Lenovo ThinkSystem SR650 V3 Microsoft SQL Server Instruction Manual

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Product Information

The Lenovo ThinkSystem SR650 V3 is a storage dense server offering designed for modernizing legacy SQL Server applications. It features up to 40 2.5 drive bays in the front, middle, and rear of the server, as well as 5 different slot configurations at the rear. The server also includes onboard NVMe PCIe ports for direct connections to 16 NVMe SSDs, reducing PCIe slot usage and lowering NVMe solution acquisition costs.

The SR650 V3 is methodically tested and tuned to save time on configuration, setup, testing, and tuning. It offers several advantages, including 40% better performance for workloads running on 4th generation Intel Xeon Scalable processors compared to servers with previous generation processors. It also improves the performance of SQL Server solutions with higher core counts, memory bandwidth, and PCIe Gen 5 devices, allowing for improved density and support for more and larger databases per host.

Lenovo ThinkSystem SR650 V3 servers come with pretested and sized hardware configurations, simplifying evaluation and enabling fast and easy deployment. They are optimized for database workloads and offer optimal compute, memory, storage, and networking components. By utilizing these servers, users can reduce total cost of ownership (TCO) through better performance, rapid deployment, and advanced hardware.

SQL Server 2022 is the included database software. It comes with updates to existing features such as Intelligent Query Processing and offers improved management capabilities. Starting with SQL 2022, runtimes for R, Python, and Java are no longer installed with SQL Setup. Instead, users can install any desired custom runtime(s) and packages.

The Lenovo ThinkSystem SR650 V3 servers are compatible with Windows Server and support technologies like Hyper-V and Storage Spaces Direct for high performance. They also natively support NVMe storage and Remote Direct Memory Access (RDMA) networking in Windows Server to enable the highest levels of performance.

Product Usage Instructions

To use the Lenovo ThinkSystem SR650 V3 server with Microsoft SQL Server 2022, follow these steps:

1. Ensure that the server is properly installed and connected to power and network.
2. Install Windows Server on the server according to the provided instructions.
3. Once Windows Server is installed, install Microsoft SQL Server 2022 using the provided setup instructions.
4. During the SQL Server installation, choose the desired custom runtimes and packages for R, Python, and Java, as they are no longer installed by default.
5. After the SQL Server installation is complete, configure the server for optimal performance by following the recommended hardware configurations provided by Lenovo.
6. If desired, utilize Hyper-V and Storage Spaces Direct technologies in Windows Server to achieve high performance for bare metal or virtualized SQL Servers.
7. Take advantage of the native support for NVMe storage and RDMA networking in Windows Server to further optimize performance.

By following these steps, you can effectively utilize the Lenovo ThinkSystem SR650 V3 server with Microsoft SQL Server 2022 for your database workloads, benefiting from its low cost, high-performance capabilities, and optimized hardware configurations.

Technical Brief for Microsoft SQL Server 2022 on Lenovo ThinkSystem SR650 V3

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 continues to increase exponentially. As the volume and velocity of data increase, however, extracting meaningful insight in a timely manner becomes more complex. This results in missed opportunities and wasted effort for businesses of all sizes. To compete, companies in the 21st century are demanding the tools to derive true value from their data. Lenovo Solutions for Microsoft SQL Server on ThinkSystem SR650 V3 are optimized for both Online Transaction Processing (OLTP) and Data Warehouse (DW) and are Accelerated by Intel offerings. This technical brief features

Microsoft SQL Server 2022 running on a high-performance Lenovo dual-socket 2U rack mount enterprise server. The server is configured with 4th Generation Intel® Xeon® Scalable processors, TruDDR5 4800MHz 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 up to 60 cores and 16x 4800 MHz DDR5 DIMMs per socket.
The SR650 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.

Enterprise database solutions with faster time-to-value
Lenovo SR650 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 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 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
- 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 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.
Lenovo ThinkSystem SR650 V3 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.

This configuration features the following main components:

- Server: Lenovo ThinkSystem SR650 V3
- Processor: 2x 4th Gen Intel Xeon Scalable, 8480+ 64 core
- Memory: 4TB of TRUDDR5 4800 MHz memory
- DB Storage: 6x Intel P5620 1.6TB NVMe SSDs
- Log Storage: 2x Intel P5620 1.6TB 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 Intel Optane NVMe SSDs. These SSDs help build a low latency solution for mission critical SQL Server applications.

Backup Compression and Off-Loading
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 on-chip QAT hardware offloading with the latest Intel Xeon Scalable processors.

The benefits of QAT include:

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

In software only mode, it still utilizes the Intel QAT algorithm to improve backup times. The table below shows Lenovo test results of hardware mode QAT backups. We saw considerable performance improvement over the standard MS_XPRESS compression method.

Backup and Restore Tests
The tests were run with the server under load, at 98% CPU usage, backing up a 1000 scale TPCH database. This

is where the most benefit can be seen with QAT as it performs a hardware offload to improve backup performance. There is significant improvement over the standard SQL compression during heavy loads.

Compression Type	Time (sec)	MB/sec	Backup File Size
MS_XPRESS			
Backup	2299	216	390 GB
Restore	994	500	
QAT HW Offloaded			
Backup	919	542	357 GB
Restore	447	1112	

Table 1. Comparison of MS_XPRESS and Intel QuickAssist Technology (QAT) Compression

Enable and Configure QAT

Enable QAT:
sp_configure ‘show advanced options’, 1

GO
RECONFIGURE with override

GO
sp_configure ‘hardware offload enabled’, 1

GO
RECONFIGURE with override

GO

Restart SQL to apply

Enable QAT hardware mode
ALTER SERVER CONFIGURATION
SET HARDWARE_OFFLOAD = ON (ACCELERATOR = QAT)

Restart SQL to apply

Verify QAT status:
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

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 V3
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.

Figure 1. Lenovo ThinkSystem SR650 V3

Performance Testing Details and Results

HammerDB Configuration and Intel Gen 3 – Gen 4 Comparison
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 was run on a separate load server. Below are details of the testing and results.

Processor Generation	SR650 V2 – 3rd Gen Intel Xeon SP	SR650 V3 – 4th Gen Intel Xeon SP
Hardware Configuration	ThinkSystem SR650 V2, 2x Intel Xeon 8380 processors, 2TB memory, Intel P5600 NVMe drives	ThinkSystem SR650 V3, 2x Intel Xeon 8480+ processors, 4TB memory, Intel P5620 NVMe drives
Database tested	MS SQL Server 2022 Enterprise Edition	MS SQL Server 2022 Enterprise Edition
Benchmarks simulated	TPC-C and TPC-H	TPC-C and TPC-H
Database size: TPC-C	100 GB 800 warehouse, distributed over 8 NVMe drives (6 DB, 2 Log)	100 GB 800 warehouse, distributed over 8 NVMe drives (6 DB, 2 Log)
Database size: TPC-H	1000 Scale Factor	1000 Scale Factor
Run time parameters: TPC-C		
Virtual users	150	150
User delay	1 ms	1 ms
Run time parameters: TPC-H		
Virtual users	7	7
Scale	1000	1000
TPC-C results		
NOPM (million)	1.95	2.48
TPC-H results		
Query Time (minutes)	7.2	6.4

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

Bill of Materials

7D76CTO1WW	Server: ThinkSystem SR650 V3 – 3yr Warranty	1
BLKK	ThinkSystem V3 2U 24 x 2.5″ Chassis	1
BNOM	Intel Xeon Platinum 8480+ 64C 350W 2.0GHz Processor	2
BNFC	ThinkSystem 128GB TruDDR5 4800 MHz (4Rx4) 3DS RDIMM	32
B8NY	ThinkSystem RAID 940-8i 4GB Flash PCIe Gen4 12Gb Adapter	1
BNEG	ThinkSystem 2.5″ U.2 P5620 1.6TB Mixed Use NVMe PCIe 4.0 x4 HS SSD	8
B8LU	ThinkSystem 2U 8 x 2.5″ SAS/SATA Backplane	1
BH8D	ThinkSystem 2U/4U 8 x 2.5″ NVMe Backplane	1
BM8X	ThinkSystem M.2 SATA/x4 NVMe 2-Bay Enablement Kit	1
AUUV	ThinkSystem M.2 128GB SATA 6Gbps Non-Hot Swap SSD	2
B93E	ThinkSystem Intel I350 1GbE RJ45 4-port OCP Ethernet Adapter	1
BLKM	ThinkSystem V3 2U x16/x16/E PCIe Gen4 Riser1 or 2	2
BMUF	ThinkSystem 1800W 230V Platinum Hot-Swap Gen2 Power Supply	2
BLL6	ThinkSystem 2U V3 Performance Fan Module	6
BRQ1	ThinkSystem SR650 V3,SATA CBL,SLx8-SLx4,M.2-M.2(MB),150mm	1
BSYM	ThinkSystem SR650 V3,PCIe4 Cable,Swift8x-SL8x,2in1,PCIe 6/5(MB) to BP1/BP2/td>	1
BETS	ThinkSystem V3 2U SFF C0 (RAID) to Front 8×2.5″ BP1	1
BPE3	ThinkSystem SR650 V3 MCIO8x to SL8x CBL, PCIe4, 8×2.5 AnyBay, 200mm	2
BQ12	G4 x16/x16/E PCIe Riser BLKM for Riser 1 Placement	1
BQ19	G4 x16/x16/E PCIe Riser BLKM for Riser 2 Placement	1
7S0XCTO2WW	Lenovo XClarity XCC2 Platinum Upgrade	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
QAA8	SR650 V3 3Y STANDARD	1

Table 3. Bill of Materials

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
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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 V3: **https://lenovopress.lenovo.com/lp1601**
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 V3 Server

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Documents / Resources

	**Lenovo ThinkSystem SR650 V3 Microsoft SQL Server** [pdf] Instruction Manual ThinkSystem SR650, ThinkSystem SR650 V3 Microsoft SQL Server, V3 Microsoft SQL Server, Microsoft SQL Server, SQL Server

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