Scaling SQL Server 2022 VMs on Dell Integrated System for Microsoft Azure Stack HCI

August 2023

H19653

White Paper

Abstract

This white paper describes a cloud-ready, scalable, high performing solution for Microsoft SQL Server 2022 enabled by the Dell Integrated System for Microsoft Azure Stack HCI.

Dell Technologies Solutions

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Introduction

Executive summary

Data has the power to identify and resolve weaknesses in business strategy, enhance customer relationships, and create market disrupting solutions and services. Due to the overwhelming amount of available data, businesses rely on various data management tools and techniques to extract these crucial insights. Microsoft SQL Server data platform continues its record of breakthrough innovation with its recent release of SQL Server 2022.

A database solution can only achieve its full potential on the correct infrastructure. Many database administrators (DBAs) and IT professionals have discovered the benefits of consolidating their databases onto a modern hyperconverged infrastructure (HCI). Dell Integrated System for Microsoft Azure Stack HCI (Azure Stack HCI) is an ideal platform for delivering maximum performance, scalability, resiliency, and operational efficiency from your data estates. As an integrated system, Azure Stack HCI bundles engineering validated, factory-ready hardware configurations, full stack lifecycle management, and a collaborative enterprise support model.

Document purpose

The purpose of this document is to test SQL Server 2022 performance and scalability on Azure Stack HCI and validate platform management tools such as Dell OpenManage Integration with Microsoft Windows Admin Center. To address these objectives, we deployed a Dell Integrated System for Microsoft Azure Stack HCI running Microsoft SQL Server 2022 VMs. We used HammerDB, an open-source tool for performing synthetic benchmarking against SQL Server, to discover the average and maximum Transactions Per Minutes (TPM) on a single VM. We tested TPM scalability as more SQL Server VMs were created on the cluster to understand the impact of a common consolidation scenario in which more VMs are added to the platform over time.

We also observed the behavior of the integrated system under failover conditions. We examined high availability and recoverability at both the infrastructure and SQL Server application layer. We also carried out proactive lifecycle management tasks to prove the operational efficiency aspects of the integrated system using Dell OpenManage Integration with Microsoft Windows Admin Center.

Audience

This document is intended for IT managers, IT infrastructure administrators, and DBAs who are investigating new solutions to address their database management challenges.

Business challenges

Market environment

Only data that can be harnessed and processed can propel business. Obtaining data at the speed of business demands greater performance from databases. Database administrators (DBAs) are at the front lines of this push for speed, but their roles and responsibilities continue to grow more complex.

Aging, inflexible infrastructure

DBAs are under pressure to consolidate and modernize their businesses' data estates, particularly for core database workloads. However, legacy infrastructure is usually not able to provide the levels of performance and resiliency demanded by the business. Most of their organizations' current infrastructures are also too inflexible to enable scalability and the rest of IT are constantly asked to do more with less.

Shrinking budgets

The cost to operate legacy infrastructure is becoming prohibitive and strategies for organizations to perform their own infrastructure refreshes often leads to human error and can be time and budget sinks.

Operational inefficiencies

Traditional IT environments are difficult to monitor, manage, and maintain. IT organizations contend with outdated, inflexible management tools and manual, error-prone operational processes. IT requires management capabilities that are familiar enough for technical staff to operate and powerful enough to provide a high degree of automation and orchestration.

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

Using a consultative approach to sizing

Azure Stack HCI is a fully productized HCI solution, which means customers do not have to spend valuable time planning to run Microsoft SQL Server 2022 VMs. Traditional multi-tiered architectures often require extensive customization of hardware and software settings to optimize the performance and resiliency of database workloads. In the case of Azure Stack HCI, Dell Technologies engineering validates a broad range of intelligently designed configurations ready to meet the requirements of even the most demanding SQL databases. To determine the right-sized system that achieves the best return on investment, it is essential to understand the performance and capacity characteristics of your existing database environment.

Dell Technologies follows a consultative and systematic approach to help customers modernize their data estate. Dell Live Optics is a free, online software tool used to collect, visualize, and share data about existing IT infrastructures and database workloads.

Optical Prime is software that collects metrics like peak CPU utilization, IOPS, used storage, and average daily writes from various operating systems. Optical Prime also comes bundled with workload collectors to gather critical information directly from the application layer.

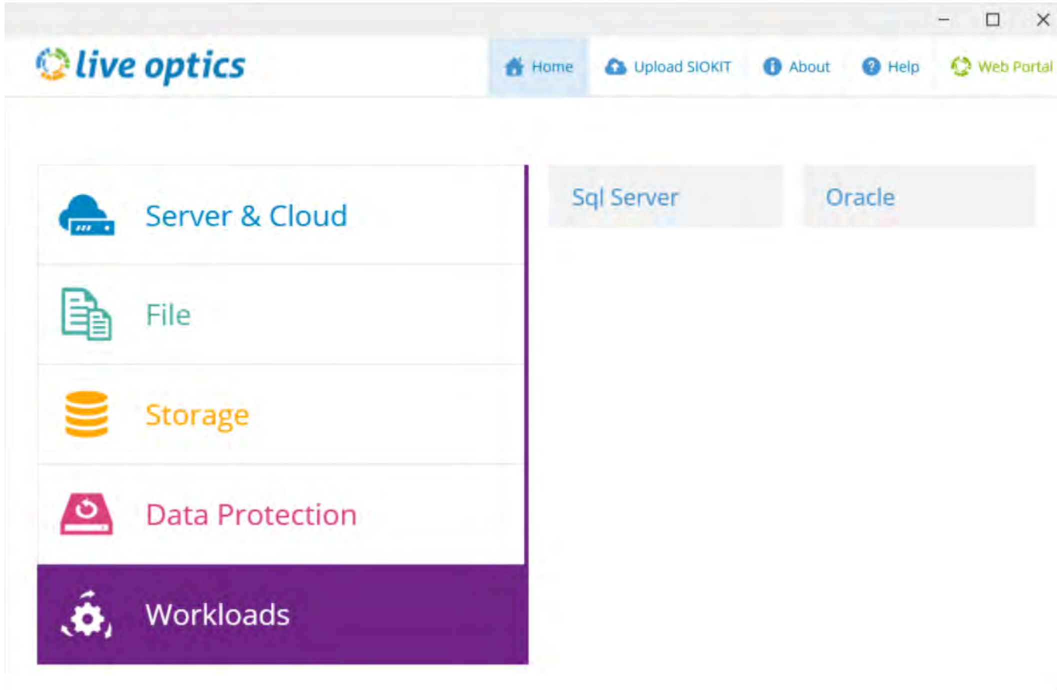

Figure 1. Optical Prime with database workload collectors

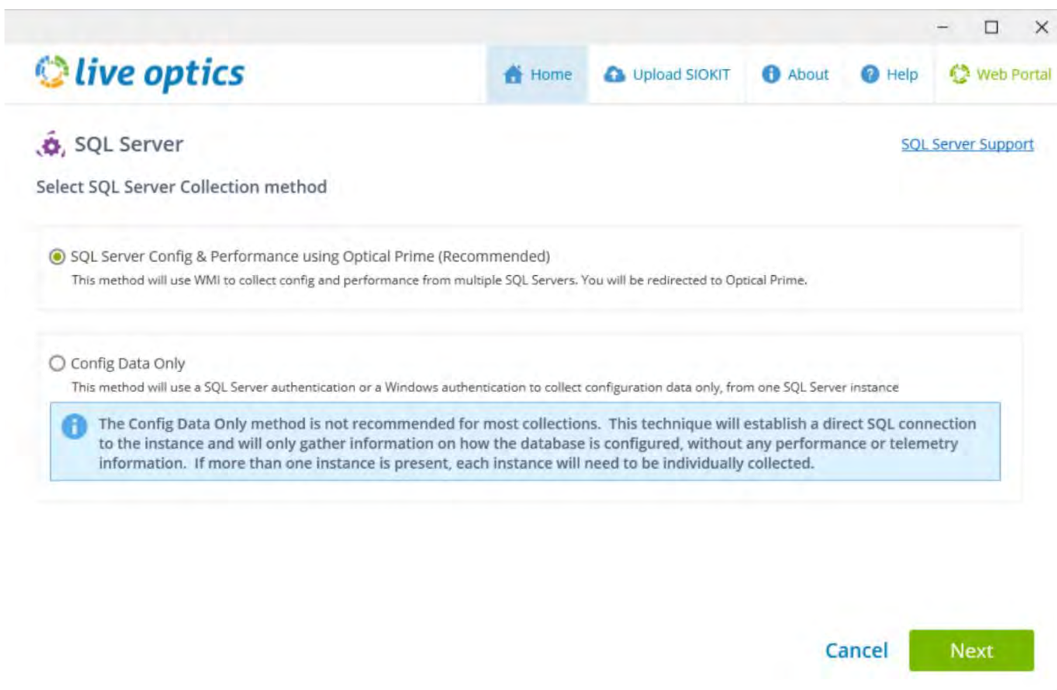

Figure 2. SQL Server collection method configuration

Results are stored in a uniform format called a Collector Run to be analyzed in the Live Optics Portal with the Live Optics Viewer. This view is required to understand the current performance and capacity requirements for your new system.

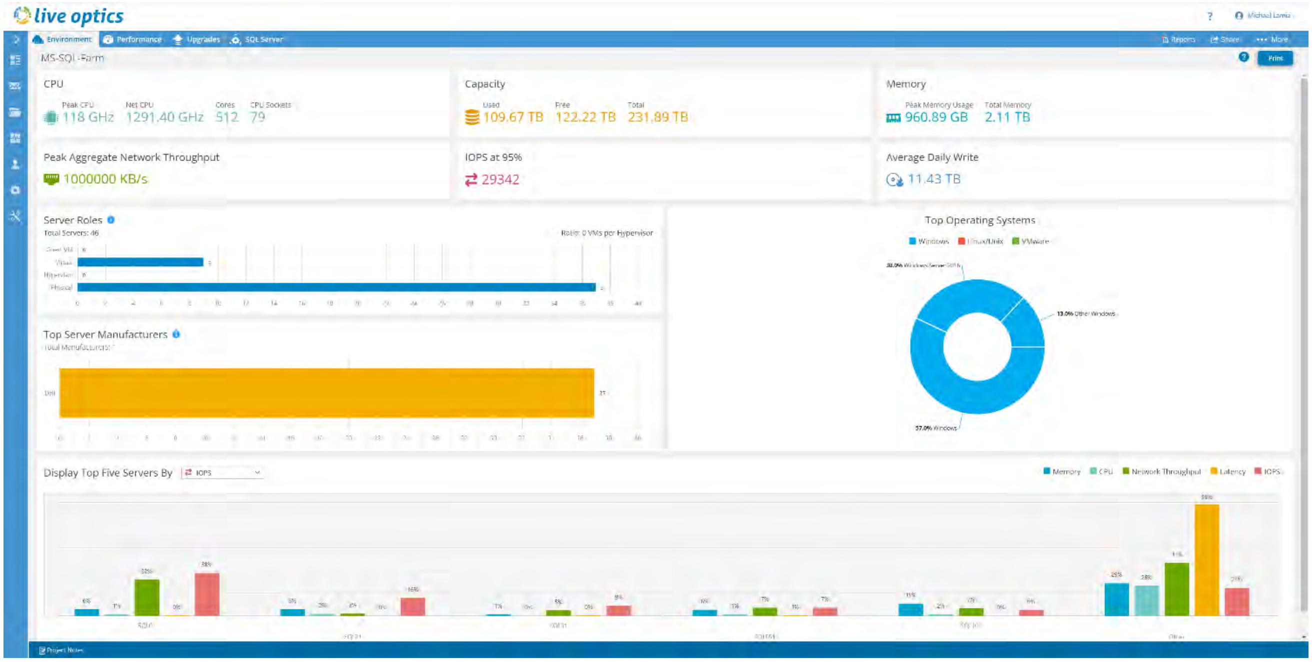

Figure 3. Visualized data collected by Optical Prime

The SQL Server workload collector goes into application-layer detail of the current environment.

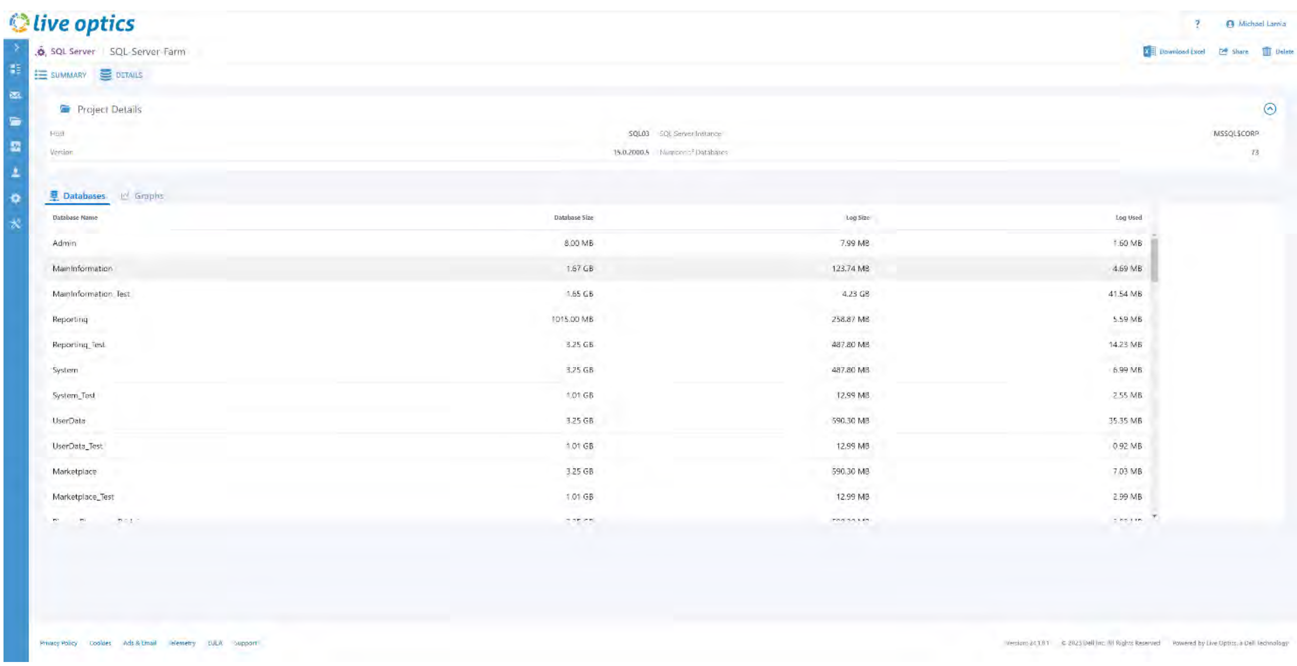

Figure 4. List of databases identified by the Optical Prime collector

Figure 5. Performance information gathered using the SQL Server workload collector

The data collected by Live Optics would then be provided to your Dell Technologies account team to influence selections in the Azure Stack HCI Sizer Tool. The sizer tool integrates all the Azure Stack HCI design constraints and best practices from extensive engineering validation efforts. This tool ensures that each potential configuration generated is a balanced and viable option. Customers can produce multiple configurations with the Dell Technologies account teams to compare and select a configuration that meets their current database performance, capacity, and resiliency requirements as well as future growth projections within the allocated budget. For more information about Live Optics, see the [Live Optics for SQL Server Knowledge Base.]

Note: Only Dell Technologies direct sales and its partners can access the Azure Stack HCI Sizer Tool. Customers can contact their Dell Technologies account team or preferred channel partner to create recommended configurations in the tool.

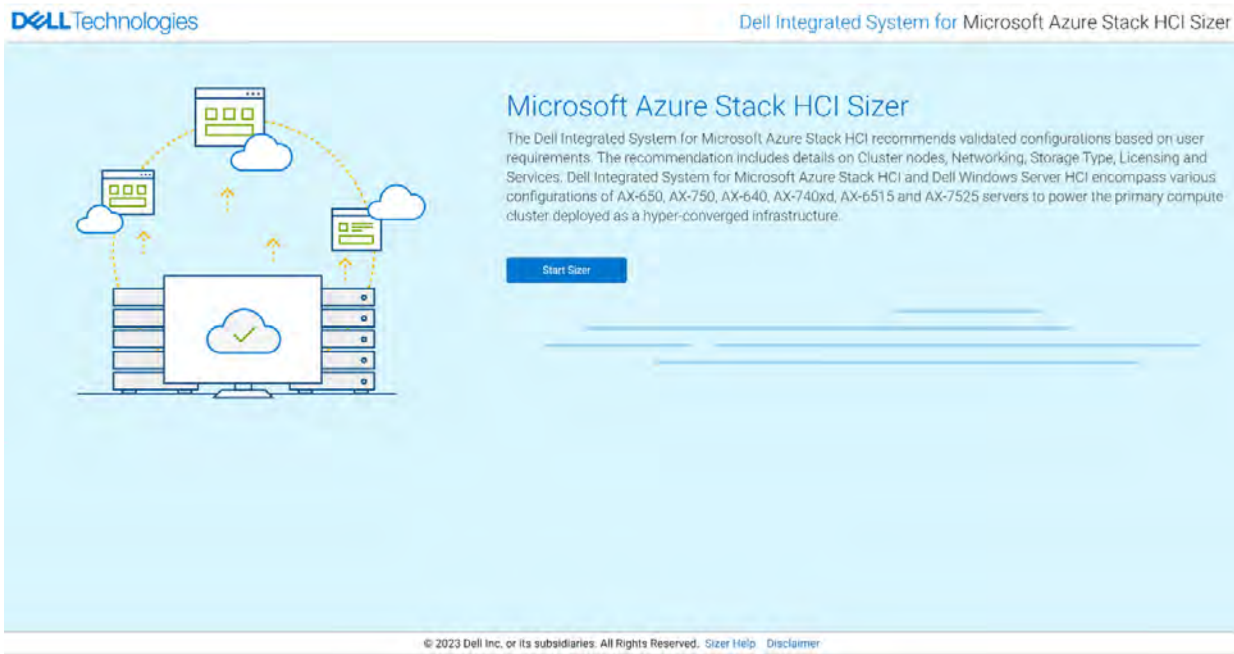

Figure 6. Azure Stack HCI Sizer Tool from Dell Technologies

Automation for operational efficiency

The only way to ensure predictable and repeatable Day 2 operations for your integrated system is to leverage automation. Dell OpenManage Integration with Microsoft Windows Admin Center provides in-depth, cluster-level automation capabilities that streamline operational efficiency and flexibility throughout the Azure Stack HCI lifecycle. Engineering tested several features of the Dell OpenManage Integration extension to monitor the impact on the running SQL workloads.

The following list describes other benefits of Dell OpenManage Integration with Microsoft Windows Admin Center:

- Provides a consistent hybrid management experience by using a single Dell HCI Configuration Profile policy definition.
- Reduces operational expense by intelligently right-sizing infrastructure to match your workload profile.
- Ensures stability and security of infrastructure with real-time monitoring and lifecycle management.
- Protects your IT estate from costly changes to configuration settings made inadvertently or maliciously.

Azure Arc-enabled infrastructure is critical for delivering fleet management at-scale across your entire data estate. If Azure Stack HCI and SQL Servers are highly distributed across data center, edge, and public cloud locations, it is critical to rely on a centralized source for monitoring and managing your data. Azure Arc projects Azure Stack HCI clusters into Azure Resource Manager (ARM) so the cluster can be monitored using Azure Monitor. The integrated systems can also be monitored for configuration drift and business rule compliance using Azure Policy. Azure Arc-enabled SQL Server also enables fleets of SQL Servers to be managed from Azure with centralized inventory and queries from ARM.

New features in Microsoft SQL Server 2022

SQL Server has been a leader in performance, availability, and security. Now, SQL Server 2022 product also delivers the most cloud connected database platform to date.

Azure Arc-enabled SQL Server extends Azure services to SQL Server instances hosted outside of Azure whether in your data center, edge locations, or any public cloud or hosting provider. To onboard a SQL Server to Azure Arc-enabled SQL Server, an agent must be installed. This agent can be deployed during the initial setup for SQL Server 2022 or after it has been running. The agent provides a rich feature set which consists of:

- A single view of all connected SQL Servers deployed on-premises or in any public cloud
- A detailed technical assessment (formally Best Practice Analyzer) to provide insight into performance, security, business continuity and more
- Microsoft Defender for threat protection
- Deploy and manage your pay-as-you-go billing configurations.
- Enable RBAC for secure identity and single sign-on with Azure Active Directory.
- Azure Arc-enabled SQL Server is supported from SQL Server 2012 forward as described on the Microsoft page for Azure Arc-enabled SQL Server.

Bi-directional HA/DR between on-premises and Azure SQL with Azure SQL link contributes to platform resiliency. DBAs can use Azure as their DR location or gain additional insights against their read-only data instance with Azure SaaS reporting services. An integrated Distributed Availability Group (DAG) will manage all the data replication. Overall, the feature requires minimal configuration and maintenance.

The SQL engine has also been improved for on-premises workloads. Intelligent Query Processing (IQP) handles daily performance tuning work from an automated, do no harm, perspective. The performance of TempDB has now removed almost all object, metadata, and temp table contention. Internal improvements to the TempDB database for SQL 2022 almost guarantee a performance boost for any environment with no additional code changes.

Another major feature in SQL 2022 includes the ability to read from S3 object storage. DBAs can also backup to and from S3 object storage. As organizations seek to gain a competitive advantage with their intelligent data estate, it is critical to have the ability to access to all types of datasets. SQL Server 2022 combined with Dell ECS, or PowerScale, are the preferred technologies for querying a data lake using a T-SQL surface area. This combination of products and tools yields modern opportunities to store and manage different types of data on-premises and at public cloud scale.

Dell ECS and PowerScale with Microsoft SQL Server 2022 can provide limitless scale to your data estate. With both products existing within the solution architecture, data stewards can do even more with data, provide deeper insights, and foster next-gen solutions. For more information, see the Dell ECS and Microsoft SQL 2022 white paper.

Solution architecture

Component details

For this solution, we deployed a Dell Integrated System for Microsoft Azure Stack HCI. The Dell Integrated System for Microsoft Azure Stack HCI is a highly scalable, configurable purpose-built system. Customers can fine tune the components available within the system to best suit their data center needs.

The Dell Integrated System for Microsoft Azure Stack HCI used in this testing had four underlying AX-7525 nodes, each powered by 2 x 24 core AMD EPYC™ 7473X, 7003 Series processors. All four nodes had identical configuration to each other. We also leveraged our next-generation open networking with Dell PowerSwitch S5248F-ON switches.

The Dell S5248F-ON switches are an optimal Top-of-Rack (ToR) for our hyperconverged environment and support up to 100 GbE connectivity.

The components configured on a single AX-7525 node are described in the following table:

Table 1. AX-7525 components

Component	Detail
Processor	2 x AMD EPYC™ 7473X
Memory	2 TB of Quad rank DDR-4 memory @ 3200 MT/s
Physical Disks	12 x 1.6 TB Dell Enterprise NVMe CM6 MU Drives
Management NIC	Broadcom Adv. Dual 25 Gb Ethernet Adapter
RDMA NIC	Mellanox ConnectX-6 Dx Dual Port 100 GbE QSFP56 Adapter
Azure Stack HCI OS	Azure Stack HCI, version 22H2 (OS build 20349)

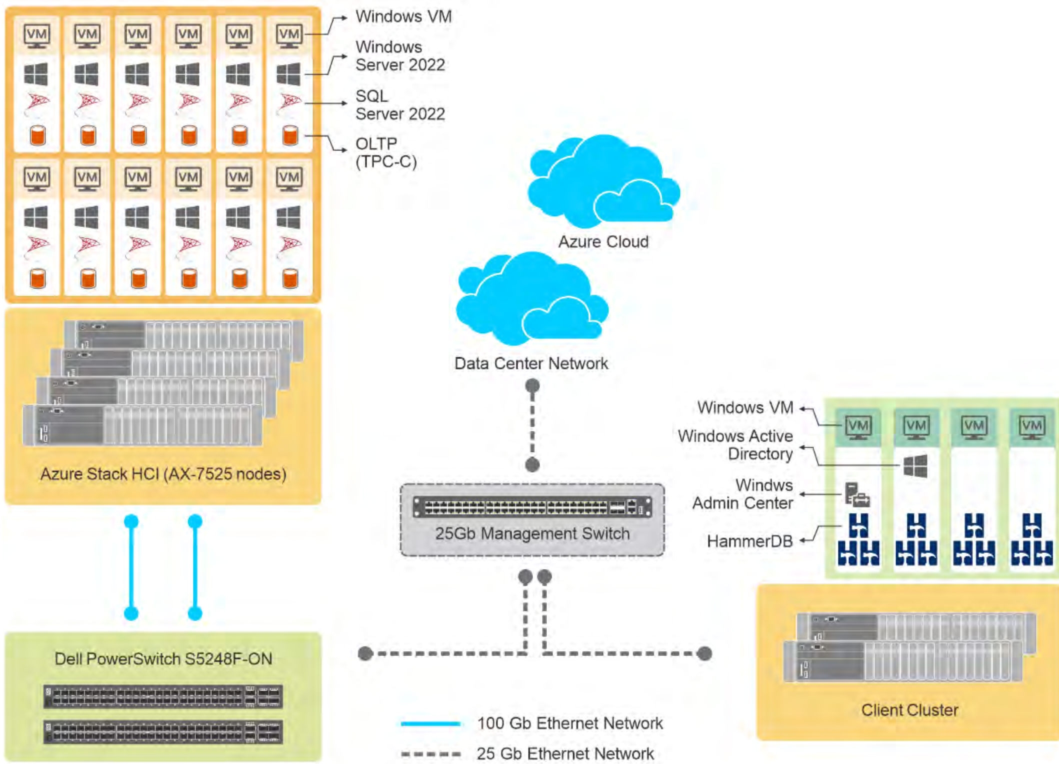

Figure 7. Architectural overview

Storage layer architecture

Each node is crucial and contributes to both storage and compute functions for HCI deployments. In environments where I/O intensive applications such as SQL Server are deployed, the underlying storage layer plays a vital role. Storage Spaces Direct is a core technology of Azure Stack HCI that enables users to pool and consolidate all hard drives across nodes into a software-defined solution.

Storage Spaces Direct uses the Software Storage Bus to dynamically bind the fastest drives available in the pool to slower drives hence enhancing overall IO and throughput. Microsoft strongly recommends customers use one pool per cluster. It is automatically created, and all eligible drives are added to it. To learn more about Microsoft's recommendations, see Storage Spaces Direct overview.

The physical drives used in this solution were configured into a single pool. To access this pool, we created parity and mirrored Cluster Shared Volumes (CSVs) based on throughput and availability requirements. On these CSVs, we placed the Virtual Hard Disks (.vhds) which were connected to each VM across multiple SCSI controllers. The volume and controller layout for our pool is described in Figure 8.

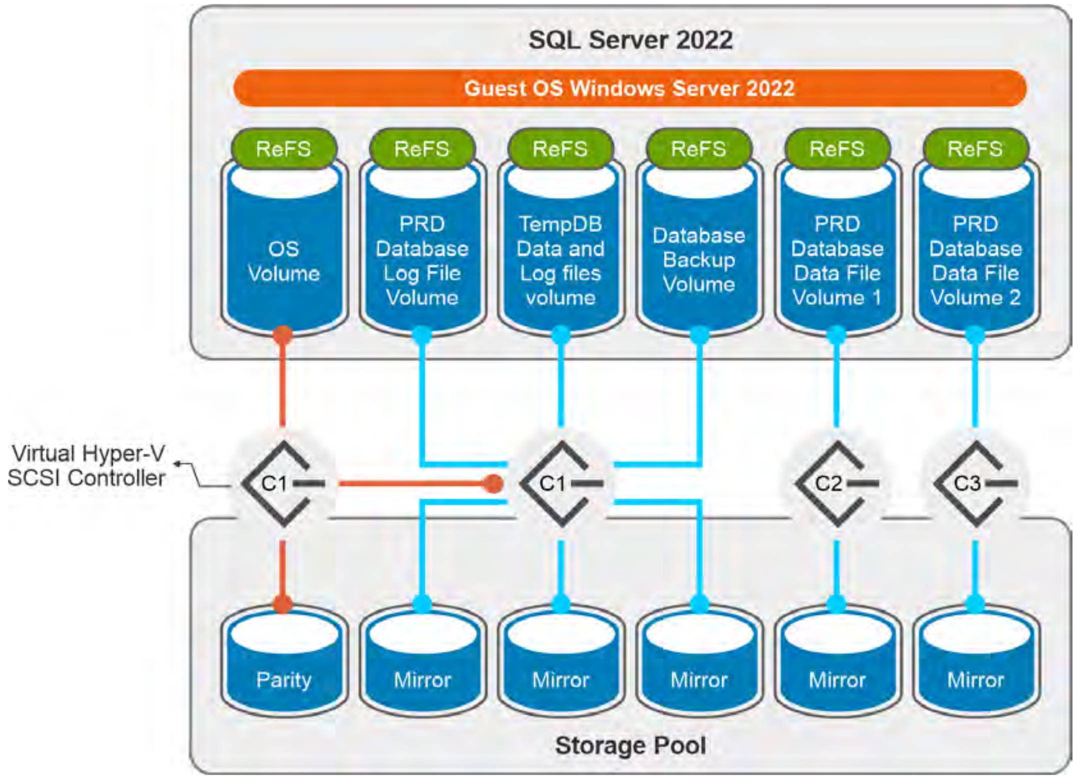

Figure 8. Storage architecture

Network layer architecture

The networking configuration and deployment is also a crucial component for HCI deployments. In the Dell Integrated System for Microsoft Azure Stack HCI system used in this solution, we configured two Dell S5248F-ON switches as ToR switches with L2 multipath support using Virtual Link Trunking (VLT) for high-availability across the switches. We used them with the NVIDIA Mellanox ConnectX-6 Dx Dual Port 100 GbE QSFP56 Adapters to provide Remote Direct Memory Access (RDMA) with RDMA over Converged Ethernet (RoCE) capabilities for our storage network. The overall network architecture is described in Figure 9.

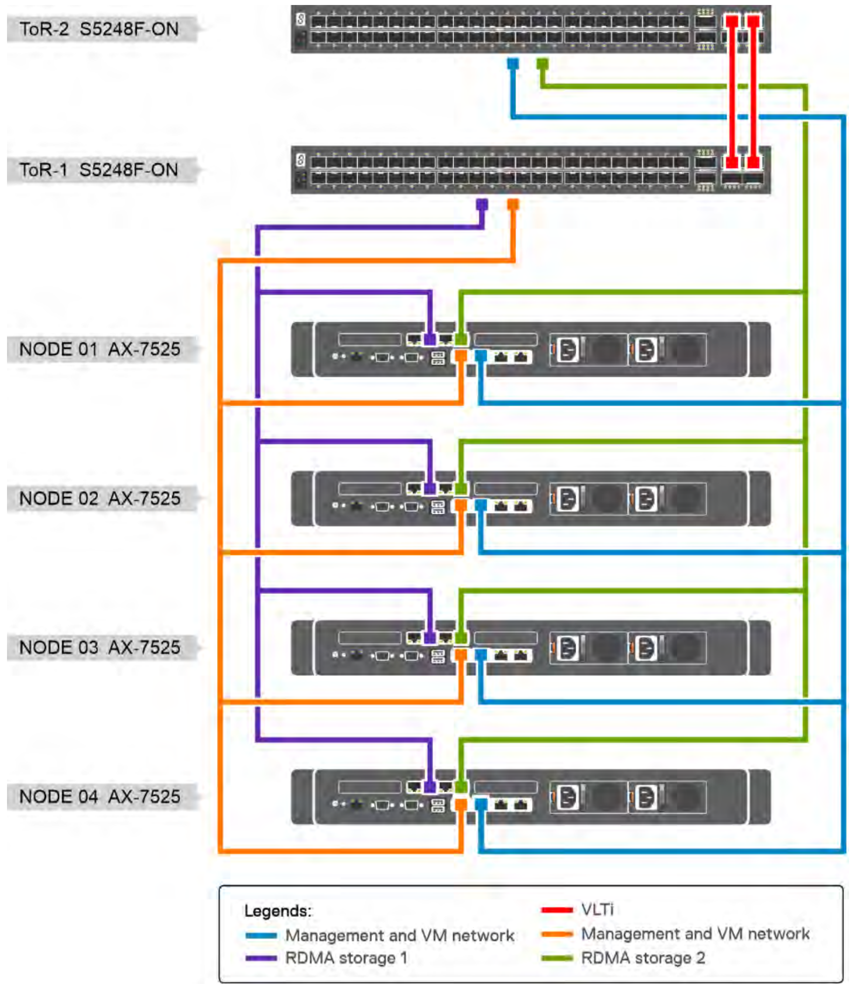

Figure 9. Network architecture

Solution deployment

Deployment overview

Dell ProDeploy and Dell ProSupport services deliver professional onsite deployment and one contact technical support for Azure Stack HCI.

For manual deployment instructions to setup the nodes, switches, Operating System and cluster, see the Dell Integrated System for Microsoft Azure Stack HCI. Once the cluster is set up, customers can progress to setting up VMs on the cluster. In addition to the deployment, the best practices we found during our deployment are also mentioned in the section that follows.

Note: The scope of these recommendations is specific to virtualized OLTP deployment on the Windows Server 2022 on Azure Stack HCI.

Storage recommendations

The storage layer is an important factor for every SQL Server deployment, especially OLTP workloads. OLTP workloads must process a large amount of reads and writes to data in a short time, which results in low latency and high-IOPs requirements.

This solution focuses tuning the entire stack from the bottom-up. Storage Spaces Direct is the initial layer that provides the capability to make internal drives available for our software-defined storage solution. It is automatically configured and managed, and it creates a storage pool that includes cache, tiers, resiliency, and erasure coding. For more information about how storage spaces direct functions, see HCI Azure Stack storage and cluster information from Microsoft.

In an HCI infrastructure, the server is central for both compute and storage resources. For this reason, users should carefully evaluate the specifications of the components within a server. The processor chosen for the server could handle the storage overhead associated with HCI and the compute requirement for workloads that the customers intend to run on the servers. By having pre-designed, certified components that complement each other, customers can fully experience the benefits of HCI with the lowest possible data center footprint.

Drive selection plays a vital role in this deployment, we recommend All-NVMe configurations. Ideally, only high speed NVMe drives should be selected for workloads that demand low latency with high IOPs like SQL Server.

Volume deployment

Volumes are data stores used to hold files for workloads running on the server. They are used to store Hyper-V files including VHD and VHDX files. All volumes are accessible to all servers within a cluster. While configuring volumes, pay attention to the following factors:

- The number of volumes created should be a multiple of the number of servers within the cluster.
- Create fixed sized, mirrored volumes for hot SQL Server data—because they provide the maximum performance for high-volume workloads.
- To maximize the efficiency of drives available, use dynamically sized mirror-accelerated parity volumes for operating system and VM files.

Note: Microsoft recommends limiting the size of each volume to a maximum of 64 TB.

For more information, see the following recommendations from Microsoft.

Parity and mirroring

Storage Spaces Direct provides a multitude of options for deploying volumes. We recommend using either three-way mirroring or mirror-accelerated parity. Details about different S2D resiliency settings can be found in the Microsoft documentation.

Networking recommendations

We deployed a Dell Integrated System for Microsoft Azure Stack HCI, which utilized the recommended non-converged, scalable network topology. It uses one dedicated NIC for management and VM communication and one dedicated for the backend Storage Spaces Direct traffic. This enables resiliency and performance benefits. It offers a wide array of different networking options to suit a range of deployment sizes. For deployments that include heavy utilization of the underlying HCI storage, like SQL Server based deployments, we recommend using NICs with Remote Direct Memory Access (RDMA) capabilities.

Switch Embedded Teaming

Switch Embedded Teaming (SET) is the recommended mechanism for teaming NICs when used with Azure Stack HCI for redundancy and optimal throughput.

Azure Stack HCI supports Remote Direct Memory Access (RDMA) by implementing either the Internet Wide Area RDMA Protocol (iWARP) or RDMA over Converged Ethernet (RoCE) protocol. SET supports teaming RDMA adapter ports. With Azure stack HCI, if you have a single adapter with RDMA capabilities, it is identified as such during the deployment and assigned as the backend network for your storage traffic to maximize performance and capabilities.

Remote Direct Memory Access VM deployment and sizing recommendations

While deploying VMs in a clustered environment, customers should follow a few rules while optimizing for performance. VMs should be sized in such a manner that they do not span across NUMA nodes, whether it be due to vCPU core or memory assignments. Disabling NUMA spanning across the Hyper-V nodes is possible by disabling the setting.

Note: This setting should be used with extreme caution as creating and migrating a conflicting VM (which is spanning multiple NUMA nodes) to a host with this setting enabled will not allow the VM to power up. This setting cannot be used with dynamic memory.

Customers should be careful not to over-subscribe resources including the number of physical cores and amount of memory when performance is a priority. For instance, over-commissioning VM vCPUs is possible but leads to overall lower performance.

Right sizing

Choosing the right size virtual disks, memory assignment, or vCPU for your configuration and not over-subscribing resources should provide a consistent architecture with predictable performance.

Operating system recommendations

The following list includes best practices for configuring the Windows operating system:

- Use Resilient File System (ReFS) for configuring volumes. Our tests showed that using 4k block sizes as recommended for S2D provides the most performance benefit.
- Enable Windows LPIM policy by adding an account with privileges to run sqlservr.exe. The Lock Pages in Memory (LPIM) policy option determines which accounts can use a process to keep data in physical memory. This prevents the Windows operating system from paging out a significant amount of data from physical memory to virtual memory on disk.
- Change the power plan to High Performance. This helps optimize the operating system for higher performance rather than lower power consumption.

SQL Server recommendations

There are several recommendations for tuning SQL Server 2022. The following list includes recommendations that were most impactful during our testing:

- Setting an appropriate MAXDOP value
- Setting minimum and maximum value for memory assigned to SQL Server
- Granting volume maintenance task privilege to SQL Server service

- Spreading data across multiple primary file group files

Setting up multiple volumes for datafiles, log files and tempdb files; each of these spread out as evenly across the maximum SCSI controllers. For more information, see SQL Server 2022 installation steps from Microsoft.

Results and findings

Benchmark testing methodology

Our methodology to scale SQL Server 2022 on the Dell Integrated System for Microsoft Azure Stack HCI included setting up a benchmarking environment. On our 4-node setup, we created an environment which included VMs running with SQL Server 2022 installed on Windows Server 2022.

HammerDB is an open-source tool used for benchmarking different types of database solutions by simulating virtual users to perform transactions against the database selected. For more information, see the HammerDB website.

For each VM with SQL Server 2022 running, we installed and configured HammerDB instances on a cluster of clients running Windows Server 2022 on VMs. The client cluster also hosted our management applications like Domain Name System (DNS), Dynamic Host Configuration Protocol (DHCP), and Windows Admin Center (WAC). Figure 10 provides a recap of our test environment architecture displaying the overview of our environment:

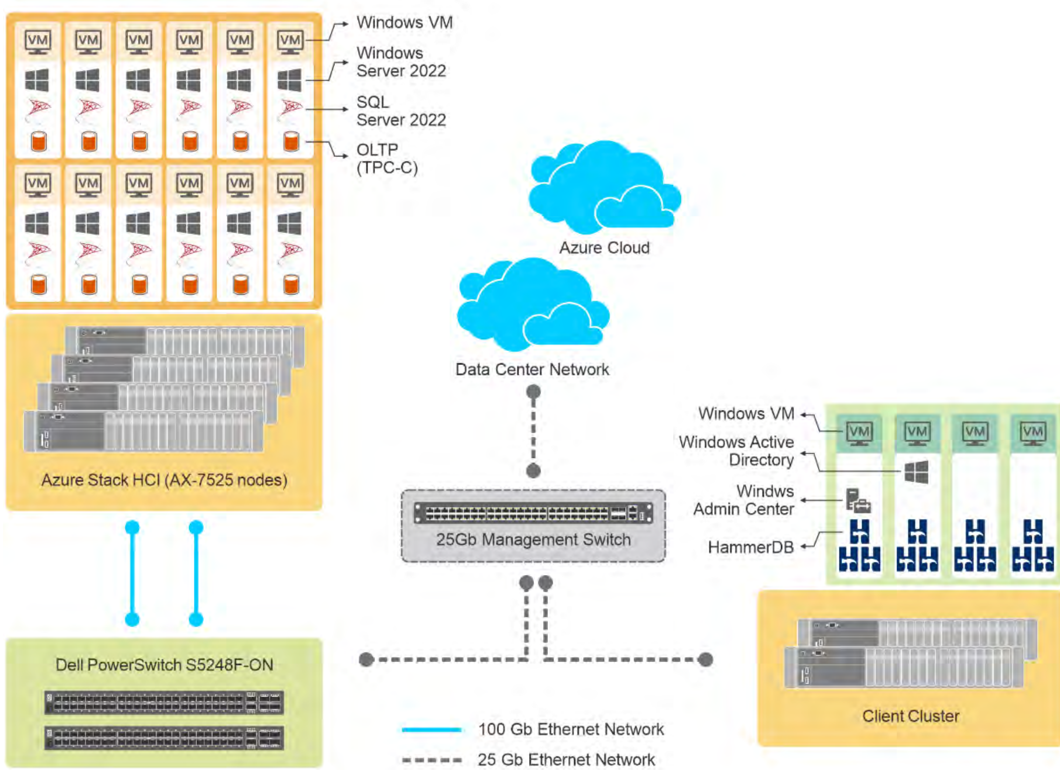

Figure 10. Architectural overview

The TPROC-C benchmark was used for our tests. This benchmark is an Online Transactional Processing (OLTP) benchmarking standard derived from the TPC-C standard. Our tests included a dataset with 4000 Scale factor. This resulted in a database sized at approximately 400 GB. These tests were initially performed with a single VM and then scaled to measure performance. The testing parameters configured for each HammerDB instance are captured in Table 2.

Table 2. Testing parameters

Parameter	Value
Number of warehouses	4000
Use all warehouses	False
Key and Think Time	Enabled
Asynchronous User Scaling	Enabled with 10 clients/user
Number of Users	10, total sessions =100

Due to the delay and low transaction load introduced by enabling *Keying and Thinking time*, we edited the virtual user script to reduce the delay induced to a single second in only the rarest of transactions. Figure 11 shows a snippet of our updated script.

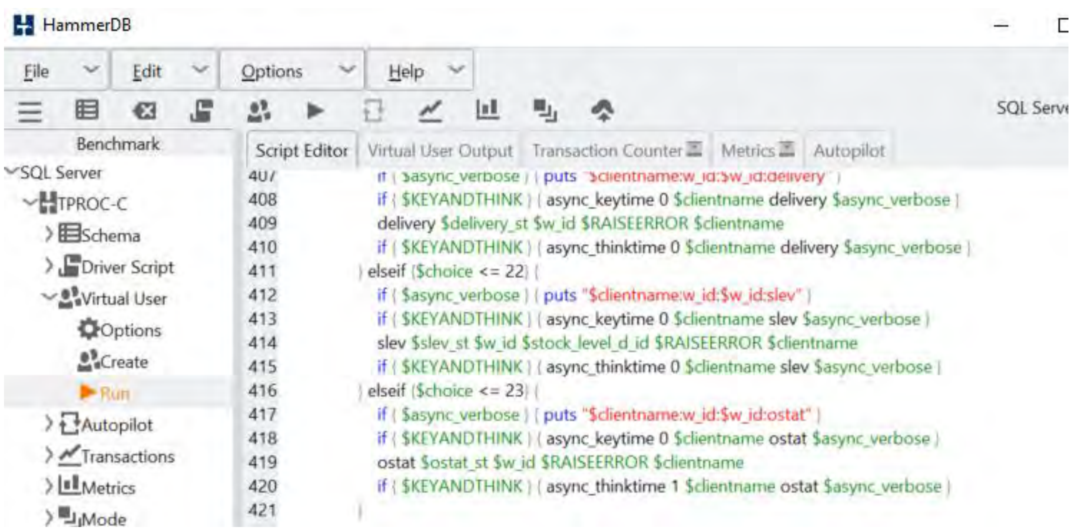

Figure 11. HammerDB Script update

For every VM running SQL Server 2022 to be benchmarked was configured with settings described in Table 3.

Table 3. Configuration settings

Setting	Value
vCPU	6
Memory for VM	384 GB
Memory assigned to SQL Server	320 GB
Dynamic Memory	Disabled
CPU reservation	100%

Each of the databases had their files on a dedicated fixed size Resilient File System (ReFS) volume which included two datafiles within the same file group and a log file. Each of these volumes were created as three-way mirrors to maximize performance.

We used Live Optics monitoring with HammerDB execution to capture the details of our testing.

Benchmarking results

We started our tests with a single VM configured with 4 vCPU and 256 GB memory. Windows Admin Center offered seamless changes to memory and vCPU assigned, which enabled us to quickly update our configurations to the values mentioned in Table 3 and right-size our VMs based on scaling out. Scaling out was also easy as VMs deployed on our 4-node Dell Integrated System for Microsoft Azure Stack HCI setup were automatically optimally balanced across nodes and available storage. We cloned the initial VM to still hasten the process.

Transactions Per Minute (TPM) and New Orders Per Minute (NOPM)

We were able to deploy and achieve linear performance for 12 VMs running our benchmarking tests. During these tests, we scaled VMs from 1, 2, 4, 8, and to 12. Each of these benchmarking tests was conducted while the TPROC-C transaction load from HammerDB was running concurrently on the respective number of VMs running SQL Server. For example, for our final tests, 12 VMs running SQL Server were benchmarked by 12 separate HammerDB instances concurrently. While running our tests, our CPU utilizations per VM ranged between 20 to 30 percent. Figure 12 shows the linear scale we achieved during our tests.

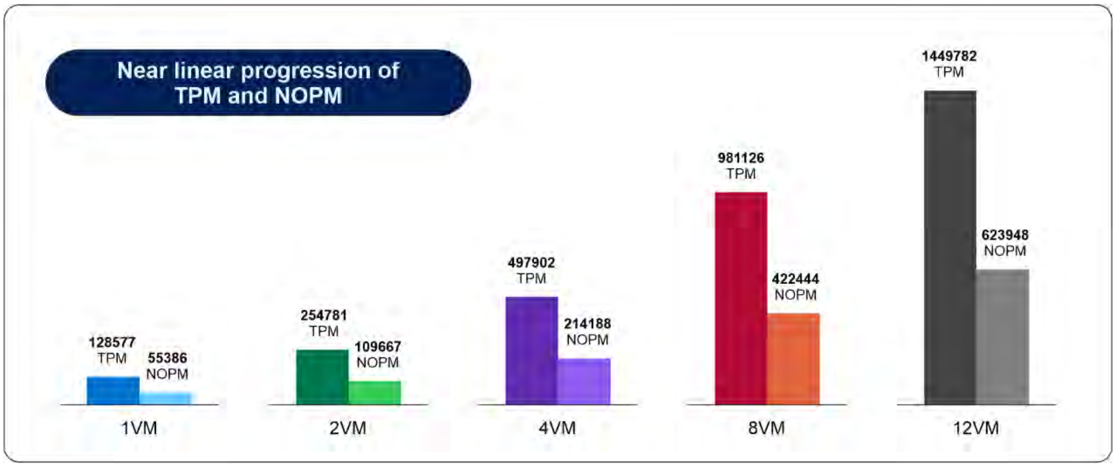

Figure 12. Linear scale for TPM and NOPM

CPU and storage parameters

The storage pool supported the near linear scaling for database performance. This demonstrated how SQL Server can optimally use the underlying storage capabilities of our cluster nodes.

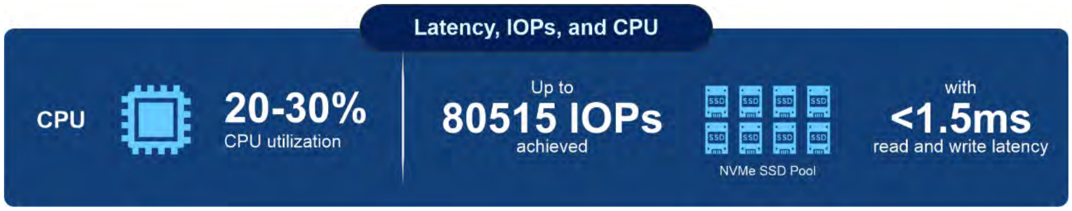

Figure 13. **CPU and storage results**

Throughout our tests, read and write latency did not exceed acceptable levels and peaked at 1.5 ms when measured for the VM volume layer. This demonstrates that even in the most demanding workloads, when 12 SQL Server VMs were benchmarked concurrently the storage pool provided by the cluster was able to meet storage requirements.

We also maintained a relatively consistent CPU utilization on the VM level for the SQL server VMs, averaging between 20 to 30 percent CPU utilization to produce a respectable workload. This consistency ensured availability for non-IO intensive applications on our cluster to maximize its utility for all types of customers. Customers can balance the CPU and storage needs of their cluster to achieve similarly optimal results.

Azure Portal connectivity

We also onboarded our servers, including the nodes, VMs, and SQL Servers to Azure Arc. This enabled us to leverage the integrated ecosystem with Azure to remotely monitor and access multiple clusters, check performance using Azure Monitor, and have another unified pane to access our VM resources. Figure 14 provides screenshots of multiple nodes added to Azure Arc. Our nodes named Azn0, Azn1, Azn2, and Azn3 are visible, along with multiple other nodes we had added from our globally distributed data centers.

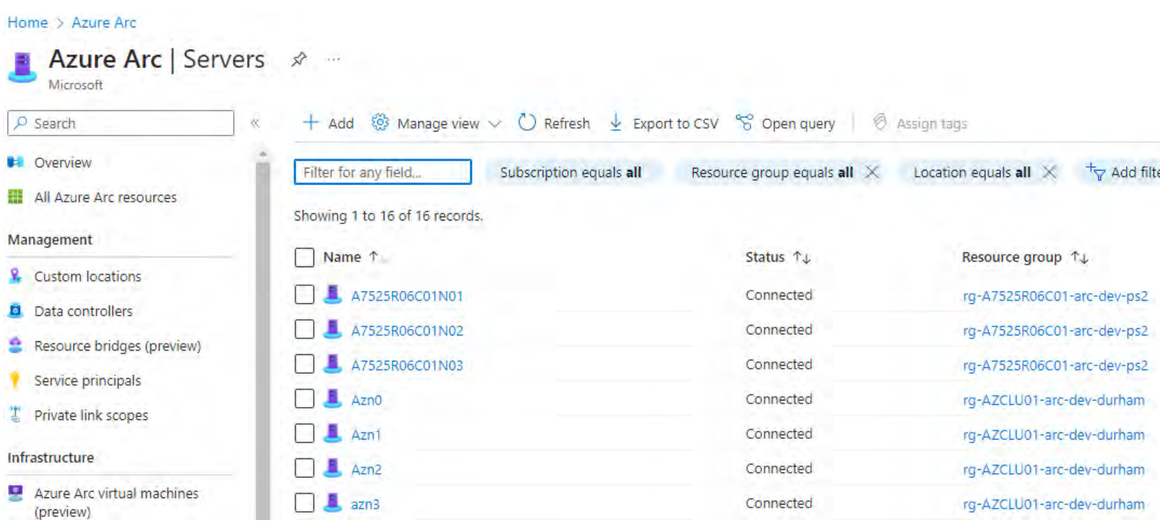

Figure 14. **Nodes added to Azure Arc**

Note: The name of our cluster *azclu01* is part of the resource group called rg-AZCLU01-dev-durham.

Scaling out Azure Stack HCI Nodes

We added a node through Windows Admin Center to demonstrate the ease of scaling out using Dell OpenManage Integration with Windows Admin Center. We initially deployed a 3-node cluster and added a fourth node prior to testing. Before adding a node to the cluster, we needed to make sure the node was joined to the Active Directory domain and added as a connection in Windows Admin Center.

Figure 15 and Figure 16 show how we used this feature for our cluster.

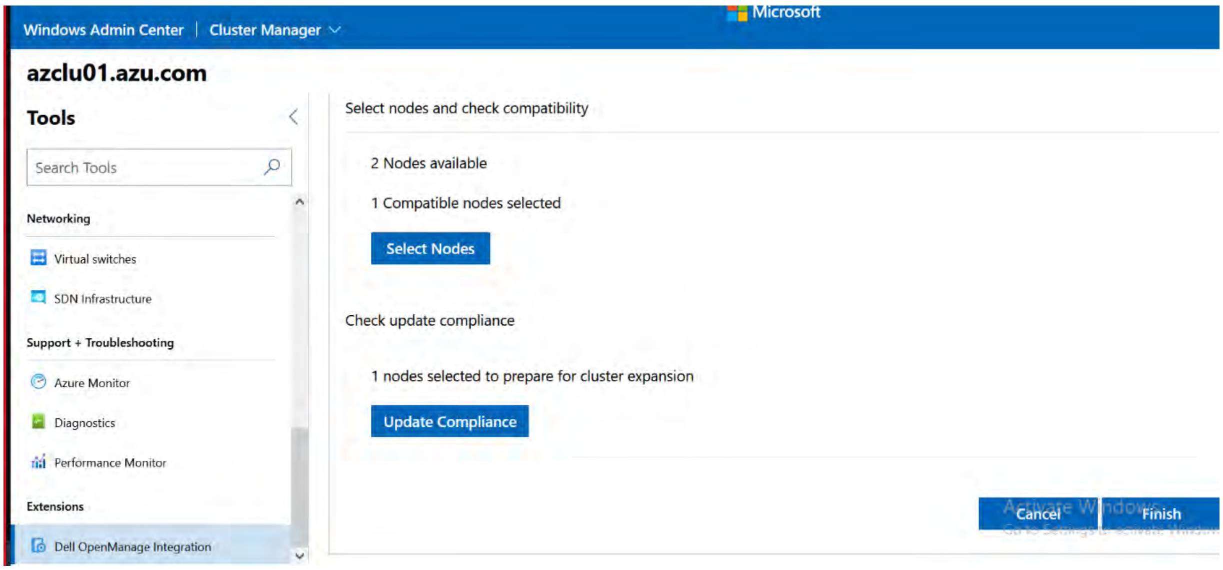

Figure 15. Select node to check compliance

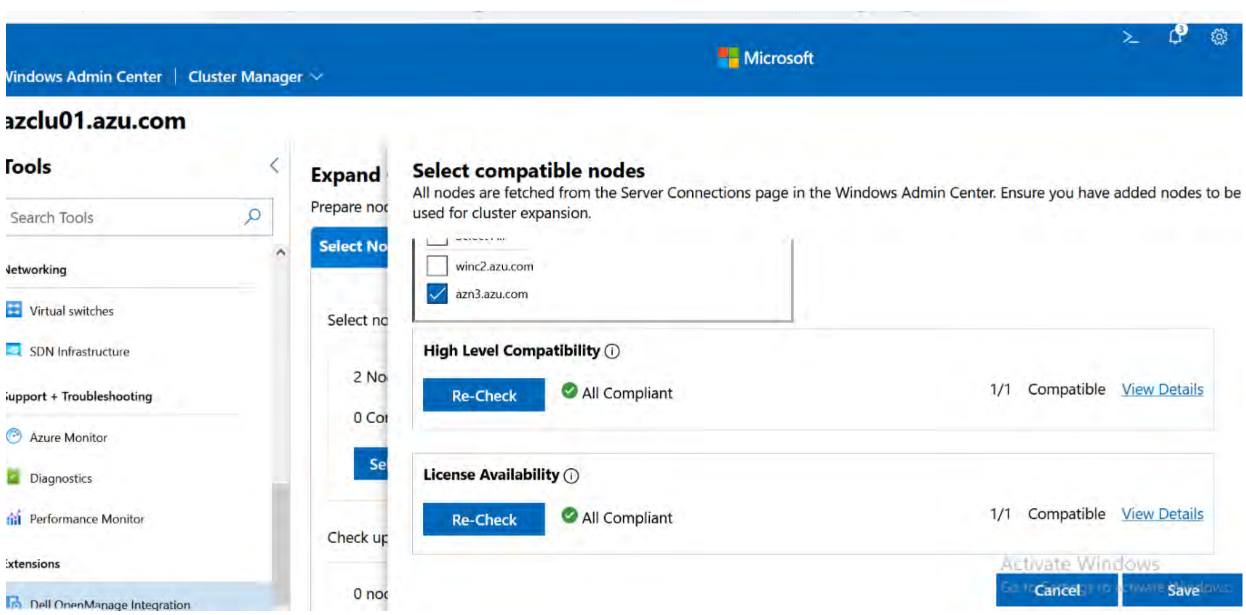

Figure 16. Nodes prepared for addition

Once the server was prepped, we could add the node to the cluster in the Servers tool in Windows Admin Center, as shown in Figure 17.

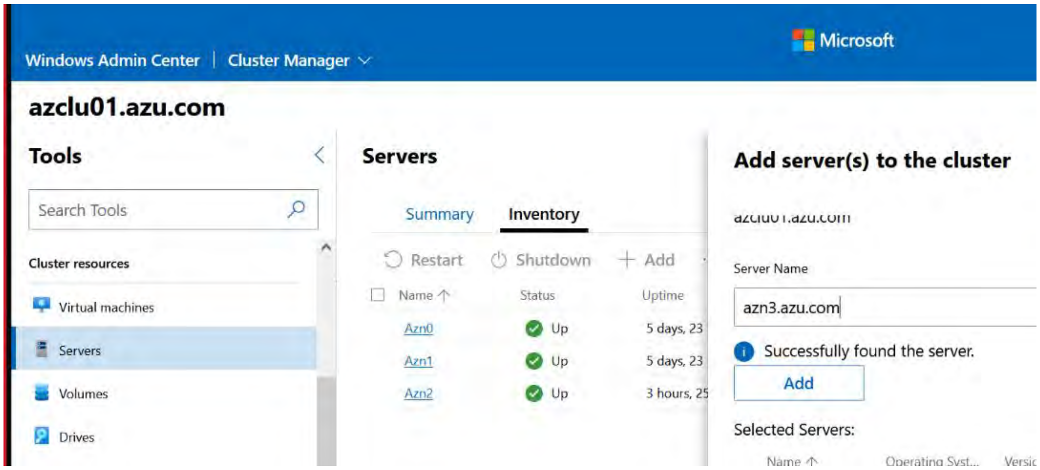

Figure 17. Ease of scaling out on the Dell Integrated System for Azure Stack HCI

HA for SQL Server databases

Always On Availability Groups (AGs) are a high-availability and disaster recovery solution from Microsoft. They provide an alternative to database mirroring. An AG facilitates an environment for failover for user databases by supporting primary databases to 1 through 8 secondary databases. As described by Microsoft, Always On AGs does not depend on any form of shared storage.

To effectively use and implement Always On AGs, each availability replica should reside on a different node of a single Windows Server Failover Clustering (WSFC) within separate fault-domains.

The SQL Server instances we deployed are already on a pre-designed optimally configured WSFC cluster which makes it easy for customers to take advantage of the SQL Server Always On AGs. For more information about Always On AGs, see the Microsoft website.

The WSFC cluster nodes we created were deployed with cluster property of ClusterEnforcedAntiAffinity which creates a hard block and prevents 2 VMs which are part of this group from running on the same node. For more information regarding affinity, anti-affinity and failover clustering, see the Microsoft website.

For the Availability Group sqlag0 we created, we used a Windows Server Failover Cluster which included the AGT1 database with the Primary replica hosted on VM sqlvm14 and Secondary replica hosted on sqlvm13 with synchronous commit mode with automatic failover.

We chose to deploy a primary and secondary replica using a shared storage to configure the Failover Cluster Instances and for the initial data synchronization between replicas using a Full database and Log backup. This was easily configured through the DNS node of our environment. However, it is possible to instead deploy and sync the primary and secondary replicas using database seeding. Figure 18 shows the Primary replica hosted on VM sqlvm14 and Secondary replica hosted on sqlvm13 on their respective SQL Server instances.

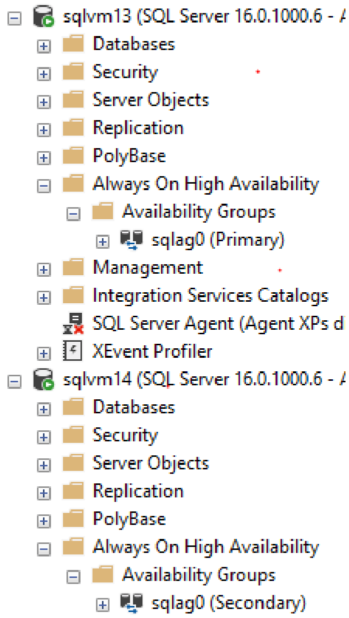

Figure 18. Availability Group sqlag0 with a primary and secondary replica

Conclusion

Dell Integrated System for Microsoft Azure Stack HCI is an optimal platform to host Microsoft SQL Server 2022 workloads. Results obtained show how Azure Stack HCI nodes provide almost linear scalability for SQL Server 2022. In a 4-node architecture, we observed the transactional output just slightly decayed from linearity when we reached the 12 VM mark. Transactional throughput must be accompanied by a latency within acceptable boundaries. In all the variants tested, the latency was below 1.5 ms, and in most of the cases showed a sub-millisecond response. IOPS also scaled as we increased the number of SQL Server instances, and the platform kept CPU utilization below 30 percent in the most demanding cases. This allowed us to use the Azure Stack HCI infrastructure to host other type of workloads concurrently.

Considerations

- Benchmark results are highly dependent upon workload, specific application requirements, and system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, this workload should not be used as a substitute for a specific customer application benchmark when critical capacity planning and/or product evaluation decisions are contemplated.
- All performance data contained in this report was obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. Dell Technologies does not warrant or represent that a user can or will achieve similar performance results.

We value your feedback

Dell Technologies and the authors of this document welcome your feedback on the solution and the solution documentation. Contact the Dell Technologies Solutions team by email.

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Note: For links to additional documentation for this solution, see the Dell Technologies Solutions Info Hub for SQL Server.