

CONVERGED ARCHITECTURE ADVANTAGES: DELL POWEREDGE FX2S AND FC830 SERVERS VS. LEGACY HP PROLIANT DL580 G7 SERVERS

PROCESS MORE NEW ORDERS AT A LOWER COST WITH THE DELL™ POWEREDGE™ FX2S

Increase data center density and get more resources from the converged architecture of the Dell PowerEdge FX2s enclosure and Dell PowerEdge FC830 servers.*

Up to
3.8X
the new orders
per minute



Up to
72%
lower cost
per new order



with 32 1.8" Intel SSDs



POWERED BY THE INTEL® XEON® PROCESSOR E5-4600 V3 PRODUCT FAMILY

*compared to two HP ProLiant DL580 G7 servers

Using the Dell PowerEdge FC830 server in a PowerEdge FX2 enclosure to run Microsoft SQL 2014 can greatly benefit your business needs. With this new converged architecture approach, you can replace your legacy servers and see benefits from more available hardware resources and efficient handling of more new orders. In addition, modern hardware allows your business to take advantage of high availability features in a much smaller space, which can help your business be more cost-effective.

In the Principled Technologies data center, we compared SQL Server 2014 database performance with the AlwaysOn Availability Groups feature on a converged-infrastructure solution, the Dell PowerEdge FX2s with two Intel processor-powered PowerEdge FC830 servers, to a legacy solution of two HP ProLiant DL580 G7 servers with the same SQL database infrastructure setup. We found that the Dell PowerEdge FX2s and FC830 servers achieved **3.8 times the database performance** of the legacy solution and offered a **72 percent lower cost per new order**, increasing the value of the solution while creating an opportunity for your business to save money. In addition, the 2U Dell PowerEdge FX2s with FC830 servers provides a denser hardware solution while delivering similar hardware redundancy features of the 8U competing solution.



CHOOSING A MODERN DIRECTION WITH A DELL POWEREDGE FX2S SOLUTION POWERED BY INTEL

How your business chooses to handle data center complexity and performance ultimately affects your bottom line. The converged architecture approach has risen in response to data centers requiring more resources in limited space. To increase density, converged architecture solutions collect compute, storage, and networking resources in a single chassis and distribute them among server nodes.

Our legacy HP solution had a more traditional, silo approach to resources than our converged architecture solution— each server had its own resources, limiting the amount of compute power that can fit within an allotted amount of data center space. We created a Windows Server 2012 R2 failover cluster on the two servers and built a highly available database solution with SQL Server 2014 and SQL's AlwaysOn Availability Groups feature. The 8U legacy HP solution comprised of two 4U servers, featured 256 GB total memory and four processors in each HP ProLiant DL580 G7 server.

On the Dell PowerEdge FX2s and FC830 solution, we configured a SQL Server solution, identical to the legacy environment. This 2U solution featured 256 GB of memory, four Intel Xeon Processor E5-4600 v3 product family processors, and sixteen Intel 1.8-inch SSDs in each server. For more hardware, software, and benchmark information, see [Appendix A](#).

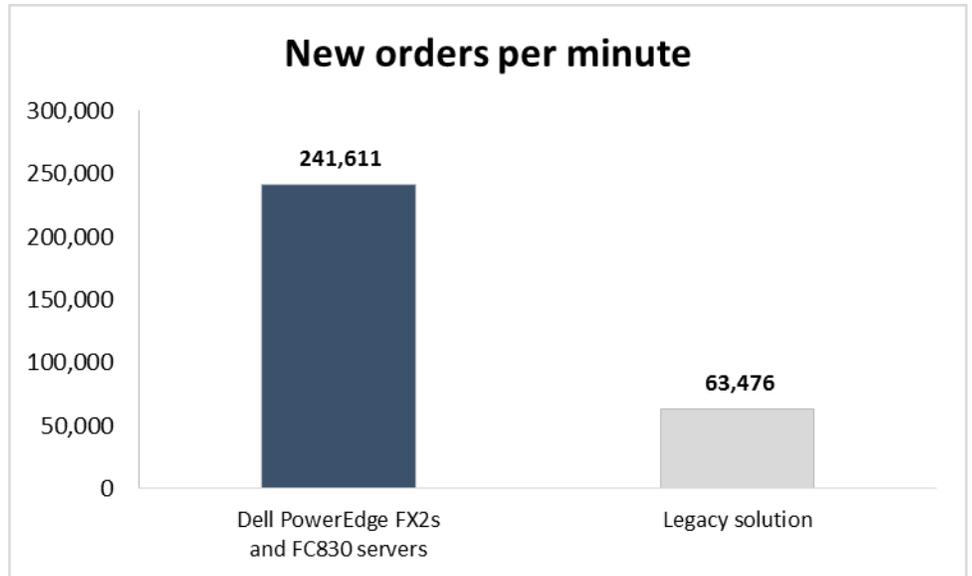
To create our real-world transactional workload, we used the HammerDB benchmarking tool. We used 40 users and no think time for both servers to generate a database workload that stressed the disk subsystem. The HammerDB benchmark measured database performance with a 5,000-warehouse database (roughly 500 GB). See [Appendix B](#) for detailed information on how we tested the servers and see [Appendix C](#) for detailed configuration information of the servers.

WHAT WE FOUND

Better performance with Dell PowerEdge FX2s and FC830 servers

Better database performance means the ability to handle more requests and changes to your database, which can potentially lead to more business growth and provide a better overall experience for your users. The Dell PowerEdge FX2s FC830 solution running the SQL Server 2014 database workload delivered 241,611 new orders per minute (NOPM), or 3.8 times the NOPM of the legacy HP solution. Figure 1 shows the median NOPM achieved by each solution.

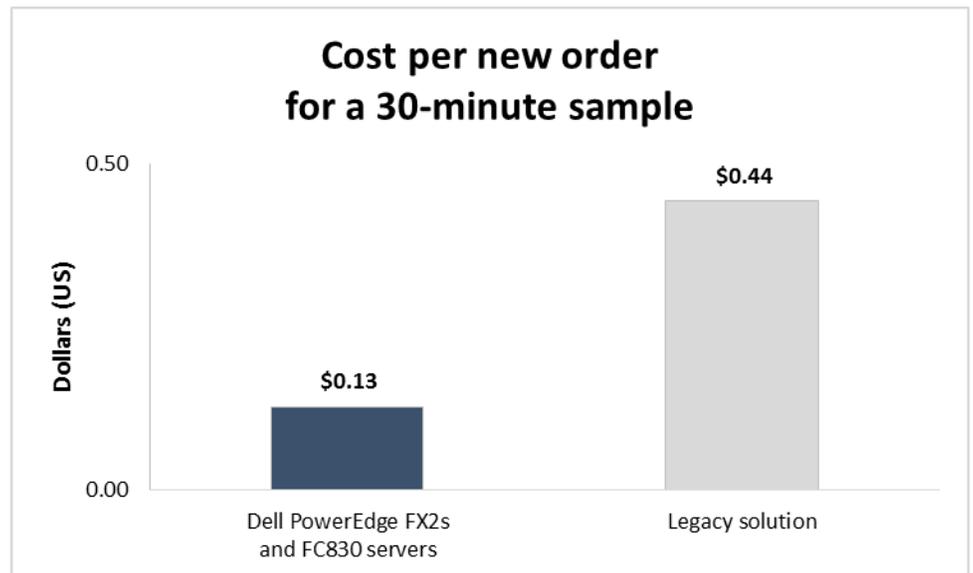
Figure 1: The Dell PowerEdge FX2s and FC830 solution delivered 3.8 times the NOPM of the legacy HP solution. Higher numbers are better.



Lower cost per new order

Better performance is great, but lower costs can make performance benefits just that much sweeter. The Dell PowerEdge FX2s and FC830 solution can do just that. We found that the Dell PowerEdge FX2s and FC830, accounting for the acquisition cost of the hardware and the software licensing, provided 72 percent lower cost per new order compared to only the licensing cost for the existing legacy server solution. Figure 2 compares the average cost per new order for each solution, using a representative sample of 30 minutes of new orders. Although individual costs per new order would decrease over time for both solutions, the percent savings would remain the same. For more information on how we determined costs for the two solutions, see [Appendix D](#).

Figure 2: The Dell PowerEdge FX2s and FC830 solution delivered over 72 percent lower cost per new order than the legacy HP solution. Lower numbers are better.



High availability features

In addition to delivering better performance than the two, 4U legacy servers delivered in just 2U, the Dell PowerEdge FX2s and FC830 solution provides the same hardware redundancy as traditional server solutions but also offers shared redundant networking and power to the enclosed servers for high availability. With redundant power supplies and networking components, highly available solutions can safeguard against downtime or service outages. As your business continues to grow, more users depend on reliable server uptime. These redundant hardware features from the FX2s and the FC830 can help preclude your data center from increased costs due to downtime tied to mission-critical workloads. In comparison, continuing to maintain a highly available environment with aging legacy servers can be a costly and challenging task as hardware begins to fail over time, potentially requiring your business to pour a large amount of money to prevent outages and downtime.

CONCLUSION

Based on our testing with heavy SQL Server 2014 database workloads, the converged architecture solution of a Dell PowerEdge FX2s chassis and FC830 servers delivered 3.8 times the performance of our legacy HP solution. We also found the Dell PowerEdge FX2s and FC830 solution offered 72 lower cost per new order compared to the legacy HP ProLiant DL580 G7 solution. In addition, the PowerEdge FX2s and FC830 solution does not sacrifice traditional hardware redundancy while providing the same highly available database solution in a smaller rack space. If your business runs Microsoft SQL Server 2014, the converged architecture approach with Dell PowerEdge FX2s chassis and FC830 servers powered by Intel could bring a harmonious balance of performance, reliability, and cost efficiency to your data center.

APPENDIX A – WHAT WE TESTED

About the Dell PowerEdge FX2s enclosure

The converged architecture approach of the Dell PowerEdge FX2s enclosure increases flexibility and can help you make the most of your data center space while reducing the cables and switches needed to run your servers. The Dell PowerEdge FX2s enclosure has a standard 2U footprint and features a modular design that can hold different combinations of compute and storage nodes to meet your specific goals. The PowerEdge FX2s fits four half-width or eight quarter-width compute nodes to increase the compute density in your rack and optimize the space in your data center. You can deploy the FX2s solution like a traditional rack-mounted server while gaining the benefits and features that more expensive dense blade solutions provide. Important features of the FX2s enclosure include:

- Up to eight low-profile PCIe expansion slots
- Two pass-through or optional networking FN I/O Aggregator modules
- Embedded network adapters within the server nodes
- Offers both chassis-based management through the Chassis Management Controller and rack-based management through Integrated Dell Remote Access (iDRAC) with Lifecycle Controller on each compute node

The Dell PowerEdge FX2s enclosure fits a number of server and storage options, including the PowerEdge FC430, FC630, and FC830 servers, and PowerEdge FD332 storage – all Intel-powered. The Dell PowerEdge FX2s solution we tested included two full-width Dell PowerEdge FC830 server blades powered by Intel Xeon processors E5-4650 v3.

For more information about the Intel-powered Dell PowerEdge FX2s solution, visit

www.dell.com/us/business/p/poweredge-fx/pd.

About the Dell PowerEdge FC830

Dell calls the PowerEdge FC830 the ultimate dense scale-up server. Powered by the Intel Xeon processor E5-4600 v3 product family, this full-width server offers power, scalability, and flexibility. The FC830 offers up to four 18-core CPUs and up to 3 TB of memory. The FX2s enclosure can be configured with up to two FC830 servers or one FC830 server and two FD332 storage sleds.

About the Intel Xeon processor E5 family

The new Intel Xeon processor E5 family, which comes standard in new Dell PowerEdge servers, incorporates new technology and features to meet the computing demands of the present and future. The Intel Xeon processor E5 family delivers intelligent and adaptive performance using such features as Intel Turbo Boost Technology 2.0, Intel Advanced Vector Extension, Intel Integrated I/O, and Intel Data Direct I/O Technology. These new processors also feature Intel Trusted Execution Technology (Intel TXT) and utilize Intel Advance Encryption Standard New Instructions (Intel AES-NI) to help keep your data safe. For more information about the Intel Xeon processor E5 family, visit

www.intel.com.

About Microsoft SQL Server 2014

SQL Server 2014 includes the AlwaysOn Availability Groups features introduced in SQL Server 2012, along with a number of advances over previous versions. The in-memory columnstore is now updatable, and a new in-memory OLTP engine boosts transactional performance dramatically. According to Microsoft, “SQL Server 2014’s in-memory OLTP technology delivers blistering performance for mission-critical applications while minimizing additional cost by only requiring the hot tables of the database to be put in memory vs. the entire database, like other solutions on the market. When these hot tables are memory optimized, they automatically transform into a new data structure that eliminates locking and latching, further increasing performance. SQL Server 2014 will also identify which stored procedures can be recompiled to further improve throughput. All this is built directly into SQL Server 2014, so there is no need to buy specialized hardware, expensive add-ons or learn new skills to achieve breakthrough performance.” Learn more at www.microsoft.com/en-us/server-cloud/products/sql-server/.

About the benchmark testing tool, HammerDB

HammerDB is an open-source benchmark tool that tests the database performance of many leading databases, including Oracle Database, Microsoft® SQL Server®, PostgreSQL®, MySQL™, and more. The benchmark includes two built-in workloads derived from industry-standard benchmarks: a transactional (derived from TPC-C) workload and a data warehouse (derived from TPC-H) workload. For this study, we used the transactional workload. The HammerDB transactional workload is derived from the TPC-C Benchmark and as such is not comparable to published TPC-C Benchmark results. For more information about HammerDB, visit hammerora.sourceforge.net.

APPENDIX B – SYSTEM CONFIGURATION INFORMATION

Figures 3 and 4 provide detailed configuration information for the test enclosure and server modules.

System	Dell PowerEdge FX2s server enclosure
Power supplies	
Number of power supplies	2
Vendor and model number	Dell D1600E-S0
Wattage of each (W)	1,600
Midplane	
Chassis midplane	1.0
Chassis firmware	
Chassis Management Controller	1.10.A00.201410160007
Chassis Infrastructure	1.10.A00.201410066
IOM	11.0.0.0
Dell PowerEdge IOA FN 410S 10 GigE	9-6(0-15)
I/O modules	
Switch	Dell PowerEdge IOA FNFN2210S 10Gb
Occupied bay	IOM Slot A1, IOM Slot A2
Management modules	
Chassis Management Controller slot 1	Chassis Management Controller Hardware X05

Figure 3: Configuration details for the test enclosure.

System	Dell PowerEdge FC830 server module
General	
Number of processor packages	4
Number of cores per processor	10
Number of hardware threads per core	2
CPU	
Vendor	Intel
Name	Xeon
Model number	E5-4650 v3
Socket type	FCLGA2011-3
Core frequency (GHz)	2.30
Bus frequency (GHz)	4.80
L1 cache	10 x 32 KB
L2 cache	10 x 256 KB
L3 cache	25 MB
Platform	
Vendor and model number	Dell PowerEdge FC830
BIOS name and version	1.0.3
BIOS settings	Default

System	Dell PowerEdge FC830 server module
Memory module(s)	
Total RAM in system (GB)	256
Vendor and model number	Samsung M393A1G43DB0-CPB
Type	PC4-2133P
Speed (MHz)	2,133
Speed running in the system (MHz)	2,133
Size (GB)	8
Number of RAM module(s)	32
Chip organization	Double-sided
Rank	Dual
Hard drive 1	
Vendor and model number	Intel SSDSC1NB080G4R
Number of disks in system	2
Size (GB)	80
Type	SSD
Hard drive 2	
Vendor and model number	Intel SSDSC1BG200G4R
Number of disks in system	14
Size (GB)	200
Type	SSD
RAID controller	
Vendor and model number	PERC H730 Mini
Firmware version	25.2.2-0004
Cache size	1GB
Ethernet adapters	
Vendor and model number	Broadcom NetXtreme II 10 Gb Ethernet BCM57810
Type	Integrated
USB ports	
Number	2
Type	2.0
Firmware	
iDRAC8 Enterprise	2.10.10.10 (16)
Lifecycle Controller	2.10.10.10
Backplane	2.09
Broadcom NetXtreme II 10 Gb Ethernet BCM57810	7.10.12

Figure 4: Configuration details for the test server modules.

Figure 5 provides detailed information for the competitive legacy HP solution.

System	2 x HP ProLiant DL580 Gen7
Power supplies	
Total number	2
Vendor and model number	HP HSTNS-PL11
Wattage of each (W)	1200

System	2 x HP ProLiant DL580 Gen7
Cooling fans	
Total number	4
Vendor and model number	HP 591208-001
Dimensions (h x w) of each	3.5" x 3.5"
Volts	12
Amps	3.30
General	
Number of processor packages	4
Number of cores per processor	10
Number of hardware threads per core	2
System power management policy	Static High Performance
CPU	
Vendor	Intel
Name	Xeon
Model number	E7-4870
Stepping	2
Socket type	LGA 1567
Core frequency (GHz)	2.40
Bus frequency	6.4 GT/s
L1 cache	32 KB + 32 KB (per core)
L2 cache	256 KB (per core)
L3 cache(MB)	30
Platform	
Vendor and model number	HP ProLiant DL 580 Gen7
Motherboard model number	DL580P 643086-B21
BIOS name and version	HP P65 (10/01/2013)
BIOS settings	Power Profile set to Maximum Performance
Memory module(s)	
Total RAM in system (GB)	256
Vendor and model number	Samsung M393B2K70CM0-CF8
Type	PC3-8500R
Speed (MHz)	1,066
Speed running in the system (MHz)	1,066
Size (GB)	16
Number of RAM module(s)	16
Chip organization	Double sided
Rank	Quad
Operating system	
Name	Windows Server 2012 R2 Datacenter
File system	NTFS
Language	English

System	2 x HP ProLiant DL580 Gen7
RAID controller	
Vendor and model number	Smart Array® P410i
Firmware version	V6.60
Cache size	1GB
Hard drives	
Vendor and model number	HP EG0300FBDSP
Number of drives	8
Size (GB)	300
RPM	10K
Type	SAS
Ethernet adapters	
Vendor and model number	HP NC375i Integrated Quad Port Multifunction Gigabit
Type	Integrated

Figure 5: Detailed configuration information for the two HP ProLiant DL580 Gen7 servers we used in testing.

APPENDIX C – HOW WE TESTED

Installing Microsoft Windows Server 2012 R2 Datacenter Edition

1. Insert the installation USB drive into a USB port, and restart the server.
2. When the option appears, press F11 to enter the Boot Manager.
3. Select BIOS Boot Menu.
4. Select the USB drive, and press Enter.
5. Press any key when prompted to boot from DVD.
6. When the installation screen appears, leave language, time/currency format, and input method as default, and click Next.
7. Click Install now.
8. When the installation prompts you, enter the product key.
9. Select Windows Server 2012 Datacenter (Server with a GUI), and click Next.
10. Check I accept the license terms, and click Next.
11. Click Custom: Install Windows only (advanced).
12. Select Drive 0 Unallocated Space, and click Next, at which point Windows begins automatically, and restarts automatically after completing.
13. When the Settings page appears, fill in the Password and Reenter Password fields with the same password.
14. Log in with the password you set up previously.

Installing .Net Framework 3.5

1. Click on Start→Server Manager→Manage→Add Roles and Features.
2. Select Role-based or feature-based installation, and click Next.
3. Select the local server under Server Pool, and click Next twice.
4. Under Features, select .NET Framework 3.5 Features, and click Next.
5. Click Install.
6. Click Close upon completion.

Installing SQL Server 2014

1. Browse to the installation media for SQL Server 2014.
2. Run SETUP.EXE.
3. In the left pane, click Installation.
4. Click New SQL Server stand-alone installation or add features to an existing installation.
5. Select the Evaluation edition, and click Next.
6. Click the checkbox to accept the license terms, and click Next.
7. Click Use Microsoft Update to check for updates, and click Next.
8. Click Install to install the setup support files.
9. If there are no failures displayed, click Next.
10. At the Setup Role screen, choose SQL Server Feature Installation, and click Next.
11. At the Feature Selection screen, select Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, Client Tools Backwards Compatibility, Management Tools – Basic, and Management Tools – Complete. Click Next.
12. At the Installation Rules screen, after the check completes, click Next.

13. At the Instance configuration screen, leave the default selection of default instance, and click Next.
14. 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 Startup Type to Automatic. Click Next.
15. At the Database Engine Configuration screen, select the authentication method you prefer. For our testing purposes, we selected Mixed Mode.
16. Enter and confirm a password for the system administrator account.
17. Click Add Current user. This may take several seconds.
18. Click Next.
19. At the Error and usage reporting screen, click Next.
20. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
21. At the Ready to Install screen, click Install.
22. After installation completes, click Close.
23. Close the installation window.

Enabling Lock Pages in Memory

1. Click Start, and type `gpedit.msc`, and hit Enter.
2. In the Local Group Policy Editor, expand Computer Configuration→Windows Settings→Security Settings→Local Policies
3. Select User Rights Assignment, and scroll down to Lock pages in memory in the right pane.
4. Right-click Lock pages in memory, and click Properties.
5. Click Add User or Group, and add your SQL user account (NT SERVICE\MSSQLSERVER).
6. Click OK.

Configuring Windows Update

1. In the left pane of the Server Manager window, click Local Server.
2. In the main frame, next to Windows Update, click Not configured.
3. In the Windows Update window, in the main pane, click Let me choose my settings.
4. Under Important updates, select Never check for updates (not recommended), and click OK.
5. In the left pane, click Check for updates, and install all available updates.
6. Close the Windows Update window.

Configuring a SQL Server 2014 AlwaysOn availability group

Installing the Windows Failover Cluster Feature

1. Open the Server Manager console and select Add roles and features. This will launch the Add Roles Features Wizard.
2. Click Next until you reach the Select Features dialog box. Select the Failover Clustering checkbox. When prompted with the Add features that are required for Failover Clustering dialog box, click Add Features. Click Next.
3. Click Install to install the Failover Clustering feature.

Windows Failover Clustering Configuration for SQL Server 2012 AlwaysOn Availability Groups

1. Launch Failover Cluster Manager from within the Server Manager console.

2. Within Failover Cluster Manager, click the Validate Configuration... link.
3. In the Validate a Configuration Wizard dialog box, click Next.
4. In the Select Servers or a Cluster dialog box, add the server hostnames of the SQL Server instances that you want to configure as replicas in your Availability Group. Click Next.
5. In the Testing Options dialog box, make sure that the option Run all tests (recommended) is selected. Click Next.
6. In the Confirmation dialog box, click Next.
7. In the Summary dialog box, click Finish to create the Windows Failover Cluster.
8. In the Access Point for Administering the Cluster dialog box, enter the virtual server name and virtual IP address of your Windows Server Failover Cluster.
9. In the Confirmation dialog box, click Next. This will create the Windows Failover Cluster using the servers as nodes of the cluster, and add DNS and Active Directory entries for the cluster hostname.
10. In the Summary dialog box, verify that the configuration is successful.
11. To configure the cluster quorum configuration to use a file share, right-click on the cluster name, select More Actions and click Configure Cluster Quorum Settings... We will be configuring a file share witness for our cluster quorum setting. By default, the wizard will configure the cluster to use Node Majority.
12. Click Next.
13. In the Select Quorum Configuration page, select the Add or change the quorum witness option. Click Next.
14. In the Select Quorum Witness page, select the Configure a file share witness (recommended for special configuration) option. Click Next.
15. In the Configure File Share Witness page, type path of the file share that you want to use in the File Share Path: text box. Click Next.
16. In the Confirmation page, click Next.
17. In the Summary page, click Finish.

Enable SQL Server 2012 AlwaysOn Availability Groups Feature

1. Open SQL Server Configuration Manager. Double-click the SQL Server (MSSQLSERVER) service to open the Properties dialog box.
2. In the Properties dialog box, select the AlwaysOn High Availability tab. Check the Enable AlwaysOn Availability Groups check box. This will prompt you to restart the SQL Server service. Click OK.
3. Restart the SQL Server service.

Create and Configure SQL Server 2012 AlwaysOn Availability Groups

1. Open SQL Server Management Studio. Connect to the SQL Server instance
2. In Object Explorer, expand the AlwaysOn High Availability folder. Right-click the Availability Groups folder and select the New Availability Group Wizard... option. This will launch the New Availability Group Wizard.
3. In the Introduction page, click Next.
4. In the Specify Availability Group Name page, enter the name of the Availability Group in the Availability group name: field. Click Next.
5. In the Select Databases page, select the checkbox beside the database that you want to include in your Availability Group. The databases have to be in Full recovery model prior to joining them in the Availability group. Click Next.

6. In the Specify Replicas page, under the Replicas tab, click the Add Replicas button and connect to the other SQL Server instances that you joined as nodes in your Windows Server Failover Cluster. Configure the following options.
 - Automatic Failover (Up to 2): Checked
 - Synchronous Commit (Up to 3): Checked
 - Readable Secondary: No
7. In the Endpoints tab, verify that the port number value is 5022.
8. In the Listener tab, select Create an availability group listener. Enter the following details.
 - Listener DNS name: Name that you will use in your application connection string
 - Port: 1433
9. Click the Add... button to provide an IP address. In the Add IP Address dialog box, enter your preferred virtual IP address in the IPv4 Address field. Click OK. Click Next.
10. In the Select Initial Data Synchronization page, select the Full option. Provide a shared folder that is accessible the replicas and that the SQL Server service account used by both replicas has Write permissions to. This is just a temporary file share to store the database backups that will be used to initialize the databases in an Availability group. If you are dealing with large databases, it is recommended that you manually initialize the databases prior to configuring them, as your network bandwidth may not be able to accommodate the size of the database backups. Click Next.
11. In the Validation page, verify that all validation checks return successful results. Click Next.
12. In the Summary page, verify all configuration settings and click Finish. This will create and configure the AlwaysOn Availability Group and join the databases.
13. In the Results page, verify that all tasks have been completed successfully.

Configuring a HammerDB workload

Installing HammerDB

1. Download the latest version of HammerDB from www.hammerdb.com/download.html
2. Double-click the exe file, chose English, and click OK.
3. Click Yes.
4. Click Next.
5. Choose a destination location, and click Next.
6. Click Next.
7. Click Finish.

Creating the Database and database backup file

1. Open HammerDB, and click Options→Benchmark.
2. Choose MSSQL Server and TPC-C.
3. Expand SQL Server→TPC-C→Schema Build.
4. Double-click on Options.
5. Choose 5000 warehouses, and 40 virtual users, and click OK.
6. Double-click Build. This build could take several hours.
7. Once the database has been created, open SQL Server Manager.

8. Right-click the tpcc database, and click Tasks→Back up...
9. Choose a location to store the backup, and click OK.

Running the test

We used HammerDB to create a 5,000-warehouse database derived from TPC-C on SQL Server, and then created a backup file of the database. We pointed the HammerDB client, hosted on a separate system, to the main database on the SQL server, and ran the job derived from TPC-C.

We captured various performance metrics on the SUTs during the run, such as CPU and RAM utilization, and drive reads and writes, and gathered the results when the run finished. We ran each test three times, and use the median score as our official run. Follow these steps to recreate how we ran the test.

1. Open SQL Manager, delete the tpcc database, and create a new one by restoring from the backup file.
2. Reboot the server.
3. Once the all nodes are back up, allow them to sit idle for 20 minutes.
4. Open HammerDB.
5. Select Options → Benchmark.
6. In the Benchmark Options window, select MSSQL Server, and click OK.
7. In the left pane, expand TPC-C, then Driver Script, and double-click Options.
8. Change the following options for the TPC-C Driver Script:
 - Authentication: SQL Server Authentication
 - SQL Server User ID: sa
 - SQL Server User Password: Your password
 - Minutes for Warmup Period: 30
 - Minutes for Test Duration: 30
9. Click OK.
10. In the left pane, double-click Load to load the driver script.
11. Start Perfmon to capture CPU, RAM, and disk counters.
12. Expand Virtual User in the left pane, and double-click Options.
13. Increase the number of virtual users to 40, check all checkboxes in the options window, and click OK.
14. Double-click Create.
15. On the HammerDB UI, hit the green → at the top of the page to begin the test.
16. When the run finishes, stop Perfmon.
17. Save the HammerDB results text file and Perfmon output.

APPENDIX D – COST DETAILS

Using the hardware details from [Appendix B](#), we performed a cost analysis of the two server configurations (see Figure 6). We multiplied the median NOPM by 30 to get the total new orders for a 30-minute window. This sample demonstrates the cost per new order needed to calculate the percentage difference of the new-order cost between the two solutions. We then divided the total cost by the total new orders in 30 minutes to reach the cost per new order. All costs are in USD.

	Dell PowerEdge FX2s and FC830 servers	HP ProLiant DL580 G7 servers (legacy configuration)
Cost		
Microsoft SQL Server 2014 and Windows Server 2012 R2 licensing cost	\$844,560.00	\$844,560.00
Acquisition cost	\$69,943.30	
Total	\$914,503.30	\$844,560.00
Orders		
Total new orders in 30 min	7,248,330	1,904,280
NOPM	241,611	63,476
Cost per new order (for a 30-minute sample)		
	\$0.13	\$0.44

Figure 6: Cost analysis of the two server configurations.

We found that the Dell PowerEdge FX2s and FC830 configuration provided a 72 percent lower cost per new order than the legacy HP configuration. The significant difference in NOPM yielded a difference of \$0.13 per new order for the FX2s configuration compared to \$0.44 per new order for the legacy configuration. Although we used the NOPM number from the 30-minute sample to calculate the percent difference in cost per new order, a window of any duration would yield the same percentage difference between the two costs per new order.

ABOUT PRINCIPLED TECHNOLOGIES



Principled Technologies, Inc.
1007 Slater Road, Suite 300
Durham, NC, 27703
www.principledtechnologies.com

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.

Principled Technologies is a registered trademark of Principled Technologies, Inc.
All other product names are the trademarks of their respective owners.

Disclaimer of Warranties; Limitation of Liability:

PRINCIPLED TECHNOLOGIES, INC. HAS MADE REASONABLE EFFORTS TO ENSURE THE ACCURACY AND VALIDITY OF ITS TESTING, HOWEVER, PRINCIPLED TECHNOLOGIES, INC. SPECIFICALLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, RELATING TO THE TEST RESULTS AND ANALYSIS, THEIR ACCURACY, COMPLETENESS OR QUALITY, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. ALL PERSONS OR ENTITIES RELYING ON THE RESULTS OF ANY TESTING DO SO AT THEIR OWN RISK, AND AGREE THAT PRINCIPLED TECHNOLOGIES, INC., ITS EMPLOYEES AND ITS SUBCONTRACTORS SHALL HAVE NO LIABILITY WHATSOEVER FROM ANY CLAIM OF LOSS OR DAMAGE ON ACCOUNT OF ANY ALLEGED ERROR OR DEFECT IN ANY TESTING PROCEDURE OR RESULT.

IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC. BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS TESTING, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC.'S LIABILITY, INCLUDING FOR DIRECT DAMAGES, EXCEED THE AMOUNTS PAID IN CONNECTION WITH PRINCIPLED TECHNOLOGIES, INC.'S TESTING. CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES ARE AS SET FORTH HEREIN.
