernet adapters	
Vendor and model number	Intel 4-port X520/I350 rNDC
Firmware	15.0.28
Type	On-board
USB ports	
Number	2
Type	USB 2.0

Figure 7: Configuration specifications of the Dell EMC XC solution system.

Network switch	Dell EMC Networking S4048-ON network switch
OS and version	Dell OS 9.8(0.0P5)
Number of switches	2
Number of 1/10 Gbps SFP+ ports	48
Number of 40 Gbps QSFP+ ports	6

Figure 8: Detailed configuration information for the Dell EMC Networking S4048-ON network switch.

Figures 9 through 11 show the configuration details of Vendor A's compute node, storage array, and network switch.

System	Competing integrated solution compute node
Power supplies	
Total number	2
Wattage of each (W)	770
General	
Number of processor packages	2
Number of cores per processor	10
Number of hardware threads per core	2
CPU	
Vendor	Intel
Name	Xeon
Model number	E5-2650 v3
Socket type	FCLGA2011-3
Core frequency (GHz)	2.3
Bus frequency	9.6 GT/s
L1 cache	32 + 32 KB (per core)
L2 cache	256 KB (per core)
L3 cache	25 MB
Memory module(s)	
Total RAM in system (GB)	256
Vendor and model number	Samsung® M393A2G40DB0-CPB
Type	PC4-2133
Speed (MHz)	2,133
Speed running in the system (MHz)	2,133
Size (GB)	16
Number of RAM module(s)	16
Chip organization	Double-sided
Rank	2Rx4
Operating system	
Name	VMware ESXi 6.0.0
Build number	3029578
Language	English
Ethernet adapters	
Vendor and model number	Intel 4-port I350 rNDC
Firmware	1.63
Type	On-board
USB ports	
Number	2
Type	USB 2.0

System	Competing integrated solution compute node

Figure 9: Configuration specifications of the integrated solution compute node.

Storage array	Competing integrated solution storage array
Number of storage arrays	1
Number of storage controllers per array	2
RAID level	Double Parity
Number of 2.5" disk enclosures	1
Number of drives (parity, hot spares)	24 (12, 1)
Drive size (GB)	900
Drive buffer size (MB)	64
Drive RPM	10,000
Drive type	SAS

Figure 10: Detailed configuration information for the integrated solution storage array.

Network switch	Competing integrated solution network switch
Number of switches	2
Number of 10 Gbps SFP+ ports	48
Number of 40 Gbps QSFP+ ports	6

Figure 11: Detailed configuration information for the integrated solution network switch.

APPENDIX B – DETAILED CONFIGURATION METHODOLOGY

To set up a cluster of hyperconverged Dell EMC XC630 appliances the way we did for this testing, follow our deployment guide for creating a VMware ESXi cluster with AOS at www.principledtechnologies.com/Dell/Nutanix_VMware_RA_1115.pdf. Figure 12 shows the Prism Central management interface, a browser-based console, which we used for configuring the cluster storage.

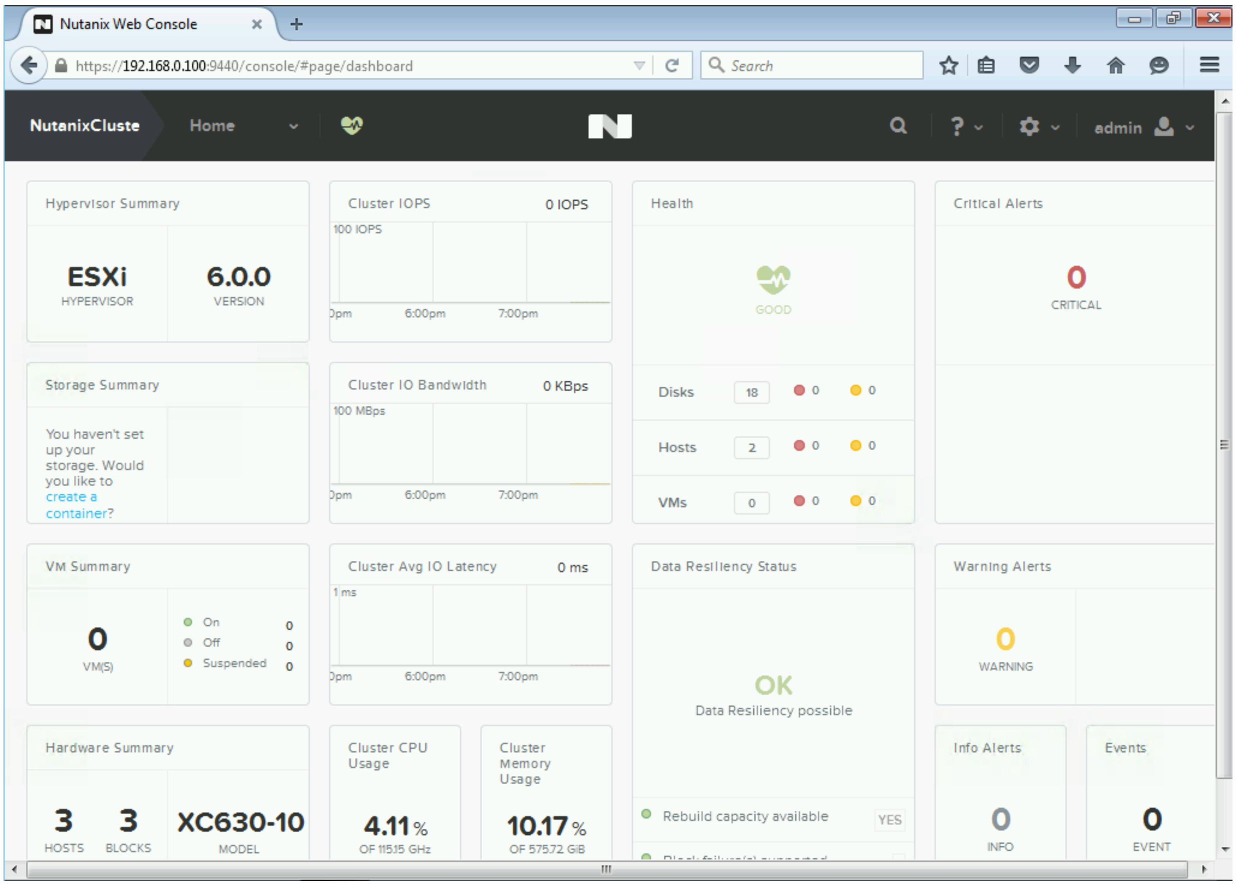


Figure 12: The Prism Central Web UI dashboard page.

Configuring application VMs

In this section, we walk through how to configure the applications we tested. We created and configured VMs for SQL Server 2014 and Iometer for ESXi in the vSphere Web Client. Each SQL Server 2014 VM was configured with eight vCPUs and 16 GB of RAM, and each Iometer VM was configured with one vCPU and 4 GB of RAM.

Creating VMs for ESXi in the vSphere Web Client

We used the vSphere Web Client to create the VMs for our application environments. Here we walk through creating a sample VM, providing generic details about the virtual hardware, which can be customized as necessary. We created the VMs on the host we wanted them to reside on, though the host for each VM can be changed after creation.

1. Log into the vSphere Web Client in a browser with administrator credentials.
2. Right-click the host on which you want to create the new VM, and select New Virtual Machine→New Virtual Machine…

3. Select Create a new virtual machine, and click Next.
4. Enter a name for the virtual machine, and click Next.
5. Select the desired host as a compute resource, and click Next.
6. Select the Acropolis storage cluster's NFS container as the storage for the VM, and click Next.
7. Click Next.
8. Select an appropriate Guest OS Family and Version, and click Next.
9. At the Customize hardware screen, set the number of vCPUs, the amount of RAM, and the size and number of hard disks and their SCSI controllers. In addition, provide installation media to the VM, and click Next.
10. Review the selected settings, and click Finish.

Installing and configuring Iometer

1. On the Iometer VMs, open a web browser, and navigate to sourceforge.net/projects/Iometer/files/Iometer-stable/1.1.0/Iometer-1.1.0-win64.x86_64-bin.zip/download.
2. Run the installer wizard with defaults.
3. Launch Iometer.
4. In the Topology pane, click the manager with the VM's host name.
5. In the Disk Targets tab, check the box next to the empty disk to be used for testing.
6. In the Access Specifications tab, click New.
7. Select the new specification, and click Edit.
8. Set the parameters based on the workload you want to test.
9. Click OK.
10. Click Add.
11. In the Test Setup tab, enter the run time details, and provide a description for the test.
12. When ready to test, click the green flag button, and provide an output file path.

Installing Microsoft SQL Server 2014

1. Insert the installation DVD for SQL Server 2014 into the DVD drive.
2. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2014 DVD, and double-click.
3. If the installer prompts you with a .NET installation prompt, click Yes to enable the .NET Framework Core role.
4. In the left pane, click Installation.
5. Click New installation or add features to an existing installation.
6. At the Setup Support Rules screen, wait for the check to complete. If there are no failures or relevant warnings, click OK.
7. Select the Evaluation edition, and click Next.
8. Click the checkbox to accept the license terms, and click Next.
9. Click Install to install the setup support files.
10. If no failures are displayed, click Next. You may see a Computer domain controller warning and a Windows® Firewall warning. For now, ignore these.

11. At the Setup Role screen, choose SQL Server Feature Installation.
12. At the Feature Selection screen, select Database Engine Services, Full-Text Search, Client Tools Connectivity, Client Tools Backwards Compatibility, Management Tools – Basic, and Management Tools – Complete. Click Next.
13. At the Installation Rules screen, once the check completes, click Next.
14. At the Instance configuration screen, leave the default selection of default instance, and click Next.
15. At the Disk space requirements screen, click Next.
16. At the Server configuration screen, choose NT Service\SQLSERVERAGENT for SQL Server Agent, and choose NT Service\MSSQLSERVER for SQL Server Database Engine. Change the SQL Server Agent Startup Type to Automatic. Click Next.
17. On the Data Directories tab, enter the SQL Server directories of the data and logs volumes created earlier.
18. At the Database Engine Configuration screen, select Mixed Mode.
19. Enter and confirm a password for the system administrator account.
20. Click Add Current user. This may take several seconds.
21. Click Next.
22. At the Error and usage reporting screen, click Next.
23. At the Installation Configuration rules screen, check that there are no failures or relevant warnings, and click Next.
24. At the Ready to Install screen, click Install.
25. After installation completes, click Close.
26. Download and install Cumulative Update 6 for SQL Server 2014 at support.microsoft.com/en-us/kb/3031047.

Configuring the database workload client

For our testing, we used a virtual client for the Microsoft SQL Server client. To create this client, we installed Windows Server® 2008 R2, assigned a static IP address, and installed .NET 3.5.

Configuring the database

We generated the data using the Install.pl script included with DVD Store version 2.1 (DS2), providing the parameters for our 4GB database size and the database platform on which we ran, Microsoft SQL Server 2014. We ran the Install.pl script on a utility system running Linux®. The database schema was also generated by the Install.pl script.

After processing the data generation, we transferred the data files and schema creation files to a Windows-based system running SQL Server 2014. We built the database in SQL Server 2014, and performed a full backup, storing the backup file on the C: drive for quick access. We used that backup file to restore the server between test runs.

The only modification we made to the schema creation scripts were the specified file sizes for our database. We deliberately set the file sizes higher than necessary to ensure that no file-growth activity would affect the outputs of the test. Besides this file size modification, the database schema was created and loaded according to the DVD Store documentation. Specifically, we performed the following steps:

1. We generated the data and created the database and file structure using database creation scripts in the DS2 download. We made size modifications specific to our database and the appropriate changes to drive letters.
2. We transferred the files from our Linux data generation system to a Windows system running SQL Server.
3. We created database tables, stored procedures, and objects using the provided DVD Store scripts.
4. We set the database recovery model to bulk-logged to prevent excess logging.
5. We loaded the data we generated into the database. For data loading, we used the import wizard in SQL Server Management Studio. Where necessary, we retained options from the original scripts, such as Enable Identity Insert.
6. We created indices, full-text catalogs, primary keys, and foreign keys using the database-creation scripts.
7. We updated statistics on each table according to database-creation scripts, which sample 18 percent of the table data.
8. On the SQL Server instance, we created a ds2user SQL Server login using the following Transact SQL (TSQL) script:

```
USE [master]
GO
CREATE LOGIN [ds2user] WITH PASSWORD=N'',
        DEFAULT_DATABASE=[master],
        DEFAULT_LANGUAGE=[us_english],
        CHECK_EXPIRATION=OFF,
        CHECK_POLICY=OFF
GO
```

9. We set the database recovery model back to full.
10. We created the necessary full text index using SQL Server Management Studio.
11. We created a database user and mapped this user to the SQL Server login.
12. We performed a full backup of the database. This backup allowed us to restore the databases to a pristine state relatively quickly between tests.

Running the test

Test start and run times

We ran the workloads with one client per target database. The specific testing parameters we used for the benchmark are included below.

Running the DVD Store tests

We created a series of batch files, SQL scripts, and shell scripts to automate the complete test cycle. DVD Store outputs an orders-per-minute metric, which is a running average calculated through the test. In this report, we report the aggregate OPM reported by the clients for each run.

Each complete test cycle consisted of the general steps listed below.

1. Clean up prior outputs from the target system and the client driver system.
2. Drop the database from the target servers.
3. Restore the database on the target servers.
4. Shut down the target.

5. Reboot the host and client systems.
6. Wait for a ping response from the server under test (the hypervisor system), the client system, and the target.
7. Let the test server idle for 10 minutes.
8. Start the DVD Store driver on each client.
9. We used the following DVD Store parameters for testing:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 --run_time=30
--n_threads=64 --db_size=20GB --think_time=0.03 --detailed_view=Y --
warmup_time=10 --csv_output=<drive path>
```

Configuring and running Iometer workloads

For our testing, we used one VM for file/print and one VM for web server activity on each solution, using a 2GB test volume.

1. Download and launch Iometer.
2. In the Disk Targets tab, select the volume to use for testing.
3. In the Access Specifications tab, create a New specification, and supply it with the appropriate settings depending on the intended workload:
    a. File/Print
        i. 512 KB transfer request size
        ii. 25% Write, 75% Read
        iii. 100% Random
        iv. 30 ms transfer delay
    b. Web
        i. 512 B transfer request size
        ii. 5% Write, 95% Read
        iii. 100% Random
        iv. 1 ms transfer delay
4. Select the new specification and click the <<Add button.
5. In the Test Setup tab, provide a description for the test, set the Run Time to 39 minutes, and the Ramp Up Time to 60 seconds.
6. When ready to test, click the green flag button, select a destination for the output file, and click Save to start testing. Note that the test will not begin until you click the Save button.

APPENDIX C – TEST BED CONFIGURATION AND WORKLOADS

Figure 13 presents the test hardware we used. Figure 14 provides an overview of the VMs in our testing. In designing our performance testing configuration, we sought to optimize usage of the hardware threads available from each solution's processors without oversubscribing. To keep the vCPU counts uniform for each SQL VM, we used eight vCPUs per SQL VM and four vCPUs per Iometer VM on each solution. With our arrangement, every hardware thread was assigned to exactly one vCPU, with 72 on the Dell EMC XC solution and 80 on the integrated solution.

Hardware	Dell EMC XC solution	Competing integrated solution
CPU	Intel Xeon E5-2630 v3	Intel Xeon E5-2650 v3
Hardware threads available for workload processing	72	80
Memory available	528 GB	512 GB
Number of SSDs	6	N/A
Number of HDDs	24	24
Number of 10 Gbps network switches	2	2

Figure 13: Test hardware.

VM	# vCPUs	Application	Role	Host
Dell EMC XC solution				
SQL-1A	8	SQL Server 2014	Database server	1
SQL-1B	8	SQL Server 2014	Database server	1
SQL-2A	8	SQL Server 2014	Database server	2
SQL-2B	8	SQL Server 2014	Database server	2
SQL-2C	8	SQL Server 2014	Database server	2
SQL-3A	8	SQL Server 2014	Database server	3
SQL-3B	8	SQL Server 2014	Database server	3
SQL-3C	8	SQL Server 2014	Database server	3
Iometer-1A	4	Iometer	File/print workload	1
Iometer-1B	4	Iometer	Web server workload	1
SQL-1A	8	SQL Server 2014	Database server	1
Integrated solution				
SQL-1A	8	SQL Server 2014	Database server	1
SQL-1B	8	SQL Server 2014	Database server	1
SQL-1C	8	SQL Server 2014	Database server	1
SQL-1D	8	SQL Server 2014	Database server	1
SQL-2A	8	SQL Server 2014	Database server	2
SQL-2B	8	SQL Server 2014	Database server	2
SQL-2C	8	SQL Server 2014	Database server	2
SQL-2D	8	SQL Server 2014	Database server	2
SQL-2E	8	SQL Server 2014	Database server	2
Iometer-1A	4	Iometer	File/print workload	1
Iometer-1B	4	Iometer	Web server workload	1

Figure 14: VM overview of the two solutions we tested.

Workloads

For our performance tests, we set up a mixed workload consisting of SQL Server 2014 and simulated disk activity to run in concert over a 40-minute period. We ran an OLTP database workload and a simulated file/print server disk workload.

OLTP database workload: DVD Store

To simulate an OLTP workload, we used DVD Store 2.1, an open-source application that models an online DVD store where customers log in, search for titles, and purchase movies. We tested with Microsoft SQL Server 2014 as our database server. Higher thread count and lower think times increase CPU utilization and IOPS. For more information on DVD Store, please see en.community.dell.com/techcenter/extras/w/wiki/dvd-store.aspx.

Testing parameters

- Database size: 20 GB
- Number of databases: one per VM
- Number of threads per VM: 64
- Actual test run time: 30 minutes
- Percentage of new customers: 20
- Number of line items: 4
- Think time: 0.03 seconds
- Warm-up time: 10 minutes
- Ramp rate: 10

Additional VM parameters

- Each SQL VM was built with virtual hard disks for the OS, SQL Database, and SQL Logs
- Each SQL VM was configured as per best practices (E:\SQL Database, F:\SQL Logs)

Output

- Orders per minute (OPM)

Disk activity workload: Iometer

To simulate disk workloads for a file/print server and for a web server, we used Iometer, an application that allows various access specifications to be run against your disk I/O subsystem, including read/write percentages, sequential/random percentages, and block sizes. For more information on Iometer, please see www.iometer.org/.

Testing parameters for file/print server

- Test file size: 2 GB
- Number of outstanding I/Os: 1 per target
- Transfer request size: 512 KB
- Percentage Read/Write Distribution: 25% Write, 75% Read
- Percentage Random/Sequential Distribution: 100% Random
- Transfer delay: 30 ms
- Burst length: 1 I/O
- Actual test run time: 40 minutes
- Warm-up time: 1 minute

Testing parameters for web server

- Test file size: 2 GB
- Number of outstanding I/Os: 1 per target

- Transfer request size: 512 B
- Percentage Read/Write Distribution: 5% Write, 95% Read
- Percentage Random/Sequential Distribution: 100% Random
- Transfer delay: 1 ms
- Burst length: 1 I/O
- Actual test run time: 40 minutes
- Warm-up time: 1 minute

Additional VM parameters

Each test file took up the entirety of a 2GB virtual hard disk, on a separate volume from the OS.

ABOUT PRINCIPLED TECHNOLOGIES

Principled Technologies, Inc.
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We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.