



Optimizing SQL Server 2022 on Lenovo ThinkAgile VX V4 servers with VMware Cloud Foundation 9.0

Last update: 27 October 2025

Version 1.0

**Lenovo hyperconverged
infrastructure solution for SQL
Server deployment with
VMware vCF 9.0**

**Microsoft SQL Server performance on Lenovo
ThinkSystem V4 servers with Intel Xeon 6
Processors and VMware vCF 9.0**

**Includes benchmark results
and Bill of Material**

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Data growth problem and a solution

In today's data-driven world, businesses of all sizes are facing an unprecedented influx of fast-moving information, and it necessitates organizations to efficiently manage large amounts of diverse data, ensuring streamlined operations and superior outcomes. It's important for businesses of all sizes to choose a database solution that matches the requirements of the company, resulting in the most efficient outcome.

VMware Cloud Foundation 9.0 modernizes private-cloud operations with a single interface for both day-to-day management and self-service consumption, adding a Quick Start build experience, integrated cost showback/chargeback, and a new SecOps dashboard for policy and compliance. VMware Cloud Foundation 9.0 treats virtual machines and Kubernetes as first-class citizens with consistent NSX networking and governance, and its Data Services Manager integrates with VCF Automation and is in tech preview for Microsoft SQL Server DBaaS to simplify database provisioning and fleet management.

General purpose and high performance OLTP workloads and data warehouse applications seamlessly run on VMware vSAN ESA using optimal NVMe drive types to meet different performance requirements. SQL Server deployment with vSphere supported storage on vSAN ESA and shared storage system with NFS, VVols and Raw Device Mapping options to support performance, capacity and operational requirements. VMware vSphere features vSphere High Availability (HA), vSphere Fault Tolerance (FT), vSphere vMotion, vSphere Storage vMotion®, and VMware Site Recovery Manager™ can be used in a business continuity design to protect virtualized SQL Server instances to protect from planned and unplanned downtime. Native SQL Server options such as SQL Server Always On Availability Groups, Always On Failover Cluster Instances, database mirroring, and log shipping are interoperable with vSphere to enable robust availability and recovery solutions. Virtualized SQL Server implementations can leverage NSX to deliver network and security services and Aria Operations for comprehensive end-end monitoring and performance analysis in hybrid cloud environments.

vSphere 9.0 Advanced NVMe Memory Tiering capability and vSAN ESA global deduplication boost density and efficiency for high performance and data intensive SQL Server workloads on ThinkAgile VX V4. Microsoft SQL Server deployments managed and upgraded at scale with VCF 9.0, Data Services Manager and vSphere Lifecycle Manager features expanded live-patching and mixed-hardware desired-state images.

This brief features SQL Server 2022 Enterprise on a high-performance Lenovo dual-socket 2U server running VMware Cloud Foundation 9.0, unifying vSphere 9.0, vSAN ESA, and NSX into a single automated stack. The platform pairs Intel® Xeon® 6 processors with DDR5 (up to 6400 MT/s at 1 DPC / 5200 MT/s at 2 DPC), high-performance NVMe, and PCIe 5.0 I/O—plus support for MRDIMMs and CXL 2.0—to deliver consistent, low-latency performance for modern data workloads. The Lenovo ThinkAgile VX650 V4 server is storage-dense, offering up to 24× 2.5-inch or 16× E3.S 1T (12× E3.S 2T) hot-swap NVMe bays at the front, plus optional rear 2.5-inch bays. It also supports M.2 drives for OS boot (internal or front/rear hot-swap), and SAS/SATA via AnyBay backplanes with a range of 12Gb/24Gb RAID controllers and SAS HBAs

Business database solutions with faster time-to-value

Lenovo ThinkAgile VX V4 systems with VMware vSphere hypervisor are rigorously tested and tuned to save you months of configuration, setup, testing, and tuning to deploy SQL server databases for variety of workloads. Lenovo ThinkAgile VX V4 offerings are ideal for modernizing your 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. VMware Cloud Foundation on Lenovo ThinkAgile VX V4 offers a full-stack, hyperconverged cloud solution, merging vSphere compute with vSAN ESA storage to deliver high performance for virtualized SQL Server, with Windows Server enabling NVMe storage and RDMA (SMB Direct) to optimize throughput and minimize latency. With these new servers, you get the following advantages:

- The new Intel Xeon 6 arrives with architectural improvements that improve performance over the previous generations and lower operational costs
- Better optimization of the power consumption is being made during peak and off-peak hours by using high priority cores and low priority cores
- support DDR5 memory operating at speeds up to 6400 MHz to support high performance SQL server instances
- Improved density and support more and larger databases per host

SQL Server 2022 features

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 column store 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
- Support for Intel QuickAssist Technology (QAT) backup compression with software or hardware acceleration (only software compression is available in SQL Standard)
- TempDB performance enhancements for scalability and 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 V4 systems with 6th Gen Intel Xeon Processors

Lenovo ThinkSystem V4 servers are bare-metal servers supporting either shared storage or local stored and ThinkAgile VX V4 systems are hyperconverged systems virtualized with VMware vSAN. Microsoft SQL server based OLTP and data warehousing workloads can seamlessly leverage ThinkAgile VX V4 hyperconverged storage and ThinkSystem V4 servers with shared storage such as Lenovo ThinkSystem DE/DM/DG storage.

Lenovo ThinkAgile VX V4 Systems are factory-integrated, pre-validated ready-to-go integrated systems and Fully tested and validated for vSAN compliance.



ThinkSystem SR630 V4



ThinkSystem SR650 V4



ThinkAgile VX630 V4



ThinkAgile VX650 V4

Lenovo ThinkAgile VX V4 Systems and ThinkSystem Series V4 servers powered by Intel Xeon 6 processors provide excellent performance, bandwidth, and speed. Specifications include:

SR650 V4	SR630 V4
• 2x Intel Xeon 6700 or 6500-series processors with Performance cores (P-cores) up to 86 cores and 172 threads; TDP up to 350W	• 2x Intel Xeon 6700 or 6500-series processor with P-cores, up to 86 cores and 172 threads; TDP up to 350W • 2x Intel Xeon 6700-series processor with E-cores, up to 144 cores (no Hyper-Threading), TDP ratings up to 330W
• DDR5 memory operating up to 6400 MHz • 8 channels per CPU	• DDR5 memory operating up to 6400 MHz • 8 channels per CPU

• 32 DIMMs (16 per processor), 2 DIMMs per channel • Supports RDIMMs, 3DS RDIMMs, and MRDIMMs • Supports CXL 2.0 memory in E3.S 2T form factor, up to 12x DIMMs with two processors • Up to 8TB of system memory	• 32 DIMMs (16 per processor), 2 DIMMs per channel • E-cores: Supports RDIMMs • P-cores: Support for 3DS RDIMMs, MRDIMMs, and CXL memory • Up to 8TB of system memory
• Up to 32x NVMe drives for high-performance storage • Up to 16x 3.5", 40x 2.5" drive bays, 32x E3.S • Support E3.S NVMe drives up to 32 • Support for 2.5" and 3.5" drive bay	• Support for up to 12x 2.5" NVMe drives (front+rear) • Support for E3.S drive formats will allow for greater drive capacities • No support for 3.5-inch drive bay

Lenovo XClarity One is unified management platform for servers, storage and edge and it is hosted on hybrid cloud and offers accelerated deployment, scalability, and speed while eliminating complex infrastructure setup and management overhead. It also offers life cycle management, secure management hub, AI powered smarter support.

Performance Testing Details and Results

HammerDB Configuration

[HammerDB](#) is an open-source database transactional and analytics load testing/benchmarking tool for databases. The OLTP workload is derived from the TPC-C Benchmark standard, and it is not comparable to published TPC-C and do not comply with the TPC-C benchmark standards. The testing described below used HammerDB instance running on a separate server. The testing was performed on one node from the 4 node ThinkAgile VX650 V4 cluster with the following configuration parameters for operating system and SQL Server database.

Table 1. TPC-C performance testing hardware configuration

Component	Details
Server	1 x Lenovo ThinkSystem VX650 V4 (4 node cluster)
CPU	2 socket, Intel Xeon 6747P 48 Core @ 2.4 GHz
RAM	1.5 TB (16 x Lenovo ThinkSystem 96GB TruDDR5 6400MHz)
Network adapter	ThinkSystem Mellanox ConnectX-6 Lx 10/25GbE SFP28 2-port PCIe Ethernet Adapter

Disks	8 x ThinkSystem 2.5" U.3 7450 PRO 1.92TB Read Intensive NVMe PCIe 4.0 x4 HS SSD 2 x ThinkSystem M.2 7450 PRO 960GB Read Intensive NVMe PCIe 4.0 x4 NHS SSD
Hypervisor	VMware vSphere 9.0
Operating System	Windows Server 2025 Datacenter
SQL Server Database (Enterprise Edition)	Microsoft SQL Server 2022 Enterprise Edition
HammerDB	5.0
Database size	100 GB
Number of warehouses	800
Virtual Users	150
Ramp Up	2 mins
Number of VMs	10
Transactions Per Minute (TPM)	8.31 million

Bill of Materials: ThinkAgile VX650 V4

Part number	Product Description	Qty
7DG6CTO1WW	Server: Lenovo ThinkAgile VX650 V4 (dual-socket, 2U)	1
C68E	ThinkAgile VX650 V4 24x2.5" Chassis	1
C5R8	Intel Xeon 6747P 48C 330W 2.7GHz Processor	2
C3QR	ThinkSystem 2U V4 Performance Heatsink	2
C0TQ	ThinkSystem 64GB TruDDR5 6400MHz (2Rx4) RDIMM	32
C26V	ThinkSystem M.2 RAID B545i-2i SATA/NVMe Adapter	1
C2BR	ThinkSystem 2.5" U.3 7500 PRO 1.92TB Read Intensive NVMe PCIe 4.0 x4 HS SSD	8
C46P	ThinkSystem 2U V4 8x2.5" NVMe Gen5 Backplane	1
BQ1Y	ThinkSystem M.2 5400 PRO 480GB Read Intensive SATA 6Gb NHS SSD	2
BPPW	ThinkSystem Broadcom 57504 10/25GbE SFP28 4-Port OCP Ethernet Adapter	1
C62D	ThinkSystem SR650 V4 x16 PCIe Gen5 Riser	1
C0U3	ThinkSystem 2000W 230V Titanium CRPS Premium Hot-Swap Power Supply	2
C3RD	Think System SR650/a V4 Performance Fan Module option kit	6
C1YR	ThinkSystem 1U/2U V4 USB Ports Extension Board	1
C2DH	ThinkSystem Toolless Slide Rail Kit V4	1
SCY0	XClarity One - Managed Device, Per Endpoint w/3 Yr SW S&S	1
BVXG	VMware Cloud Foundation (VCF)	1

References:

Lenovo ThinkSystem SR650 V4 Server

<https://lenovopress.lenovo.com/lp2127-thinksystem-sr650-v4-server>

<https://lenovopress.lenovo.com/lp1971-thinksystem-sr630-v4-server>

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Lenovo ThinkAgile VX630 V4 Hyperconverged System

<https://lenovopress.lenovo.com/lp2134-lenovo-thinkagile-vx630-v4-hyperconverged-system>

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SQL Server Solutions

<https://lenovopress.lenovo.com/software/database/sql>

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