Optimizing Microsoft SQL Server 2022 on Lenovo ThinkAgile HX650 V3
Solution Brief

Data growth problem and a solution

In today's world information is an asset that demands the right tools to store and manage critical business data. Organizations of all sizes are being inundated by information at an increasing pace. It is important to choose a database solution that matches the requirements of the company, resulting in the most productive outcome. By consolidating SQL Server in virtual machines on a Nutanix cluster, database workloads can experience improved efficiency. SQL Server 2022 includes database and business intelligence features for organizations that need a full featured enterprise database solution.

Lenovo Solutions for Microsoft SQL Server on ThinkAgile HX650 V3 are optimized for both Online Transaction Processing (OLTP) and are **Accelerated by Intel** offerings. This technical brief features Microsoft SQL Server 2022 Enterprise Edition running in Nutanix virtual machines on compact, high-performance Lenovo dual-socket 2U rack mounted systems. The server is configured with 4th Generation Intel® Xeon® Scalable processors, TruDDR5 4800MT/s memory and P5620 NVMe drives among a variety of storage options, including support for the PCIe 5.0 standard devices for I/O. These new processors from Intel offer anywhere from 16 to 60 cores and up to 16x 4800 MT/s DDR5 DIMMs per socket.

The HX650 V3 server is a storage dense offering, with up to 40 2.5" drive bays in the front, middle and rear of the server and 5 different slot configurations at the rear of the server. Onboard NVMe PCIe ports allow direct connections to 16 NVMe SSDs, which frees up PCIe slots and lowers NVMe solution acquisition costs. The HX650 V3 servers include Nutanix AHV pre-loaded and ready to setup in a cluster configuration.

Business database solutions with faster time-to-value

Lenovo HX650 V3 systems are methodically tested and tuned to save you months of configuration, setup, testing, and tuning. With these new servers, you get the following advantages:

- Realize 40% better performance for workloads running on 4th generation Intel Xeon Scalable processors than on similar servers equipped with previous generation processors
- Improve performance of SQL Server solutions with higher core counts, memory bandwidth and PCIe Gen 5 devices
- Improve density and support more and larger databases
- Consolidate SQL workloads, running on multiple Nutanix virtual machines

Highlights
- Reduce time to value with pretested and sized hardware configurations
- Simplified evaluation, fast and easy deployment and workload optimized performance
- Database sized solution with optimal compute, memory, storage and networking components
- Reduce TCO through better performance, rapid deployment and advanced hardware
- Optimize performance with pretested ThinkAgile HX650 V3 hardware configurations

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
- 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
- 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 HX650 V3

Lenovo ThinkAgile HX650 V3 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.

The HX650 V3 servers offer the necessary performance for virtualized SQL Servers. High performance server consolidation and management can be achieved using Nutanix hypervisor technology. Several technologies like NVMe storage and Remote Direct Memory Access (RDMA) networking enable the highest levels of performance.

There are several differences between the different SQL editions, too many to list in this document. A detailed comparison of SQL editions can be found here.

Each server configuration features the following main components:

- **Server:** Lenovo ThinkAgile HX650 V3
- **Processor:** 2x 4th Gen Intel Xeon Scalable, Platinum 8468 48C 2.1 GHz
- **Memory:** 1TB of TRUDDR5 4800 MT/s memory
- **Storage pool:** 4x Intel P5620 3.2TB NVMe SSDs
- **OS Storage:** 2x 960GB M.2 SATA SSDs (RAID 1)
- **Software:**
  - Nutanix AHV OS / Hypervisor
  - Microsoft Windows Server 2022 VMs
  - Microsoft SQL Server 2022 Enterprise Edition

Best Practices for SQL Server on ThinkAgile HX650 V3

For a high-performance SQL Server solution, implement the following best practices:

- Configure UEFI (BIOS) settings for Operating mode to Maximum performance.
- Enable hyper-threading in the BIOS.
- Set network cards and switches MTU to 9000
- Avoid over-subscribing VM memory or processors beyond physical availability.
- 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. More info in Microsoft TempDB Database documentation.
- 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.

Figure 1. Lenovo ThinkAgile HX650 V3

Performance Testing Details and Results

HammerDB Configuration

HammerDB is an open-source load testing / benchmarking tool for databases available at: http:///www.hammerdb.com. It offers tools for testing performance on OLTP and Analytics workloads. The OLTP workload is based on TPC-C benchmark from http://www.tpc.org and the Analytics workload is based on TPC-H benchmark from tpc.org. HammerDB 4.7 was used. Below are details of the testing and results.

Table 1. TPC-C performance testing details and results

Database tested	MS SQL Server 2022 Enterprise Edition
System	HX650 V3 Certified Node - 4th Gen Intel Xeon SP
Hardware Configuration	3x ThinkAgile HX650 V3 in Nutanix Cluster, 2x Intel Xeon Platinum 8468 48C 2.1 Ghz processors, 1TB memory, 4x Intel P5620 NVMe drives
VM configuration	12 VMs, each with 28 CPU, 96GB RAM
Benchmarks simulated	TPC-C
Database size: TPC-C	100GB 800 warehouse, on each VM
Virtual users	50 per VM
User delay	1 ms
TPC-C results	Total from 12 VMs
Transactions Per Minute (TPM)	5.1 million TPM

Bill of Materials

Table 2. Bill of Materials

7D6NCTO3WW	Server: ThinkAgile HX650 V3 Certified Node	1
BRP4	ThinkAgile HX650 V3 Base	1
B0W3	XClarity Pro	1
B15S	Nutanix SW Stack on Nutanix AHV	1
BM84	ThinkAgile HX Remote Deployment	1
BPPU	Intel Xeon Platinum 8468 48C 350W 2.1GHz Processor	2
BNF9	ThinkSystem 64GB TruDDR5 4800 MHz (2Rx4) 10x4 RDIMM	16
BH8B	ThinkSystem 2U/4U 8 x 2.5" AnyBay Backplane	1
B0SW	Nutanix Flash Node Config	1
BNEH	ThinkSystem 2.5" U.2 P5620 3.2TB Mixed Use NVMe PCIe 4.0 x4 HS SSD	4
B8P9	ThinkSystem M.2 NVMe 2-Bay RAID Adapter	1
BTTY	M.2 NVMe	1
BKSR	ThinkSystem M.2 7450 PRO 960GB Read Intensive NVMe PCIe 4.0 x4 NHS SSD	2
BN2T	ThinkSystem Broadcom 57414 10/25GbE SFP28 2-Port OCP Ethernet Adapter	1
AUKP	ThinkSystem Broadcom 57416 10GBASE-T 2-Port PCIe Ethernet Adapter	1
BMUF	ThinkSystem 1800W 230V Platinum Hot-Swap Gen2 Power Supply	2
B8LA	ThinkSystem Toolless Slide Rail Kit v2	1
BLL6	ThinkSystem 2U V3 Performance Fan Module	6
BPKR	TPM 2.0	1
BRPJ	XCC Platinum	1

Accelerated by Intel

To deliver the best experience possible, Lenovo and Intel have optimized this solution to leverage Intel capabilities like processor accelerators not available in other systems. Accelerated by Intel means enhanced performance to help you achieve new innovations and insight that can give your company an edge.

Why Lenovo

Lenovo is a US$70 billion revenue Fortune Global 500 company serving customers in 180 markets around the world. Focused on a bold vision to deliver smarter technology for all, we are developing world-changing technologies that power (through devices and infrastructure) and empower (through solutions, services and software) millions of customers every day.

For More Information

To learn more about this Lenovo solution contact your Lenovo Business Partner or visit:
https://www.lenovo.com/us/en/servers-storage/solutions/database/

References:

Lenovo ThinkAgile HX650 V3: https://lenovopress.lenovo.com/lp1668

Microsoft SQL Server 2022: https://learn.microsoft.com/en-us/sql/sql-server/what-s-new-in-sql-server-2022?view=sql-server-ver16

Related product families

Product families related to this document are the following:

- Microsoft Alliance
- Microsoft SQL Server
- Nutanix Alliance
- ThinkAgile HX Series for Nutanix

Notices

Lenovo may not offer the products, services, or features discussed in this document in all countries. Consult your local Lenovo representative for information on the products and services currently available in your area. Any reference to a Lenovo product, program, or service is not intended to state or imply that only that Lenovo product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any Lenovo intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any other product, program, or service. Lenovo may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

Lenovo (United States), Inc.
8001 Development Drive
Morrisville, NC 27560
U.S.A.
Attention: Lenovo Director of Licensing

LENOVO PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. Lenovo may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

The products described in this document are not intended for use in implantation or other life support applications where malfunction may result in injury or death to persons. The information contained in this document does not affect or change Lenovo product specifications or warranties. Nothing in this document shall operate as an express or implied license or indemnity under the intellectual property rights of Lenovo or third parties. All information contained in this document was obtained in specific environments and is presented as an illustration. The result obtained in other operating environments may vary. Lenovo may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Any references in this publication to non-Lenovo Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this Lenovo product, and use of those Web sites is at your own risk. Any performance data contained herein was determined in a controlled environment. Therefore, the result obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

This document, LP1965, was created or updated on May 24, 2024.

Send us your comments in one of the following ways:

- Use the online Contact us review form found at:
  https://lenovopress.lenovo.com/LP1965
- Send your comments in an e-mail to:
  comments@lenovopress.com

This document is available online at https://lenovopress.lenovo.com/LP1965.

Trademarks

Lenovo and the Lenovo logo are trademarks or registered trademarks of Lenovo in the United States, other countries, or both. A current list of Lenovo trademarks is available on the Web at https://www.lenovo.com/us/en/legal/copytrade/.

The following terms are trademarks of Lenovo in the United States, other countries, or both:
Lenovo®
AnyBay®
ThinkAgile®
ThinkSystem®
XClarity®

The following terms are trademarks of other companies:

Intel® and Xeon® are trademarks of Intel Corporation or its subsidiaries.

Microsoft®, Azure®, SQL Server®, Windows Server®, and Windows® are trademarks of Microsoft Corporation in the United States, other countries, or both.

TPC, TPC-C, and TPC-H are trademarks of Transaction Processing Performance Council.

Other company, product, or service names may be trademarks or service marks of others.