Running SQL Server 2022 on Lenovo ThinkAgile HX665 V3 Systems Integrated with Nutanix™ Software

Last update: **June 13th 2025**

Version 1.1

Highlights ThinkAgile HX665 V3 Systems Integrated with Nutanix™ Software

Performance and scalability testing of Microsoft SQL 2022. Comparing OLTP and DSS workloads in Scale-Up and Scale-out scenarios

Includes benchmark results and Bill of Material

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Data growth challenge and a solution

In our data-rich environment, businesses of all sizes are grappling with a surge of fast-moving information, making the right data collection and management tools crucial. Businesses of all sizes are being inundated by information at increasing velocity. It's important to choose a solution that matches the requirements of the company, resulting in the most efficient outcome.

The Hyperconverged Infrastructure solution offered by Lenovo with Nutanix software simplifies IT and data center operations. By using it, the TCO is lower than the that of traditional, bare metal environments. The appliance is powered by 4th Gen AMD EPYC processors that support a high number of cores and PCI express lanes.

Lenovo ThinkAgile HX665 V3 Integrated Systems with Nutanix Software are optimized for Online Transaction Processing (OLTP) and Decision Support Systems (DSS) . This document is based on tests performed with Microsoft SQL Server 2022 on Nutanix Software. The nodes used are 2U systems equipped with two socket 4th Gen 48-core AMD EPYC CPU`s, DDR5 4800MT/s memory (by using 256GB 3DS RDIMM`s 6TB of system memory can be achieved) and PCI Express 5.0 expansion capabilities. The HX665 V3 server is a storage dense offering, supporting up to 24x 2.5-inch hot-swap bays, 16 NVMe drives (with 1:1 PCIe lanes connectivity, no oversubscription) and M.2 RAID adapters for OS.

Business database solutions with faster time-to-value

Lenovo ThinkAgile HX665 V3 systems are rigorously tested and tuned to save you months of configuration, setup, testing, and tuning. The main features offered by the 4th Gen AMD EPYC platform are:

- Up to 128 cores (256 threads) per processor
- Up to 384MB L3 cache
- Up to 4 links of Gen 3 Infinity Fabric™ at up to 32 Gbps
- 12 memory channels that support up to 6TB of DDR5- 4800 memory
- Support for PCIe® Gen 5 at up to 32 Gbps
- AVX-512 instruction supports for enhanced HPC and ML performance.

Figure 1 Lenovo ThinkAgile HX665 V3

Microsoft SQL Server 2022

SQL Server 2022 includes updates to existing features like Intelligent Query Processing in addition to management, platform or language.

Starting with SQL 2022, runtimes for R, Python, and Java are no longer installed with SQL Setup. Instead, install any desired custom runtime(s) and packages.

Here are some performance enhancements in SQL Server 2022:

- Improvements have been made to all ColumnStore indexes that benefit from enhanced segment elimination by data type.
- Concurrent updates to global allocation map pages reduce page latch contention
- Improvements in buffer pool scan operations on large-memory systems by using multiple CPU cores for parallel scans
- Improvements to Clustered ColumnStore Indices to sort existing data in memory before index builder compresses the data
- TempDB performance enhancements for scalability
- Shrink database uses low priority processing to minimize impact on performance
- In-memory OLTP enhancements

Here are some management improvements:

- Additional Azure integration
- Link to Azure SQL Managed Instance
- Accelerated Database Recovery (ADR)
- Always On Availability Group enhancements

Lenovo ThinkAgile HX665 V3 Integrated Systems with Nutanix Software solutions are ideal for modernizing your current environment and migrate the legacy SQL Server applications because of their low cost and high-performance capabilities. They are industry standard x86 servers providing cost effective computing and fast high-density local storage.

Cluster Configuration on ThinkAgile HX665 V3

Hardware:

In our testing we configured a four-node, dual socket ThinkAgile HX665 V3 Nutanix HX cluster with the following configuration:

Item	Description
Server	4 x Dual-Socket Server (Lenovo ThinkAgile HX665 V3 Appliance)
CPUs	2 x AMD EPYC 9474F (48 cores/CPU)
Frequency: Base | Boost	3.60 GHz | 4.10 GHz
Memory	1.5 TB DDR5 4800 MT/s per server (24 x Lenovo Think System 64 GB TruDDR5)
NIC	100 Gb
Storage	12 x Think System 2.5" U.3 7450 PRO 3.84 TB Read Intensive NVMe PCIe 4.0 x4 HS SSD, 2 x Think System M.2 7450 PRO 960 GB Read Intensive NVMe PCIe 4.0 x4 NHS SSD
Hypervisor	Nutanix Acropolis™ Hypervisor (AHV v. 20230302.100173)
Nutanix AOS	6.8
OS	Windows Server 2022 Datacenter (Version: 21H2 Build: 20348.3207)
Database	Microsoft SQL Server 2022 (RTM) - 16.0.1000.6 (X64) Enterprise Evaluation Edition (64-bit) on Windows Server 2022 Datacenter 10.0
MSTPCE Toolkit	Version 2.5.6
MSTPCH Toolkit	Version 2.18.0-2600
MS SQL Server 2022 storage configuration (virtual disks)	OS Disk (1 x 600 GB) Data Disk 1 (8 x 1 TB) Data Disk 2 (8 x 1 TB) Log Disk (1 x 1 TB) Tempdb Disk (2 x 1 TB) Backup Disk (1 x 2 TB)

Testing configuration

The configuration of the cluster and the virtual machines used for testing are visualized in the following diagram:

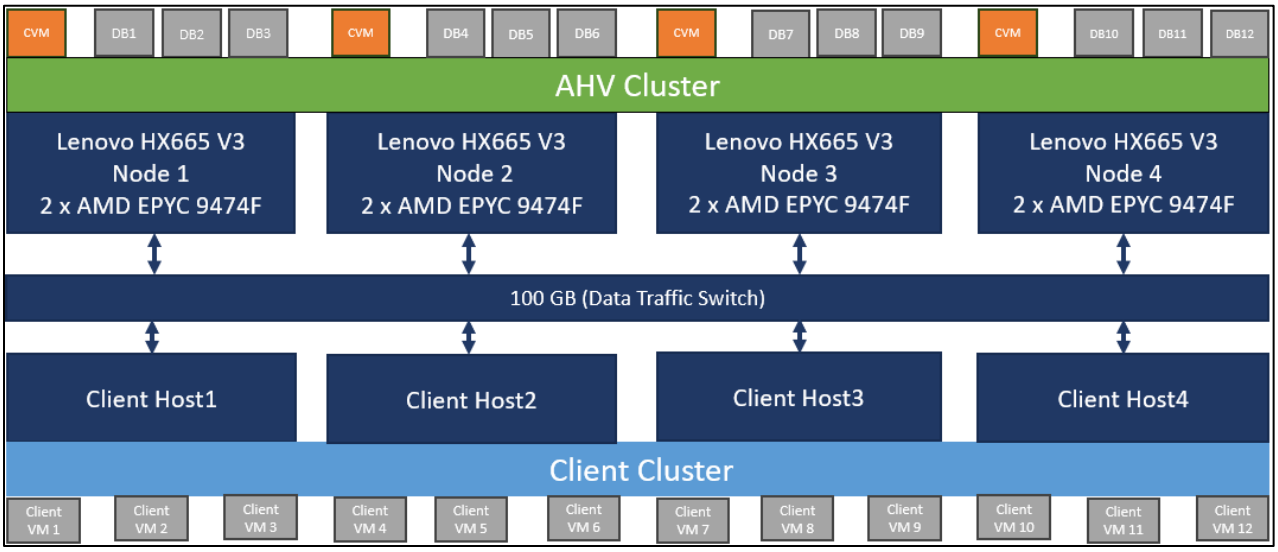

Figure 1 MS SQL 2022 topology

For the database testing, the CVM`s was configured with 16vCPU and 64GB of memory.

Performance testing was done on Online Transaction Processing (OLTP) workload while the second set of testing was done on Decision Support Systems (DSS) workload.

The virtual machines that were used for testing out the Scale-Up and Scale-Out for OLTP and DSS were configured with the following resources:

VM SIZING	CUSTOMER COUNT	CPU SIZING	MEMORY (GB)
Small	80K	6 vCPU	48
Medium	160K	12 vCPU	96
Large	320K	24 vCPU	192
xLarge	480K	48 vCPU	384
Monster	640K	64 vCPU	512
Colossal	1000K	78 vCPU	768

Table 1 VM Sizing

OLTP testing

Scale-Up OLTP Workload testing

During the Scale-UP OLTP workload testing, the focus was to achieve around 80-90% CPU usage on the tested VM. The overall test duration was 2 hours. We measured the performance after the OLTP workload entered a steady state, which occurred from the 30-minute mark until the end of the test run, spanning 90 minutes. Figure 2 shows the scalability of the results using the Lenovo ThinkAgile HX665 V3 Nutanix Acropolis Hypervisor (AHV) Storage Architecture.

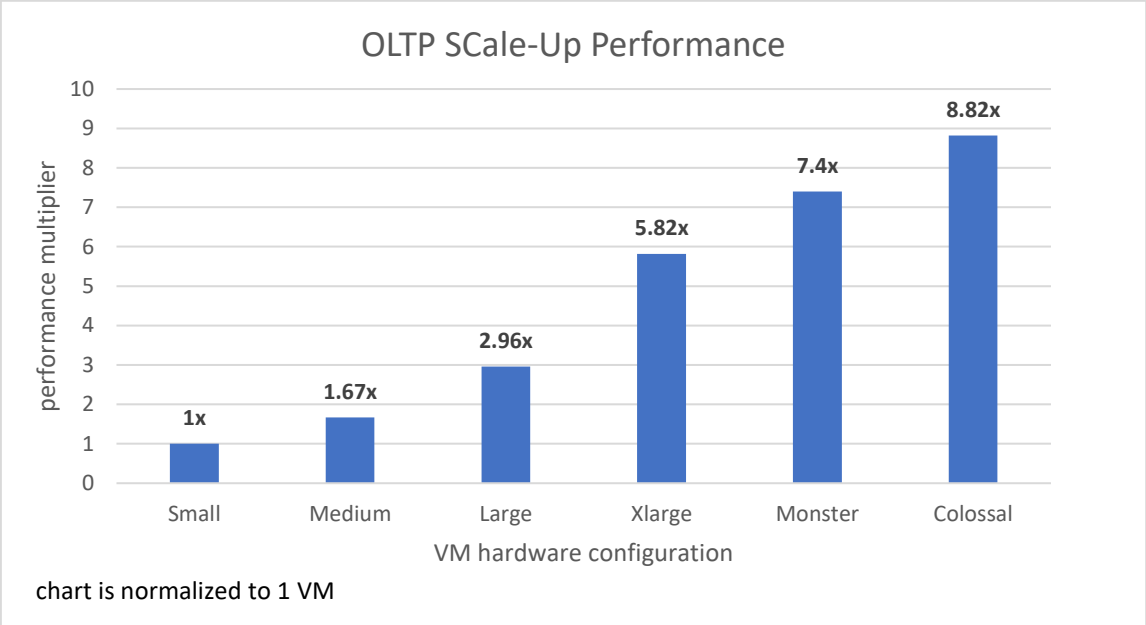

Figure 2 Scale-Up Performance (normalized data to small instance)

Scale-Out OLTP Workload testing

The Scale-Out OLTP test is intended to illustrate the consistent performance that can be achieved on the ThinkAgile HX665 V3 Nutanix cluster. The test is thought for heavy SQL server OLTP workloads and this is why it was run with the Large VM configuration. With every test the number of Large VM`s has increased until we`ve reached a total of 12 VM`s. The MSTPCE toolkit was used with a 320K customer count and each VM`s had the SQL service configured to used 80% of the total memory available. After collecting the IOPS and TPS data we reached ~11.69x when running the OLTP workload on twelve VM`s. In Figure 3 we can see the results for each number of VM`s tested

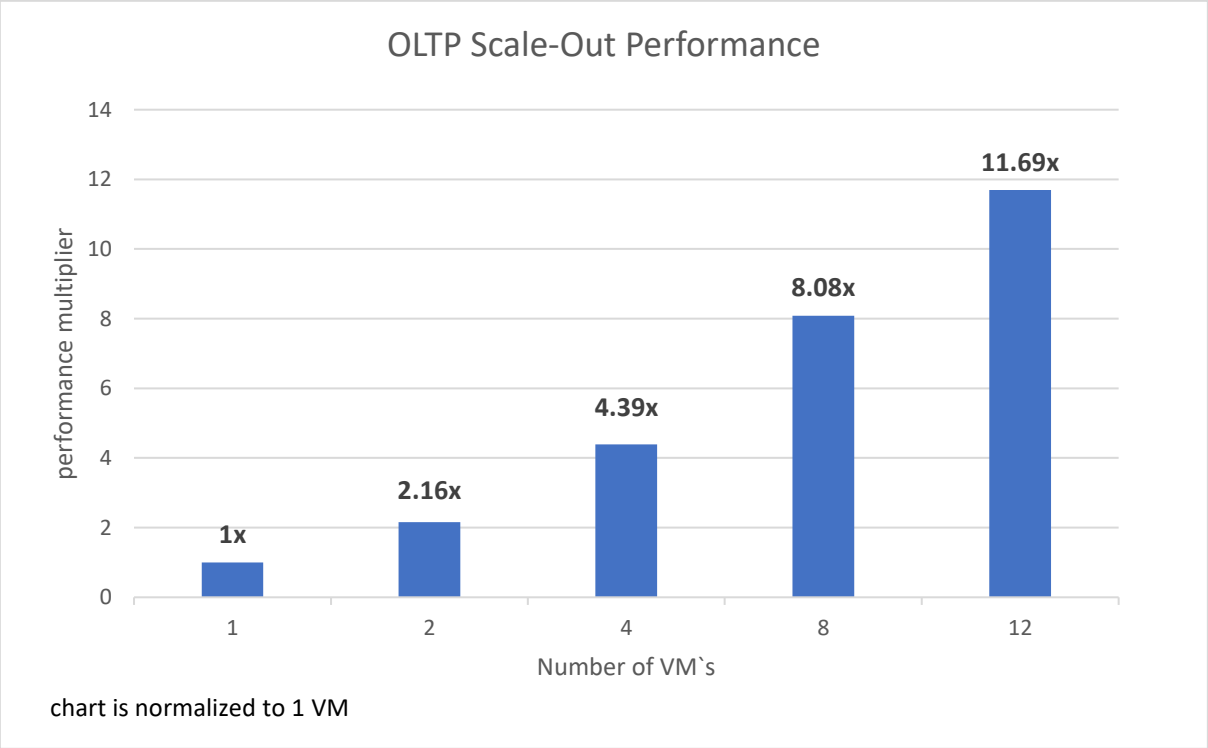

Figure 3 Scale-Up performance (normalized data to one large VM)

DSS testing

Decision Support Systems (DSS) specialize in data analysis for business intelligence. The TPC-H benchmark was specifically developed to measure how well databases perform under these analytical DSS workloads.

Scale-Up DSS Workload testing

For the DSS Scale-UP workload test we`ve modified a bit the resources, modifying the allocated ram to 512GB (except the Colossal config where it had 768GB allocated). The other parameters presented in Table 1 remained unchanged. The database was generated by using the MSTPCH Toolkit and the target was to reach 80 to 90 percent CPU utilization. In figure 4 we have displayed the results obtained when testing each VM configuration.

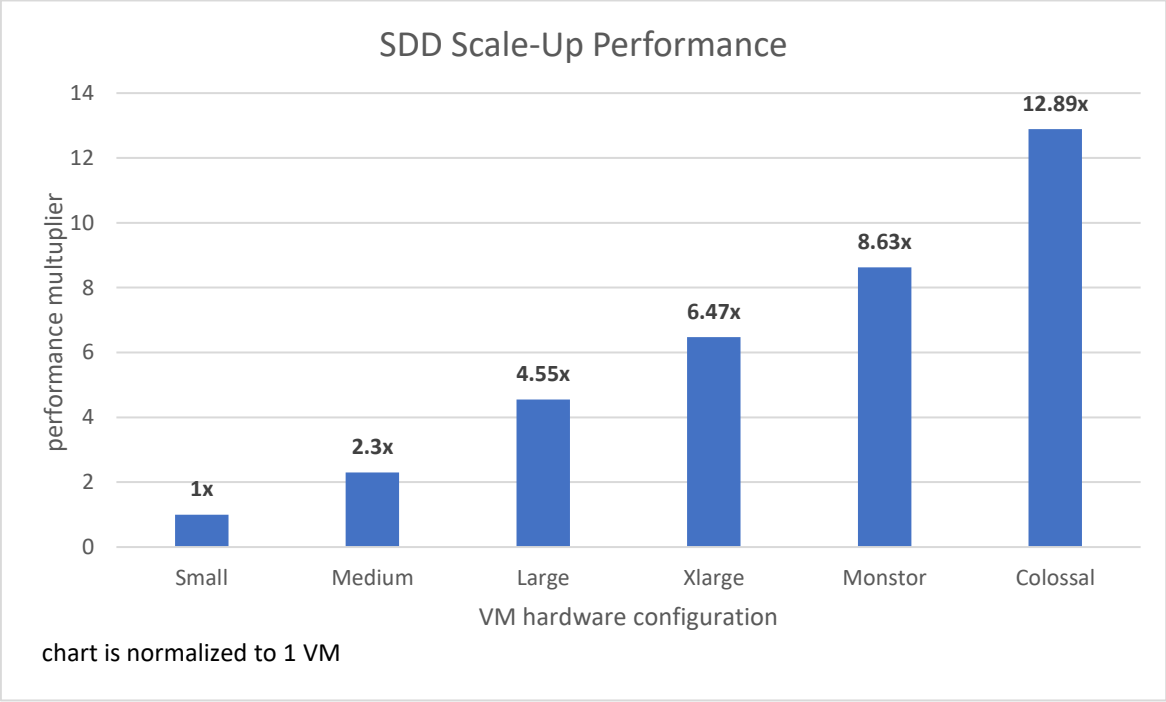

Figure 4 QPH performance on different VM configuration

Scale-Out DSS Workload testing

In testing the Scale-Out capabilities of the the ThinkAgile HX665 V3 Nutanix cluster the same approach was used where one VM was tested and then the results obtained with more VM`s were reported to that. The SQL server was configured to use 80 percent of the available memory in the context of a 320K customer count. The results collected show the great scalability of the solution and the results can be viewed in Figure 5.

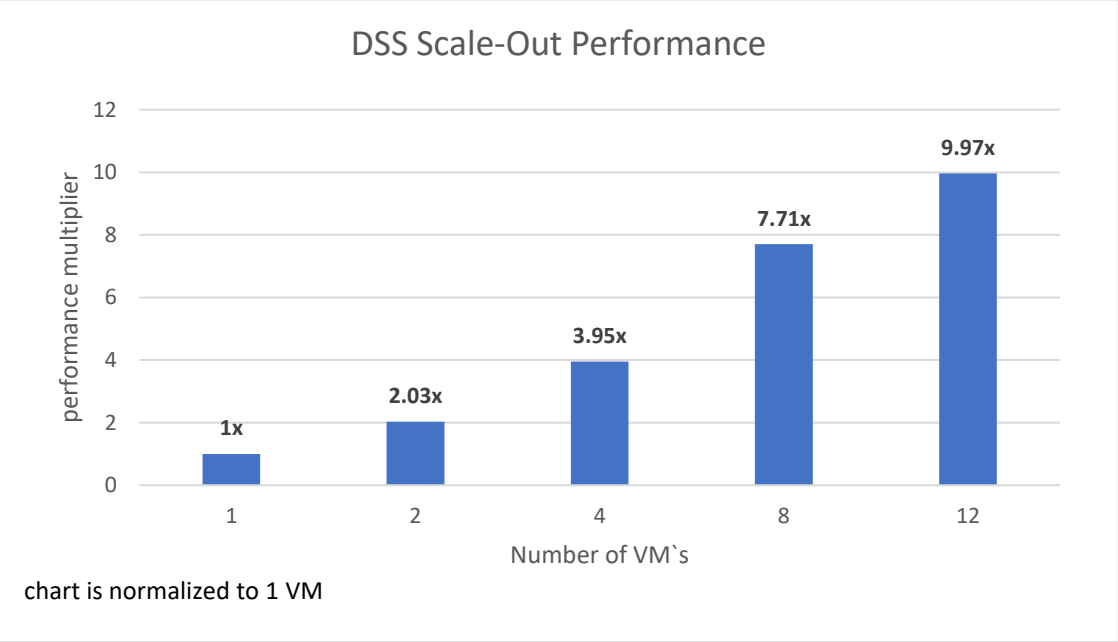

Figure 5 QPH performance with multiple large VM`s

CONCLUSION

Lenovo`s ThinkAgile HX665 V3 Nutanix HX Appliance servers integrated with Nutanix Software can help customers optimize their IT infrastructure and streamline operations. Alongside AMD EPYC CPU`s they are capable to offer exceptional results in a multitude of high resource scenarios.

To show the performance and scalability we have tested with Microsoft SQL Server 2022 and on the Nutanix Acropolis Hypervisor. This was done with OLTP and DSS workloads and testing both Scale-Up and Scale-Out. The results validated the clear benefits that can be achieved with our solution.

Also, the Nutanix software includes solid data protection and disaster recovery features alongside self-healing and robust management tools.

Additional information can be found in the following links:

Lenovo ThinkAgile HX Series:
https://www.lenovo.com/au/en/servers-storage/sdi/thinkagile-hx-series

AMD EPYC 9004 Series:
https://www.amd.com/en/products/processors/server/epyc/4th-generation-9004-and-8004-series.html

Microsoft SQL Server 2022:
https://www.microsoft.com/en-au/sql-server/sql-server-2022

Bill of Materials

Part number	Product Description	Qty
7D9NCTO1WW	Server : ThinkAgile HX665 V3 Integrated System	1
BR31	ThinkSystem AMD EPYC 9474F 48C 360W 3.6GHz Processor	2
BQ3D	ThinkSystem 64GB TruDDR5 4800MHz (2Rx4) 10x4 RDIMM-A	24
B8P9	ThinkSystem M.2 NVMe 2-Bay RAID Adapter	1
BKSR	ThinkSystem 2.5" U.3 7450 PRO 3.84TB Read Intensive NVMe PCIe 4.0 x4 HS SSD	12
BKSR	ThinkSystem M.2 7450 PRO 960GB Read Intensive NVMe PCIe 4.0 x4 NHS SSD	2
B8PP	ThinkSystem Mellanox ConnectX-6 Dx 100GbE QSFP56 2-port PCIe Ethernet Adapter	1
BPQU	ThinkSystem V3 2U x16/x8/x8 PCIe Gen5 Riser 1 or 2	1
BPK9	ThinkSystem 1800W 230V Titanium Hot-Swap Gen2 Power Supply	2
BLL6	ThinkSystem 2U V3 Performance Fan Module	6
BH8D	ThinkSystem 2U/4U 8x2.5" NVMe Backplane	2
B8LA	ThinkSystem Toolless Slide Rail Kit v2	1
BVKV	Nutanix Cloud Platform (NCP) Pro Software License with Mission Critical Support	1
7S0PCTO3WW	Nutanix P&P Software for ThinkAgile HX	1
SAPU	Nutanix Cloud Platform Pro, Mission Critical Support Per Core, 3Yr	96
BRPJ	XCC Platinum	1
7S0XCTO5WW	XClarity Controller Platin-FOD	1
SBCV	Lenovo XClarity XCC2 Platinum Upgrade (FOD)	1

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