

Modernize or Perish: Dell EMC™ Solutions for Microsoft® Azure® Stack HCI Throw a Lifeline to Your Database Workloads

Prowess Consulting's testing shows that Dell EMC AX-740xd nodes provide near-linear scalable performance for Microsoft® SQL Server® 2019 coupled with modern manageability.

Executive Summary

Data drives business, but businesses too often struggle to keep up. Nowhere is this more evident than with databases. Business and IT leadership look to database administrators (DBAs) to modernize the data estate, but DBAs are just trying to coax performance out of their current infrastructure. Overall, IT today is held back by legacy systems that grow ever more costly to operate, all while budgets are shrinking. DBAs and IT leadership alike are wrestling with outdated data-management solutions and processes, with results that hurt the organization at large.

Hyperconverged infrastructure (HCI) can act as a lifeline for organizations who need to modernize. HCI promises to reduce expenses, increase agility, and simplify operations, but the choice of HCI solution is crucial. For an HCI solution to be effective, it needs to meet current and future performance needs while reducing total cost of ownership (TCO) and management complexity.

Prowess Consulting evaluated one such solution, Dell EMC™ Solutions for Microsoft® Azure® Stack HCI, with an eye toward performance and overall value. Our testing and research showed that this Dell EMC HCI solution running Microsoft® SQL Server® 2019 provides:

- Near-linear scalability and an overall level of performance that help ensure the solution can meet both current and future performance needs.
- Lower TCO through a preinstalled, original equipment manufacturer (OEM)-licensed operating system and database that saves on licensing costs and accelerates deployment compared with volume licensing and manual installation.
- Modernization benefits including greater reliability and cluster-aware, cloud-ready management capabilities built into the solution.

Decommissioning legacy servers can free up IT budgets to be reallocated toward innovation. Moving to AX nodes from Dell Technologies running Windows Server® 2019 and SQL Server 2019 can consolidate physical server footprint, simplify management, and provide higher reliability for the workloads the business depends on.

Highlights



Performance that scales with the cluster



Lower TCO and faster time to value compared with volume licensing and manual installation



Built-in, modern management tools

The Challenge: Harnessing Data with Outdated, Fraying Tools

It's accepted wisdom that data powers business. However, that's only partly true. Only data that can be harnessed, processed, and presented can propel business. Doing this at the speed of business drives the need for ever greater performance from databases. DBAs are at the front lines of this push for speed, but their roles and responsibilities only continue to grow more complex. DBAs are under pressure to modernize their businesses' data estates, particularly for core database workloads. But their legacy infrastructure is not able to provide the levels of performance and latency demanded by business. Worse, most of their organizations' current infrastructures are too inflexible to enable scalability, even as they and the rest of IT are constantly asked to do more with less.

For their part, IT organizations are caught between the dual fires of aging infrastructure and shrinking budgets. On the one hand, the cost to operate legacy infrastructure is becoming prohibitive. On the other hand, do-it-yourself (DIY) strategies for organizations doing their own infrastructure refreshes often lead to human error and can be time and budget sinks.

These traditional IT environments are difficult to monitor, manage, and maintain. IT organizations contend with antiquated, inflexible management tools and manual, error-prone operational processes. IT needs management capabilities that are familiar enough for technical staff to operate, yet powerful enough to provide a high degree of automation and orchestration. In addition, many organizations are looking to make use of hybrid operations by introducing monitoring and management functionality, delivered as a service from the public cloud, to supplement or replace their existing management ecosystems.

Solution Overview: Dell EMC Solutions for Microsoft Azure Stack HCI

HCI can help organizations achieve their strategic goals with data modernization while “keeping the lights on” with ongoing operations: compared to legacy IT infrastructure, HCI simplifies deployment and operations, saves on costs through a smaller footprint, and delivers higher performance. It also preserves choice for IT organizations by meeting both current and future needs without forcing organizations to overprovision now to prepare for growth. However, it is vital that IT organizations build on HCI clusters capable of continuing to meet SQL Server performance and availability requirements as their SQL Server environments scale out. This infrastructure must predictably and linearly scale with SQL Server workloads.

AX nodes from Dell Technologies deliver a broad, intelligently curated hyperconverged platform that can meet the requirements of even the most demanding SQL Server workloads. The solution comes validated and certified to remove the guesswork when building a modernized, business-critical database environment. Comprehensive management with Dell EMC™ OpenManage™ Integration with Microsoft Windows® Admin Center, rapid time to value with Dell EMC™ ProDeploy options, and solution-level Dell ProSupport™ complete this modernized portfolio.

Key Results

Evaluation and load testing by Prowess Consulting show that this database solution provides:

- **Near-linear scalability and performance**—Each additional Dell EMC AX-740xd node provides nearly linear additional performance for SQL Server workloads running on the expanding cluster. Running additional virtual databases to Dell EMC AX-740xd nodes provides nearly the same performance as running those same virtual machines (VMs) on dedicated servers.
- **Lower TCO**—Dell EMC AX-740xd nodes can come preinstalled with Windows Server 2019 and SQL 2019 software.¹ OEM licensing of preinstalled operating systems can reduce licensing costs by up to 31 percent, while preinstallation accelerates deployment up to 86 percent compared with volume licensing and manual installation.² The included support from Dell Technologies will reduce management effort and cost.
- **Modernization benefits**—Moving legacy SQL Server workloads to new HCI hardware can improve performance for business-critical databases and enable IT organizations to do more with less physical hardware and increase database performance and reliability. This scalable performance makes Dell EMC AX-740xd nodes a great platform for SQL Server. And the solution comes with additional modernization benefits, such as Cluster-Aware Updating and simple integration with Azure services, that are part of AX nodes from Dell Technologies. These solutions make it easy for IT organizations to reap the benefits of scale-out performance without greater management complexity.

Scalability Details

Prowess Consulting's goal in developing the test methodology for this study was to establish the linearity of performance for a cluster of Dell EMC AX-740xd nodes under conditions similar to the workload scaling out. We designed our test approach to simulate a real-world online transaction processing (OLTP) workload comparable to an enterprise-resource-management (ERM) system that drives critical back-office operations.

Hyperconverged Incremental Load Testing

To test the hyperconverged systems, Prowess used an incremental load test that was designed to distribute load across four Dell EMC AX-740xd nodes. For example, one virtualized database ran on each node in test 4, and two databases ran on each node in test 8. Table 1 shows the incremental test plan with the distributed workload.

Table 1. Test plan with the Microsoft® SQL Server® 2019 workload distributed across Dell EMC™ Solutions for Microsoft® Azure® Stack HCI with Dell EMC AX-740xd nodes

	Node 1		Node 2		Node 3		Node 4	
	VM 1	VM 2	VM 3	VM 4	VM 5	VM 6	VM 7	VM 8
Test 1	Active							
Test 2	Active		Active					
Test 3	Active		Active		Active			
Test 4	Active		Active		Active		Active	
Test 5	Active	Active	Active		Active		Active	
Test 6	Active	Active	Active	Active	Active		Active	
Test 7	Active	Active	Active	Active	Active	Active	Active	
Test 8	Active	Active	Active	Active	Active	Active	Active	Active

For the testing, we used HammerDB to capture performance and utilization data. For more information, see [Appendix C](#).

Test Results

Our engineers totaled transactions per minute (TPM) and new orders per minute (NOPM) per VM across test runs. Both of these measurements are commonly used database-performance metrics, with TPM providing a metric for comparing performance between different versions of the same database engine (in this case, SQL Server) and NOPM providing a means of comparing performance between different databases. The hyperconverged platform showed near-linear scalability in the incremental load-test scenario, as shown in Figure 1.

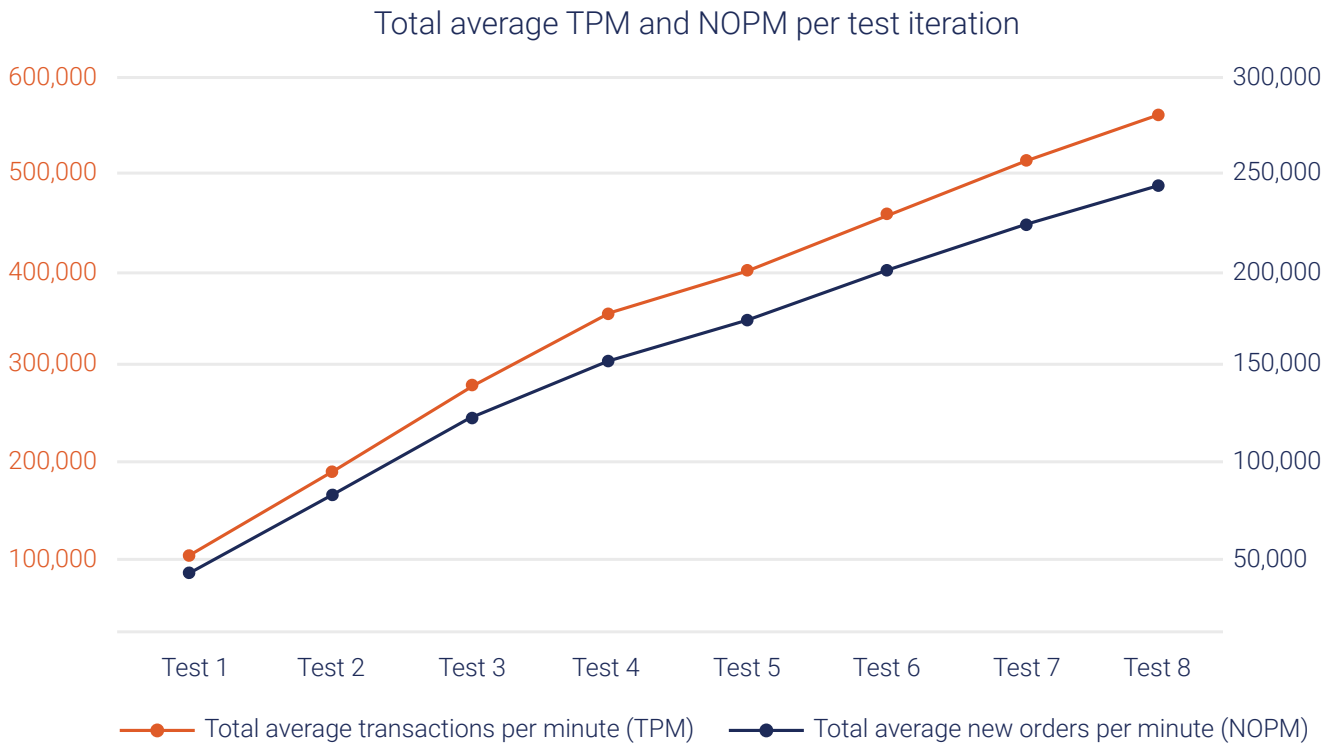


Figure 1. Total average TPM and NOPM per test iteration

A single VM running on the platform achieved a total average of 102,177 TPM. Eight VMs running concurrently generated a total average of 561,773 TPM. The greatest deviation in linearity for performance came with the addition of the fifth virtualized database; however, even when two VMs were running on servers, performance remained near-linear as more VMs were added.

NOPM yielded similar results. When one virtualized database was running on the platform, it achieved a total average peak of 44,414 NOPM; when all eight virtualized databases were running, the average total NOPM was 244,237, with the inflection point in the performance line coming as multiple VMs began to run per node. However, scalable performance is far from the only benefit of using AX nodes from Dell Technologies for SQL Server 2019 workloads.

Because the testing was conducted on new, well-tuned servers, these numbers represent good performance. The four-node Dell EMC AX-740xd cluster achieved 81,469 IOPS at sub-millisecond median write latency (293 microseconds) with eight VMs running.³

TCO and Modernization Benefits

AX nodes from Dell Technologies come preinstalled with Windows Server 2019 software, discounted through special OEM licensing from Microsoft. OEM licensing from Microsoft can reduce operating system licensing costs and speed deployment. Dell EMC Solutions for Azure Stack HCI nodes powered by 2nd Generation AMD EPYC® processors can qualify for additional operating system–licensing savings from Microsoft that cap the number of AMD® processor cores assessed for licensing fees. And these servers are eligible for Dell ProSupport IT-management services that support the entire solution—both hardware and software—after deployment, reducing management effort and cost.

Moving legacy SQL Server workloads to new HCI hardware benefits business-critical databases in two ways: not only can IT organizations do more with less physical hardware, they also gain greater performance and reliability by moving from earlier versions of SQL Server on older operating systems to SQL Server 2019 and Windows Server 2019.



Manageability Details: Dell Technologies Differentiators

Dell EMC OpenManage Integration with Microsoft Windows Admin Center is an extension for Windows Admin Center, which provides troubleshooting and managing capabilities for clusters and HCIs based on Windows Server. This integration supplies scalable monitoring and inventory capabilities for AX nodes from Dell Technologies and simplifies the tasks of IT administrators and DBAs throughout the life cycle of the SQL Server infrastructure. For example, Dell EMC OpenManage Integration with Microsoft Windows Admin Center can reduce the total time required and the resulting maintenance window when performing hardware updates on a Dell EMC Solutions for Azure Stack HCI four-node Dell EMC AX-740xd cluster by up to 40 percent compared with following a manual approach.⁴

Dell EMC OpenManage Integration with Microsoft Windows Admin Center enables streamlined life-cycle management at the server level for Azure Stack HCI clusters based on Dell EMC AX nodes, in addition to enabling deep monitoring and inventorying. OpenManage Integration makes use of Cluster-Aware Updating to orchestrate seamless BIOS, firmware, and driver updates with minimal impact to the workloads running in the VMs.

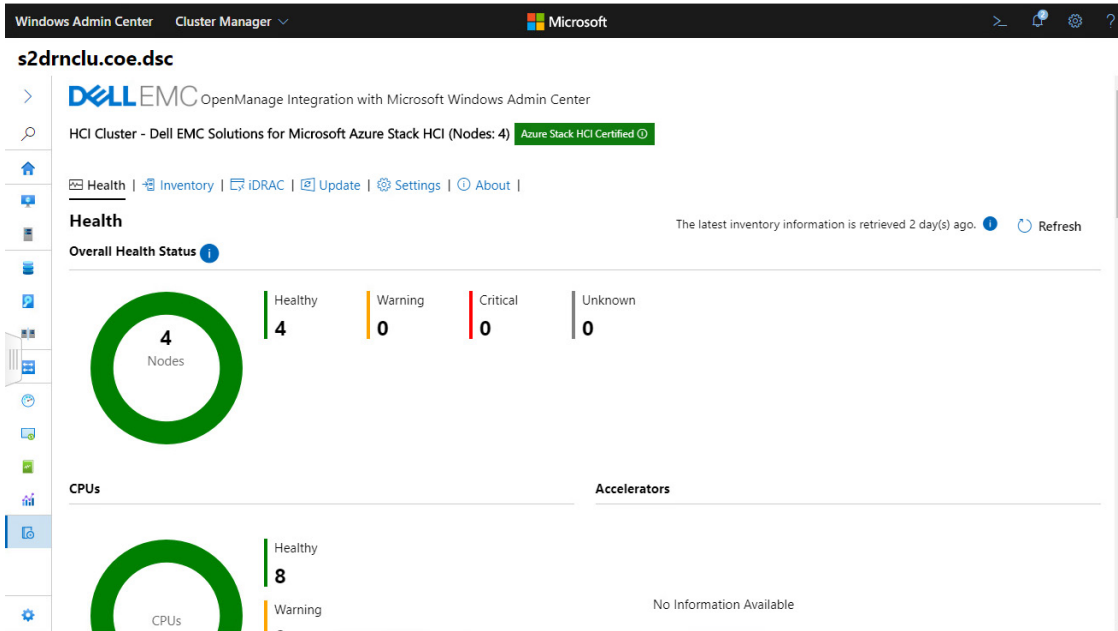


Figure 2. Screenshot of Dell EMC™ OpenManage™ Integration with Microsoft® Windows® Admin Center console

Azure has numerous extensions into Windows Admin Center. Principal among these, from the manageability perspective for SQL Server 2019 workloads, are the following:

- **Azure Site Recovery**—The built-in Azure disaster-recovery-as-a-service (DRaaS) solution to deploy replication, failover, and recovery processes
- **Azure Backup**—The native Azure backup solution, which provides one-click backup support for Azure SQL Database
- **Azure Monitor**—The Azure monitoring solution for infrastructure, including databases

These extensions make DBAs' lives easier from a business continuity/disaster recovery (BCDR) and service-monitoring perspective.

Technology Overview

From a technology perspective, our testing dealt with three principal items: AX nodes from Dell Technologies with AX-740xd nodes, Windows Server 2019, and SQL Server 2019.

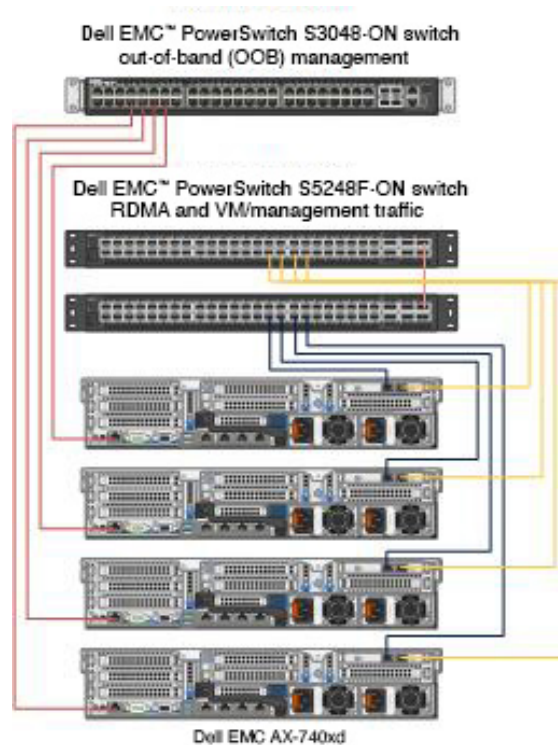


Figure 3. Diagram of hardware as configured for testing

AX-740xd Nodes

AX nodes are built using Dell EMC™ PowerEdge™ servers. They provide fully productized, validated, and factory-configured HCI nodes. Moreover, the portfolio of Dell EMC AX nodes is configured to meet the requirements of a wide range of workloads—especially SQL Server workloads—with the higher-end configurations using NVMe Express (NVMe), solid-state drives (SSDs), and Intel® Optane™ persistent memory (PMem).

Dell EMC Solutions for Azure Stack HCI also enable access to a dedicated team of Dell ProSupport experts that know all aspects of the solutions, which helps improve IT performance, stability, and workload availability. Dell EMC ProDeploy can provide 66 percent faster time to deploy,⁵ reducing time to value for initial deployment and for expansion later on. Additional services such as Dell ProConsult™ Migration Services can accelerate migration of SQL Server workloads to Azure Stack HCI through Dell Technologies' global delivery team, allowing organizations' in-house IT resources to focus on higher-priority initiatives.

Dell EMC OpenManage Integration with Microsoft Windows Admin Center provides cluster-aware updates and monitoring for AX nodes from Dell Technologies. This makes it possible for IT organizations to scale out their SQL Server workloads while easing management.

Windows Server® 2019

Windows Server 2019 is built on the strong foundation of Windows Server 2016, and it brings numerous innovations on key themes: HCI, hybrid cloud, and security:

- **Native support for persistent memory**—Storage Spaces Direct (S2D) supports persistent memory modules, such as Intel Optane PMem, for increased performance, and it enables those modules to be managed just like any other drive in Windows PowerShell® or Windows Admin Center.
- **Nested resiliency**—Two-node S2D clusters can provide continuously accessible storage for apps and VMs, even if one server node goes down and a drive fails in the other server node.
- **Deduplication**—Resilient File System (ReFS) volumes can store up to 10 times more data on the same volume through multithreaded post-processing that keeps performance impact minimal.⁶
- **Microsoft® Defender Advanced Threat Protection (ATP)**—Microsoft Defender ATP provides deep platform sensors and response actions that expose memory-level and kernel-level attacks and that respond by suppressing malicious files and terminating malicious processes.
- **Cluster sets**—Organizations boost the number of servers beyond the current limits of a cluster by grouping multiple clusters into a *cluster set* and moving running VMs within the cluster set.

For more information, see [“What’s new in Windows Server 2019.”](#)

SQL Server 2019

SQL Server 2019 builds on previous releases to grow SQL Server as a platform that gives organizations choices in development languages, data types, and on-premises or cloud environments. It also provides additional capabilities and improvements for the SQL Server database engine, high availability, and SQL Server Analysis Services:

- **Data virtualization and SQL Server 2019 big data clusters**—SQL Server 2019 can provide near-real-time insights from all of an organization’s data with SQL Server 2019 big data clusters, which provide a complete environment for working with large datasets, including machine learning (ML) and artificial intelligence (AI) capabilities.
- **Intelligent database**—SQL Server 2019 builds on innovations in previous versions to provide industry-leading performance out of the box. From intelligent query processing to support for persistent memory devices, the SQL Server intelligent database features help improve the performance and scalability of organizations’ database workloads without any changes to their application or database designs.
- **High availability**—Keeping mission-critical SQL Server instances and the databases within them available whenever the business and end users need them is an essential task for all IT organizations. SQL Server 2019 introduces many new features and enhancements that allow businesses to better ensure that their database environments are highly available at all times.
- **SQL Server Analysis Services**—SQL Server 2019 introduces new features and improvements for performance, resource governance, and client support.

For more information, see [“What’s new in SQL Server 2019.”](#)

Modernization with Performance, Value, and Manageability

AX nodes from Dell Technologies provide near-linear scalability and performance for scaling out SQL Server 2019 workloads. Prowess testing showed that adding single virtual databases to Dell EMC AX-740xd servers in a four-node cluster maintained linearly increased performance across the cluster; additional VMs in each cluster node experienced only slight reduction in performance.

Beyond the predictable, scalable performance that makes them great platforms for SQL Server 2019, AX nodes from Dell Technologies come with additional advantages. Windows Admin Center natively provides powerful monitoring and management capabilities for SQL Server 2019 environments running on Azure Stack HCI clusters. Windows Admin Center is also extensible, and more capabilities can be added to it via extensions from Azure and Dell EMC OpenManage Integration with Windows Admin Center. Additionally, deployment and support options from Dell Technologies can speed organizations' time to value for database workloads and free up IT staff to pursue strategic goals.

Decommissioning legacy servers alleviates pressure for companies to spend IT budget on outdated technology, and it provides more money for innovation. OEM licensing from Microsoft on Dell Technologies servers can make an even more compelling economic argument for migrating to AX nodes from Dell Technologies. Moving to HCI can consolidate physical server footprint, simplify management, and provide higher reliability for the workloads on which business depends.

Appendix A: Hardware Configuration Details

System Information	Node Configuration
Model	Dell EMC™ AX-740xd
CPU	2 x Intel® Xeon® Gold 5220 processor at 2.20 GHz (18 cores)
Memory	12 x Hynix® HMA84GR7CJR4N-WM 32 GB (384 GB total per node)
Memory Frequency	2.67 GHz
DIMM Config	12 DDR4 DIMMs
Cluster Storage Controller	12 gigabits per second (Gbps) Dell EMC HBA330 adapter
Cluster Drives	4 x 1.75 TB Intel® SSDSC2KG019T8R SSD
Storage	Storage Spaces Direct cluster pool
Network Config	25 gigabit Ethernet (GbE) QLogic® FastLinQ® QL41262-DE adapter
BIOS Version	Dell Inc 2.6.4 4/9/20
Operation System Version	Windows Server® 2019 Datacenter 1809 (Build 17763.1397)
Application Versions	
Window® Admin Center	2007 (Build 1.2.2007.18002)
HammerDB	v3.3

Appendix B: VM Configuration Details

VM Component	Configuration
Number of vCPUs	4
Memory	64 GB
Operating System Virtual Hard Disk	50 GB
Data Virtual Hard Disk	400 GB
Log Virtual Hard Disk	75 GB
Operating System	Windows Server® 2019 Datacenter 1809 (Build 17763.1397)

Appendix C: Test Methodology Details

Prowess cloned eight SQL Server 2019 Standard VMs across the four Dell EMC AX-740xd nodes (two VMs per node). Prowess then shut down the VMs, starting them sequentially and running the tests incrementally. Prowess started VM 1, ran the HammerDB testing on the VM to its conclusion, then started VM 2, ran the test on both running VMs, and so on until Prowess ran HammerDB with all eight VMs running in the final iteration of the testing.

We maintained a 50–60 percent CPU usage range on the VMs tested.



Windows Server 2019

¹ Specific details about software preinstallation are available through the Dell Technologies sales channel.

² Prowess Consulting. "Streamline Your Server Deployments by Choosing Dell EMC™ PowerEdge™ Servers with Preinstalled Microsoft® Software." November 2019. www.prowesscorp.com/wp-content/uploads/2020/01/190115-DellMSFT-PowerEdge-PerformanceBrief-Final.pdf.

³ Median IOPS and latency of 100 percent random read/write operations on eight VMs running on four host nodes generated using HammerDB.

⁴ Dell. "Dell EMC Solutions for Microsoft Azure Stack HCI Lifecycle Management Comparison." August 2020. <https://infohub.delltechnologies.com/t/dell-emc-solutions-for-microsoft-azure-stack-hci-life-cycle-management-approach-comparison-1/>.

⁵ Principled Technologies. "Bring new systems to production readiness faster and with less effort from in-house administrators." Commissioned by Dell Technologies. February 2017. <https://facts.pt/YU95pg>.

⁶ Microsoft. "What's New in Data Deduplication." April 2019. <https://docs.microsoft.com/en-us/windows-server/storage/data-deduplication/whats-new>.



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