Microsoft SQL Server 2025 on Lenovo ThinkAgile MX650 V4

Planning / Implementation

Deploying hyperconverged infrastructure has become the standard for organizations seeking to modernize their aging datacenter environments. Traditional large-scale storage arrays are being replaced by HCI platforms designed to support a broad range of general-purpose workloads. This shift is driven by the efficiency, resiliency, and improved price-to-performance that HCI delivers. At the same time, many customers are adopting hybrid strategies, moving selective workloads to the cloud while maintaining others on-premises to meet compliance, latency or operational requirements.

Azure Local is Microsoft's HCI solution for customers who want to run workloads on-premises while extending to Azure for hybrid capabilities such as backup, site recovery, storage, cloud-based monitoring, and additional services.

Lenovo ThinkAgile MX Series systems, combine the Storage Spaces Direct (S2D) technology in the Azure Local host OS with Lenovo's industry-leading server platforms to create a reliable solution. This offering provides a consistent and reliable approach to constructing modern hybrid data center infrastructures.

Lenovo Solutions for Microsoft SQL Server on ThinkAgile MX650 V4 are optimized for both Online Transaction Processing (OLTP) and Data Warehouse (DW) workloads and take advantage of the latest Intel innovations. This paper features Microsoft SQL Server 2025 running on high-performance ThinkAgile MX650 V4 servers in a 2-node configuration. The servers are powered by Intel Xeon 6 Scalable processors, delivering significant architectural improvements, expanded core counts, enhanced AI acceleration, and higher memory bandwidth. The MX650 V4 supports DDR5 memory operating at speeds up to 6400 MT/s and offers broad storage flexibility, including NVMe and PCIe 5.0 devices for high-speed, low latency storage.

Figure 1. Lenovo ThinkAgile MX650 V4

The MX650 V4 solution is a storage dense offering, with up 28x 2.5-inch hot-swap drive bays, by using combinations of front-accessible (up to 24 bays), and rear-accessible (4 bays).It also supports 28x NVMe drives without oversubscription of PCIe lanes (1:1 connectivity), 12x 3.5-inch drive bays for lower-cost high-capacity HDD storage and M.2 drives for convenient operating system boot functions or data storage.

ThinkAgile MX Series is built with certified hardware components, and can be managed by using local tools like Windows Admin Center or the Azure Portal. Benefits like these allow businesses to deploy solutions quickly and easily.

Key benefits

The solution offers the following benefits:

- **Hybrid consistency:** Azure Local on ThinkAgile MX delivers a unified hybrid model. Workloads stay on-premises while seamlessly extending to Azure for backup, recovery, monitoring, and cloud services.
- **High SQL Server performance:** ThinkAgile MX650 V4 provides strong performance for SQL Server 2025 through Intel Xeon 6 processors, high-speed DDR5 memory, and NVMe/PCIe 5.0 storage, supporting low-latency OLTP and analytic workloads.
- **Simplified deployment and operations:** ThinkAgile MX systems use certified hardware and integrate with Windows Admin Center and Azure Portal, making them fast to deploy and straightforward to manage.

Excellent value

The Lenovo ThinkAgile MX Series delivers strong value by combining Lenovo server engineering with Microsoft's hyperconverged and hybrid technologies.

The Azure Local instance on ThinkAgile MX provides the following benefits:

- **Storage Spaces Direct** (S2D) provides a resilient and scalable software-defined storage layer, using local NVMe and SSD resources to deliver predictable throughput and low-latency performance for virtualized and database workloads
- **Hyper-V virtualization** enables efficient consolidation, consistent workload isolation and support for mixed enterprise applications across the cluster.
- **Windows Admin Center** (WAC) offers a unified, browser-based management experience for hosts, clusters, virtual machines, networking and storage, reducing operational overhead.
- **Azure Local** integration extends the on-premises environment with cloud capabilities such as backup, site recovery, monitoring and lifecycle services without changing existing operational models.
- The hardware platform enhances performance and capacity through Intel Xeon 6 processors, DDR5 memory and PCIe/NVMe storage options, supporting both OLTP and analytical database scenarios.

ThinkAgile MX Series

The ThinkAgile MX650 V4 and MX630 V4 are the flexible building block for your Microsoft Azure Local solutions.

Table 1. ThinkAgile MX Series

Model	MX630 V4 System	ThinkAgile MX650 V4
Form Factor	1U	2U
CPU	2x Intel® Xeon® 6 (Granite Rapids-SP)	2x Intel® Xeon® 6 (Granite Rapids-SP)
CPU types	- Intel Xeon 6 with P-cores - Intel Xeon 6 with E-cores	Intel Xeon 6 with P-cores
Memory	- Up to 8TB of system memory - DDR5 memory operating up to 8000 MHz 8 channels per CPU 32 DIMMs (16 per processor), 2 DIMMs per channel	- Up to 8TB of system memory - DDR5 memory operating up to 8000 MHz 8 channels per CPU 32 DIMMs (16 per processor), 2 DIMMs per channel
Memory types	- E-cores: Supports RDIMMs - P-cores: Supports RDIMMs, 3DS RDIMMs, MRDIMMs, and CXL memory	Supports RDIMMs, 3DS RDIMMs, and MRDIMMs
Drive bays	- Front: 10x 2.5" SAS/SATA/NVMe hot-swap drives 16x E3.S 1T NVMe hot-swap drives 8x E3.S 2T NVMe hot-swap drives - Rear: - Up to 2x 2.5'" SAS/SATA/NVMe hot-swap drives 16x onboard NVMe ports - PCIe 5.0 NVMe drive support 2x Internal M.2 with optional RAID 1 2x front or rear hot-swap M.2 with RAID 1	- Front: 12x 3.5" SAS/SATA/NVMe hot-swap drives 24x 2.5" SAS/SATA/NVMe hot-swap drives - Rear: - Up to 4x2.5", hot-swap drives 36x onboard NVMe ports - PCIe 5.0 NVMe drive support 2x Internal M.2 with optional RAID 1 2x front or rear hot-swap M.2 with RAID 1
Drive configuration	All flash	All Flash or Hybrid Depending on configuration: 4-14x HDDs: 1TB to 14TB 4-28x SSDs: 480GB to 7.68TB 4-24x NVMe: 750GB to 7.68TB
HBAs	440-8i HBA 440-16i HBA	440-16i HBA
OCP Networking	2x OCP slots: 1Gb, 10Gb, 25Gb Ethernet	2x OCP slots: 1Gb, 10Gb, 25Gb Ethernet
PCIe Networking	Up to 5x adapters: 1Gb, 10Gb, 25Gb, 100Gb	- Up to 10x rear PCIe slots (6x full height, 4x low-profile) - All slots are PCIe 5.0 - Riser cards are modular for easy upgrades - Supports a RAID/HBA in CFF form factor (does not occupy a PCIe slot)

Model	MX630 V4 System	ThinkAgile MX650 V4
GPUs	• Supports up to 3x single-wide GPUs	• Supports up to 10x single-wide GPUs • Supports up to 2x double-wide GPUs
Hypervisor	• Azure Local OS preloaded • Windows Server 2025 Datacenter optional	• Azure Local OS preloaded • Windows Server 2025 Datacenter optional

Microsoft SQL Server 2025

SQL Server 2025 (17.x) builds on SQL Server 2022 by extending Intelligent Query Processing, improving performance, enhancing availability features, and adding new language, developer, and platform capabilities. It continues Microsoft's direction of offering a unified data platform across on-premises, hybrid, and cloud environments.

As with SQL Server 2022, SQL Server 2025 does not install R, Python, or Java runtimes through SQL Setup. Users install any required custom runtimes separately.

Performance enhancements in SQL Server 2025 include:

- Improvements to Query Store and Intelligent Query Processing, enabling broader plan optimization and more adaptive execution behaviour
- Native JSON enhancements, including support for large JSON documents and improved indexing options.
- Optimised locking to reduce database contention and improve concurrency without code changes
- TempDB and metadata engine improvements that enhance scalability and workload
- In-memory OLTP improvements for better engine efficiency and workload consistency

Management improvements include:

- Deeper Azure integration, including Fabric shortcuts, semantic search, and cloud-connected management capabilities
- New linkage options for hybrid deployments using Azure SQL and Microsoft Fabric
- Always On Availability Group enhancements continue with improved failover behavior and better integration with modern cloud architectures
- Accelerated Database Recovery (ADR) remains a core engine feature for faster recovery.

Lenovo ThinkSystem MX650 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.

Lenovo ThinkSystem MX650 V4 servers offer the necessary performance for bare metal or virtualized SQL Servers. High performance can be achieved using Hyper-V and Storage Spaces Direct technology which are built into Windows Server. Several technologies like NVMe storage and Remote Direct Memory Access (RDMA) networking are natively supported in Windows Server to enable the highest levels of performance.

Lab configuration

The configuration used for testing has the following configuration.

Table 2. Lab configuration

Feature	Descirption
Server	Lenovo ThinkSystem MX650 V4
Processor	2x Intel Xeon 6505P processors up to 4.1 GHz (3.9 GHz base) with 12 cores and 24 threads each
Memory	512GB of DDR5 6400 MT/s memory
Storage pool	8x ThinkSystem 7500 PRO NVMe drives 3.8TB NVMe SSDs PCIe 4.0
OS Storage	2x 960GB M.2 NVMe SSDs PCIe 4.0 for the operating system (RAID 1)
OS	Azure Stack HCI 24H2
Networking	1 x Mellanox ConnectX-6 Lx 10/25GbE SFP28 2-port OCP for management 1 x Mellanox ConnectX-6 Dx 100GbE QSFP56 2-port PCIe for storage traffic

Best practices for SQL Server on ThinkSystem MX650 V4

To achieve the best performance from the hardware, configure the system using the following settings:

- Configure UEFI settings to set Operating mode to Maximum performance.

- Enable Hyper-Threading in the UEFI.

- Configure power profile in Windows Server to "High performance".

- SQL Server database and log drives are recommended to be formatted with 64KB NTFS cluster size.

- SQL Server database and log files should be on separate physical drives. The OS and SQL Server binary drives are recommended to be formatted with standard 4KB NTFS cluster size. TempDB is shared by many processes and users as a temporary working area and should be configured appropriately. Default configuration will be suitable for most workloads. Use the install experience for guided configuration

- If the server is dedicated to the SQL Server workload, use the default dynamic memory management model or follow Microsoft SQL documentation guidelines for manually configuring memory options if finer grain control is desired.

Performance testing and results

The testing was performed under the following conditions:

- The Azure Local environment hosted two SQL Server virtual machines per node, resulting in a total of four SQL Server 2025 VMs across the cluster.
- Each virtual machine ran SQL Server 2025 and hosted a TPC-C database configured with 800 warehouses.
- Each VM was allocated with 16 vCPUs and 128 GB RAM to ensure consistent resource availability during testing.
- HammerDB was used as the workload generator, specifically running the TPC-C benchmark to simulate an OLTP workload

Across the four SQL Server 2025 virtual machines, the test configuration delivered a combined throughput of 7,715,373 TPM and 1,676,634 NOPM. These values were obtained on a instance built with Intel Xeon 6505P processors, a mid-range part with 12 performance cores per socket.

The results show that the platform maintains consistent OLTP throughput even when core counts are lower. This is relevant for customers who prioritize predictable latency and stable performance rather than maximum core density.

The Xeon 6505P operates at a lower TDP compared to higher-end models in the same generation. Because of this, the system shows favorable performance-per-watt behaviour under OLTP load.

SQL Server 2025 benefits from improved intelligent query processing and metadata engine efficiencies, which help sustain throughput without requiring high-frequency turbo states for long periods. Lower power draw reduces thermal load, keeps fan speeds stable and contributes to overall efficiency.

About the benchmarks:

- HammerDB was used as the workload generation tool for performance validation. HammerDB is an open-source benchmarking framework that implements industry-standard workloads and can automate large-scale transactional testing. More information about HammerDB is available at: https://www.hammerdb.com
- The TPC-C workload used in this test is defined by the Transaction Processing Performance Council and represents a classic OLTP profile composed of order entry, payment, delivery and stock-level transactions. Full details on the TPC-C benchmark specification can be found at: https://www.tpc.org

Bill of Materials

The following table lists the feature codes for the lab configuration.

Table 3. Bill of Materials

Feature code	Description	Quantity
7DFHCTO1WW	Server : ThinkAgile MX650 V4	1
C8HB	MX650 V4 IS 24x2.5" Chassis	1
C5QQ	Intel Xeon 6505P 12C 150W 2.2GHz Processor	2
C3QR	ThinkAgile 2U V4 Performance Heatsink	2
C0TQ	ThinkSystem 64GB TruDDR5 6400MHz (2Rx4) RDIMM	8
C46P	ThinkAgile 2U V4 8x2.5" NVMe Backplane	1
C2BS	ThinkAgile 2.5" U.3 7500 PRO 3.84TB Read Intensive NVMe PCIe 4.0 x4 HS SSD	8
C26V	ThinkAgile M.2 RAID B545i-2i SATA/NVMe Adapter	1
BKSR	ThinkAgile M.2 7450 PRO 960GB Read Intensive NVMe PCIe 4.0 x4 NHS SSD	2
BE4T	ThinkSystem Mellanox ConnectX-6 Lx 10/25GbE SFP28 2-port OCP Ethernet Adapter	1
C0U3	ThinkAgile 2000W 230V Titanium CRPS Premium Hot-Swap Power Supply	2
B8PP	ThinkSystem Mellanox ConnectX-6 Dx 100GbE QSFP56 2-port PCIe Ethernet Adapter	1
C3RD	ThinkAgile 2U 6056 20K Performance Fan Module	6
C2DH	ThinkAgile Toolless Slide Rail Kit V4	1
C3RM	ThinkAgile 2U Air duct Filler for 1P	2
5641PX3	XClarity Pro, Per Endpoint w/3 Yr SW S&S	1
1340	Lenovo XClarity Pro, Per Managed Endpoint w/3 Yr SW S&S	1
C1XN	3Yr Premier 24x7 4Hr Resp MX650 V4	1

For More Information

To learn more about Lenovo MX solution contact your Lenovo Business Partner or visit:
https://www.lenovo.com/au/en/servers-storage/sdi/thinkagile-mx-series/

References:

Microsoft SQL 2025
What's New in SQL Server 2025 - SQL Server | Microsoft Learn

Lenovo ThinkSystem MX650 V4:
https://lenovopress.lenovo.com/lp2137-lenovo-thinkagile-mx650-v4-hyperconverged-system

Author

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Related product families

Product families related to this document are the following:

- Microsoft Alliance
- Microsoft SQL Server
- ThinkAgile MX Series for Microsoft Azure Local

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