Running Microsoft SQL Server 2022 on Lenovo ThinkSystem SR650 V2
Solution Brief

Data growth problem and a solution

The rapid growth of technology means the amount of available data and the ability to collect that data increased to a level unthinkable as little as five years ago. As the volume and velocity of data increased, however, extracting meaningful insight in a timely manner became more complex. Therefore, opportunities are being missed and effort is being wasted. To compete, businesses in the 21st century are demanding the tools to derive true value from their data.

Lenovo Solutions for Microsoft SQL Server on ThinkSystem SR650 V2 are optimized for both Online Transaction Processing (OLTP) and Data Warehouse (DW) or Decision Support Systems (DSS). This solution guide features Microsoft SQL Server 2022 running on the high-performance Lenovo dual-socket 2U rack mount enterprise server. The server is configured with 3rd Generation Intel® Xeon® Scalable processors, TruDDR4 3200MT/s memory and Samsung NVMe among a variety of storage options, including support for the PCIe 4.0 standard devices for I/O. These new processors from Intel offer up to 40 cores and 16x 3200 MT/s DDR4 DIMMs per socket.

The SR650 V2 server is a storage dense offering, with 28 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 12x NVMe SSDs, which frees up PCIe slots and lowers NVMe solution acquisition costs.

Enterprise database solutions with faster time-to-value

Lenovo SR650 V2 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 3rd 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 4 devices
- Improve density and support more and larger databases per host

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 ThinkSystem SR650 V2 hardware configurations

Microsoft SQL Server 2022

SQL Server 2022 is now GA and its database engine 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 ThinkSystem SR650 V2 offerings are ideal for modernizing your legacy SQL Server applications because of their low cost and high-performance capabilities. This solutions uses industry standard x86 servers to provide cost effective computing and fast high-density local storage.

Lenovo ThinkSystem SR650 V2 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, Remote Direct Memory Access (RDMA) networking are natively supported in Windows Server to enable the highest levels of performance.

Lenovo has measured over 5.4 million transactions per minute (TPM) with TPC-C workload.

This configuration features the following main components:

- **Server:** Lenovo ThinkSystem SR650 V2
- **Processor:** 2x 3rd Gen Intel Xeon Scalable, 8380 40 core
- **Memory:** 1TB of TRUDDR4 3200 MT/s memory
- **DB Storage:** 8x Samsung PM983 1.92TB NVMe SSDs
- **Log Storage:** 2x Samsung PM983 1.92TB NVMe SSDs Raid1
- **OS Storage:** 2x 480GB M.2 SATA SSDs for the operating system (RAID 1)
- **Software:**
    - Microsoft Windows Server 2022
    - Microsoft SQL Server 2022 Enterprise Edition

This high-performance database solution with Microsoft SQL Server 2022 Enterprise Edition features the latest Samsung NVMe SSDs. These SSDs help build a low latency solution for mission critical SQL Server applications.

Backup Compression and Off-Load

SQL Server 2022 introduces backup performance improvements with a new compression algorithm and hardware offloading and acceleration with Intel QuickAssist Technology (QAT).

Improvements can be seen with either software only compression or by using Intel hardware that supports QAT offloading and acceleration. Intel offers PCIe accelerator cards that support QAT hardware offloading.

The benefits of QAT include:

- Reduced backup capacity
- Minimal CPU impact
- Minimal workload impact
- Faster backups
- Faster restores

This document shows performance benefits of software mode. In software only mode, it still utilizes the Intel QAT algorithm to improve backup times. The table below shows Lenovo test results of software only mode QAT backups. We saw nearly 3x the performance over the previous compression method (MS_XPRESS) and minimal additional CPU impact.

Intel QuickAssist Technology (QAT) Backup Compression
Database: TPCH 1000GB scale

Backup Type	Time (sec)	CPU %	MB/sec	Backup Size
No Compression	120	1.3	4222	516 GB
MS_XPRESS Compression	601	12.5	839	189 GB
QAT SW Compression	247	13	2042	167 GB

Table 1. Intel QuickAssist Technology (QAT) Backup Compression

Enable and Configure QAT

Enable QAT (required for both hardware and software)

sp_configure 'hardware offload enabled', 1

GO

RECONFIGURE

GO

Enable QAT hardware mode (if your system has accelerator cards)

ALTER SERVER CONFIGURATION

SET HARDWARE_OFFLOAD = ON (ACCELERATOR = QAT)

GO

Enable QAT software mode

ALTER SERVER CONFIGURATION

SET HARDWARE_OFFLOAD = ON (ACCELERATOR = QAT, MODE = SOFTWARE)

GO

Verify QAT is enabled and the type

SELECT * FROM sys.dm_server_accelerator_status

GO

Restart the SQL instance to apply changes

Run Backups

No compression

BACKUP DATABASE [TPC-H1000] TO DISK = 'D:\backups\MSSQL1.bak' WITH FORMAT, NO_COMPRESSION

GO

MS_XPRESS compression

BACKUP DATABASE [TPC-H1000] TO DISK = 'D:\backups\MS-XPRESS.bak' WITH FORMAT, COMPRESSION (ALGORITHM = MS_XPRESS)

GO

QAT compression

BACKUP DATABASE [TPC-H1000] TO DISK = 'D:\backups\QAT-DEFLATE.bak' WITH FORMAT, COMPRESSION (ALGORITHM = QAT_DEFLATE)

GO

Best practices for running SQL Server on ThinkSystem SR650 V2

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

- Configure UEFI (Bios) settings to set Operating mode to Maximum performance.
- 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.

Performance Testing Details and Results

HammerDB Configuration and Parameters

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. OLTP workload is based on TPC-C benchmark from http://www.tpc.org and Analytics workload is based on TPC-H benchmark from tpc.org. Hammerdb was run on a separate load server. Below are details of the testing and results.

Hardware Configuration	ThinkSystem SR650 V2, 2x Intel Xeon 8380 40 core processors, 2TB GB memory, Samsung PM983
Database tested	MS SQL Server 2022 Enterprise Edition
Benchmarks simulated	TPC-C and TPC-H
TPC-C database size	100 GB 800 warehouse, distributed over 8 NVMe drives
TPC-C run time parameters	
Virtual users	300
User delay	1 ms
TPC-C results	
TPM	5,412,553
NOPM	2,350,664
TPC-H database size	1000GB Scale Factor
TPC-H run time parameters	
Virtual users	7
Scale	1000
TPC-H results	
Query Time	7.92 minutes
Average query time per user	475 seconds

Table 2. TPC-C and TPC-H performance testing details and results

Bill of Materials

7Z73CTO1WW	Sql Config : ThinkSystem SR650 V2-3yr Warranty	1
BH8H	ThinkSystem 2U 2.5" Chassis with 8, 16 or 24 Bays	1
BFYE	Operating mode selection for: "Efficiency - Favoring Performance Mode"	1
BB3G	Intel Xeon Platinum 8380 40C 270W 2.3GHz Processor	2
B964	ThinkSystem 32GB TruDDR4 3200 MHz (2Rx4 1.2V) RDIMM	32
2212	Storage devices - Custom RAID Configuration	1
B8P6	ThinkSystem 48 port 12Gb Internal Expander	1
B34N	ThinkSystem U.2 PM983 1.92TB Entry NVMe PCIe 3.0 x4 Hot Swap SSD	10
B5XJ	ThinkSystem M.2 SATA/NVMe 2-Bay Enablement Kit	1
BKSR	ThinkSystem M.2 7450 PRO 960GB Read Intensive NVMe PCIe 4.0 x4 NHS SSD	2
BH8D	ThinkSystem 2U/4U 8x2.5" NVMe Backplane	2
BE4U	ThinkSystem Mellanox ConnectX-6 Lx 10/25GbE SFP28 2-Port PCIe Ethernet Adapter	2
BQ0W	ThinkSystem V2 1100W (230Vac/115Vac) Platinum Hot Swap Power Supply	1
6400	2.8m, 13A/100-250V, C13 to C14 Jumper Cord	1
BH8E	ThinkSystem 2U Performance Fan	6
B8LA	ThinkSystem Toolless Slide Rail Kit v2	1
BMJ7	ThinkSystem 2U EIA Latch Standard (Left) v2	1
B0MK	Enable TPM 2.0	1
B7XZ	Disable IPMI-over-LAN	1
B97L	ThinkSystem SR650 V2 MB	1
B0ML	Feature Enable TPM on MB	1
BHS7	UEFI Operating Modes Support	1
B97A	ThinkSystem SR650 V2 Service Label for LI	1
AWF9	ThinkSystem Response time Service Label LI	1
B97E	ThinkSystem SR650 V2 Model Number Label	1
B97C	ThinkSystem SR650 V2 Agency Label	1
B8K8	ThinkSystem 2U MS 24x2.5" NVMe HDD Type Label1	2
AUTQ	ThinkSystem small Lenovo Label for 24x2.5"/12x3.5"/10x2.5"	1
B8JY	ThinkSystem 1100W Pt Power Rating Label WW	1
BMPF	ThinkSystem SR665/SR650 V2 Power Cable from MB to Front 2.5" BP v2	2
BMJS	ThinkSystem 2U M.2 Cable v2	1
BMP2	ThinkSystem SR665/SR650 V2 Power Cable from MB to CFF / Exp v2	1
BA77	ThinkSystem V2 PSU Filler	1
B955	ThinkSystem 4R ICX CPU HS Clip	2
AVWK	ThinkSystem EIA Plate with Lenovo Logo	1
B986	ThinkSystem V2 2U Package	1
BHJN	2U MB PSU Airduct	1
BC4X	MS 2FH Riser Filler	1
AVEQ	ThinkSystem 8x1 2.5" HDD Filler	1
BMJ8	ThinkSystem 2U EIA Latch with FIO (right) v2	1
B8MP	ThinkSystem 2U MS Air Duct Filler(For 2U Gap)	2

B5WJ	ThinkSystem OCP3 Filler	1
B8MM	ThinkSystem 2U MS 3FH Riser Filler	2
B977	ThinkSystem SR650 V2 Performance Heatsink	2
B8KY	Thinksystem WW Lenovo LPK	1
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

Table 3. Bill of Materials

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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 ThinkSystem SR650 V2: https://lenovopress.lenovo.com/lp1392-thinksystem-sr650-v2-server

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
- ThinkSystem SR650 V2 Server

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