Scalable performance on Lenovo ThinkAgile HX665 V3, powered by AMD EPYC 9005 and Nutanix, with Microsoft SQL Server 2022

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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 5th 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 5th Gen 9005 series 48-core AMD EPYC CPU`s, DDR5 6400MT/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 5th Gen AMD EPYC platform are:

- Up to 192 cores (384 threads) per processor
- Up to 512MB 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- 6400 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 systems, powered by AMD EPYC™ 9005 series and integrated with Nutanix software, provide an ideal platform for modernizing environments and migrating legacy SQL Server applications. These industry-standard x86 servers deliver cost-effective computing, high performance, 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 9475F (48 cores/CPU)
Frequency: Base | Boost	3.65 GHz | 4.80 GHz
Memory	1.5 TB DDR5 6400 MT/s per server configured 6000 (24 x Lenovo Think System 64 GB TruDDR5)
NIC	100 Gb/s
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	7.0.1.5
OS	Windows Server 2022 Datacenter (Version: 21H2 Build: 20348.3207)
Database	Microsoft SQL Server 2022 (RTM-CU20) (KB5059390) - 16.0.4205.1
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:

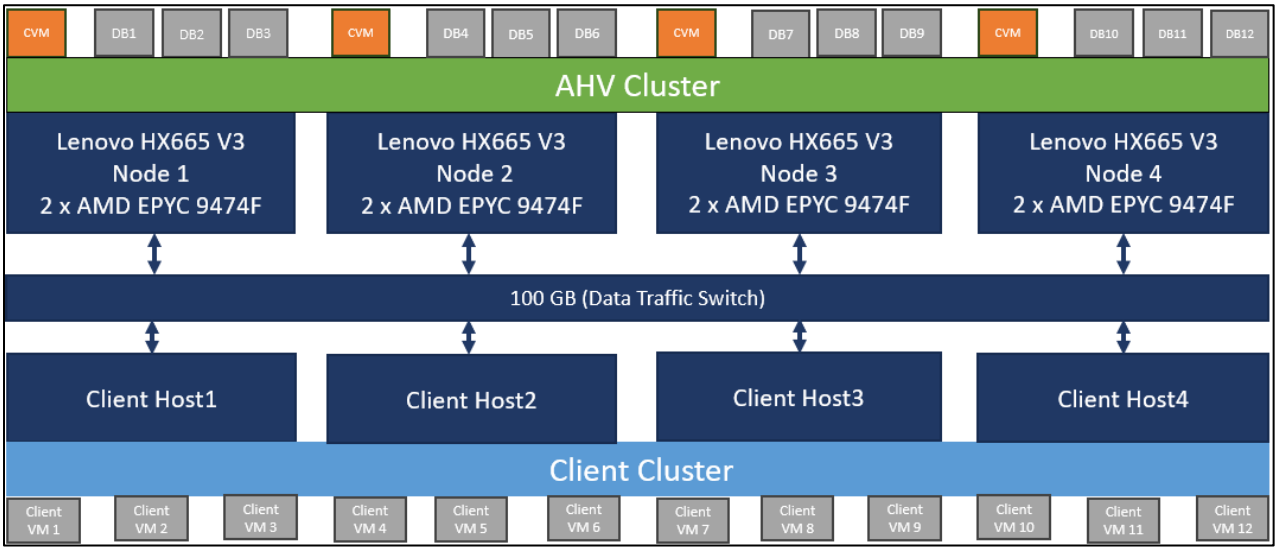

Figure 1 MS SQL 2022 topology

For the database testing, the CVMs 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 goal was to maintain approximately 80–90% CPU utilization on the tested VM. The total test duration was two hours. Performance measurements were taken after the workload reached a steady state, starting at the 30-minute mark and continuing for 90 minutes. Figure 2 illustrates the scalability results achieved using Lenovo ThinkAgile HX665 V3 systems powered by AMD EPYC™ 9005 processors and Nutanix clusters with the Acropolis Hypervisor (AHV) storage architecture.

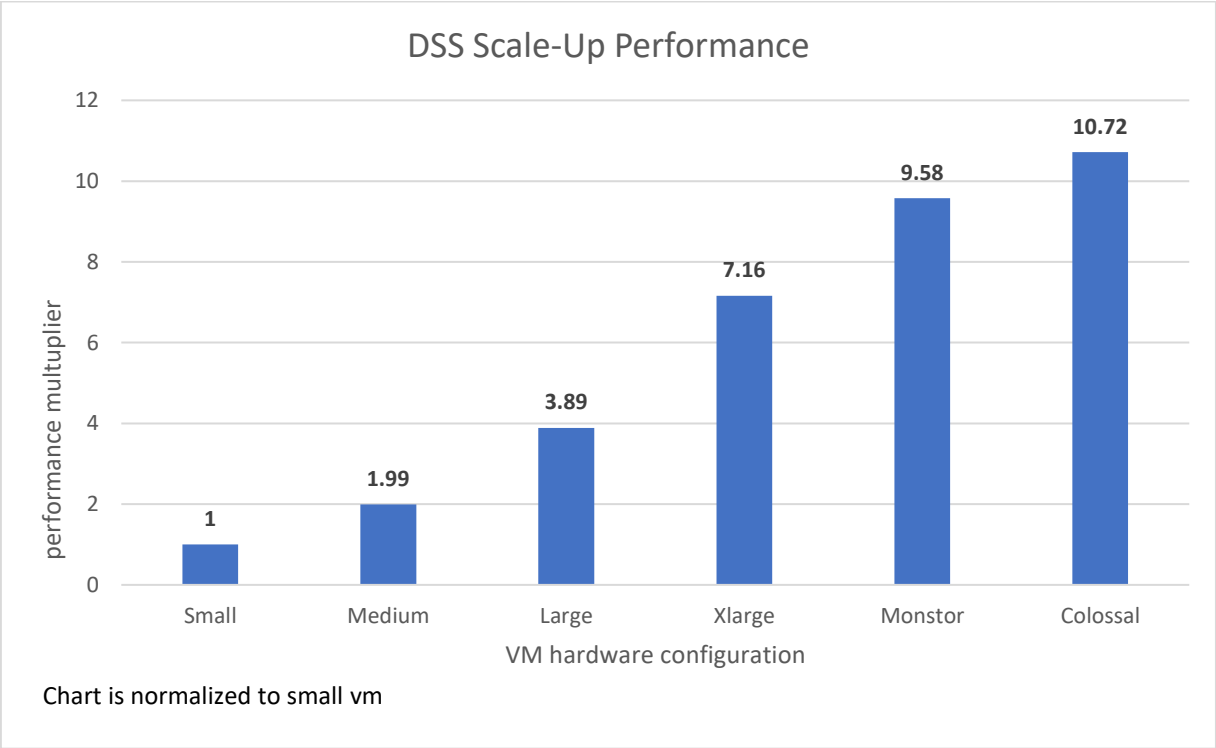

Figure 2 Scale-Up Performance (normalized data to small instance)

Scale-Out OLTP Workload testing

The Scale-Out OLTP test demonstrates the consistent performance achievable on Lenovo ThinkAgile HX665 V3 systems powered by AMD EPYC™ 9005 processors and Nutanix clusters. Designed for heavy SQL Server OLTP workloads, the test was executed using a Large VM configuration. The number of Large VMs was gradually increased until reaching a total of 12 instances. The MSTPCE toolkit was used with a 320K customer count, and each VM's SQL service was configured to utilize 80% of the available memory. After collecting IOPS and TPS data, the results showed approximately 11.44x scalability when running the OLTP workload across twelve VMs. Figure 3 illustrates the performance results for each VM count tested.

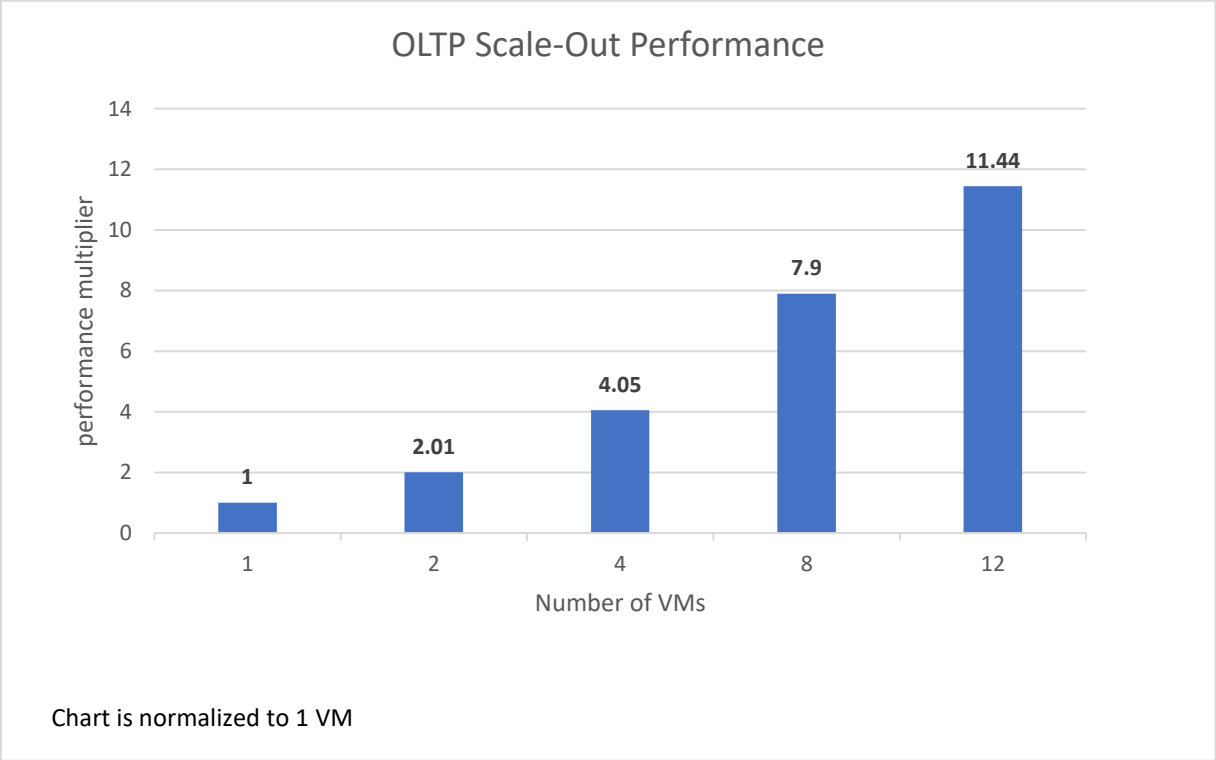

Figure 3 Scale-Up performance (normalized data to one large VM)

DSS testing

Decision Support Systems (DSS) are designed to process large volumes of data and provide insights for business intelligence. These systems typically run complex queries that involve aggregations, joins, and data analysis across multiple tables. The TPC-H benchmark was developed to evaluate how well database systems handle these analytical workloads. It measures performance using a set of business-oriented ad hoc queries and concurrent data modifications, simulating real-world DSS environments where responsiveness and scalability are critical.

Scale-Up DSS Workload testing

The Scale-Up DSS workload test is designed to assist in sizing SQL Server VMs running on a Nutanix Acropolis Hypervisor storage architecture cluster, using varying customer counts and database sizes. Table 1 lists the tested VM configurations along with the corresponding customer counts for each database. For all configurations, 768 GB of memory was allocated per VM. Databases were generated using the MSTPCH toolkit, and SQL Server was configured to utilize 80% of the VM's available memory. The primary objective of the test was to achieve an average CPU utilization of 80–90%, measured through Windows Performance Monitor counters during each run. Figure 4 presents the scalability results obtained from these tests.

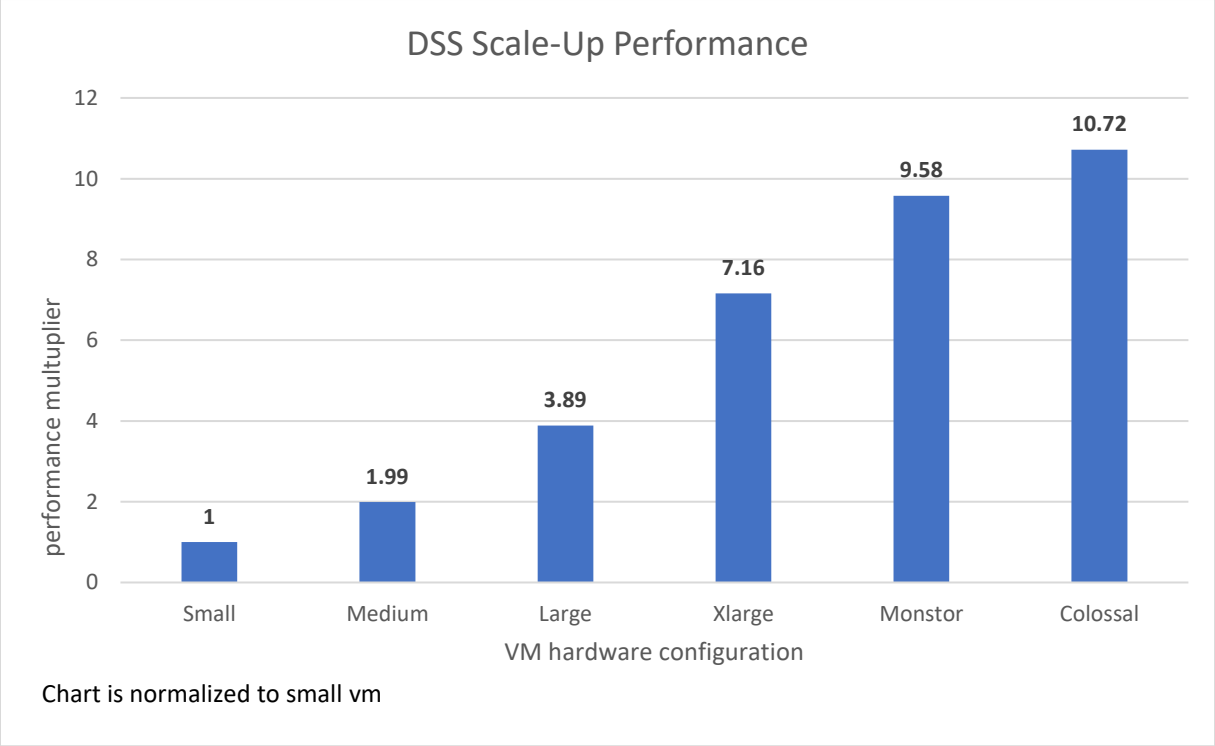

Figure 4 DSS performance on different VM configuration

Scale-Out DSS Workload testing

Scale-out testing is essential for identifying potential bottlenecks and scalability limits in database systems, ensuring they can support business growth and deliver timely insights from analytics. DSS workload testing demonstrates performance capabilities and evaluates how well a distributed computing platform processes and analyzes large data volumes across a scalable infrastructure. The Lenovo ThinkAgile HX665 V3 systems powered by AMD EPYC™ 9005 processors with Nutanix and running the Acropolis Hypervisor provides a seamless platform for deploying, scaling, and managing data-intensive applications such as Microsoft SQL Server 2022.

In this DSS scale-out test, we assessed the Nutanix environment's ability to handle workloads generated by the DSS benchmark, which simulates complex decision-support queries on large datasets. Using the MSTPCH toolkit, we ran DSS workloads across up to 12 SQL Server VMs simultaneously, each configured with 80% memory utilization and databases sized for 320K customers. The objective was to measure overall performance on a 4-node AMD EPYC-powered Nutanix cluster. Starting with a single VM and scaling to 12 VMs, we monitored aggregated IOPS and normalized DSS results to evaluate scalability. Figure 5 shows results for 1, 2, 4, 8, and 12 VMs, achieving ~9.18x scalability at 12 VMs, demonstrating strong performance growth as the environment scales.

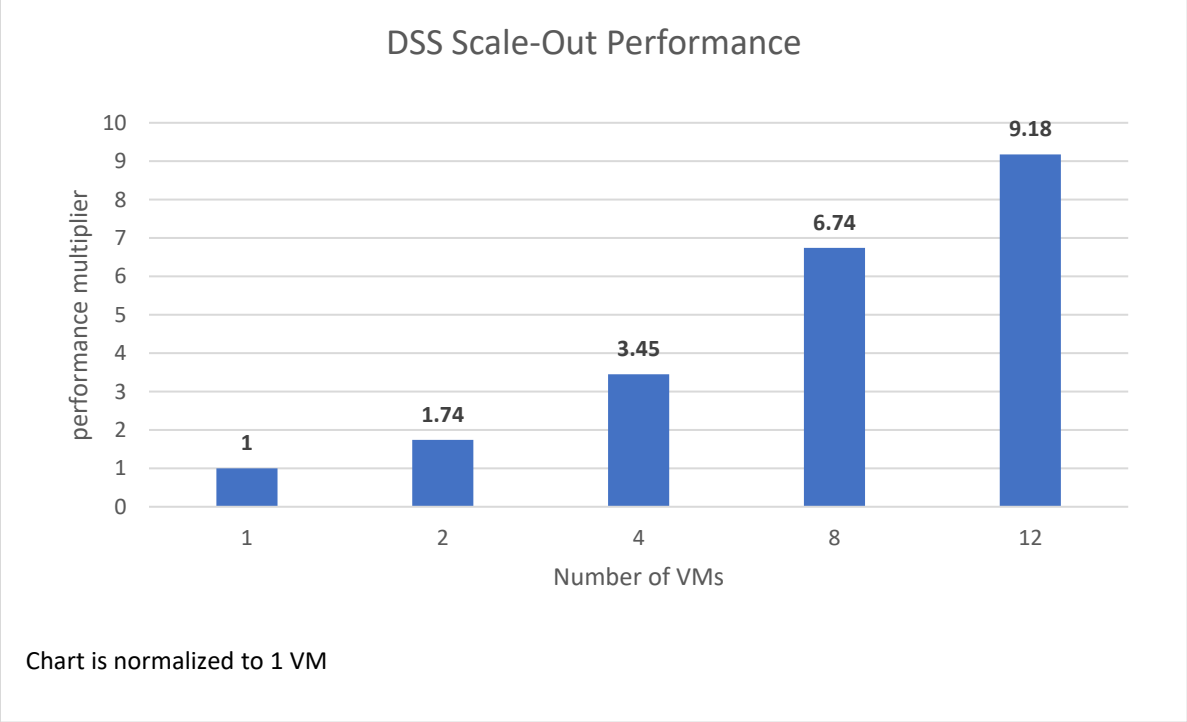

Figure 5 DSS performance with multiple VMs

CONCLUSION

Lenovo ThinkAgile HX665 V3 systems, powered by AMD EPYC™ 9005 processors and integrated with Nutanix software, deliver exceptional scalability and performance for Microsoft SQL Server 2022 workloads. Through comprehensive testing of OLTP and DSS workloads in both Scale-Up and Scale-Out scenarios, the solution demonstrated strong linear scalability and consistent performance across increasing VM counts. These results validate the platform's ability to support demanding, data-intensive applications while simplifying infrastructure management. Combined with Nutanix's robust data protection, disaster recovery, and automation capabilities, this solution offers a cost-effective, high-performance foundation for modernizing enterprise environments and accelerating business insights.

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 9005 Series:
https://www.amd.com/en/products/processors/server/epyc/9005-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
C2A3	ThinkSystem AMD EPYC 9475F 48C 400W 3.65GHz 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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