

Lenovo Database Configuration

for Microsoft SQL Server OLTP on Flex System with DS6200

Reduce time to value with pretested hardware configurations - 20TB Database and 3 Million TPM

OLTP problem and a solution

The rapid growth of technology means that the amount of available data and the ability to transact on that data increased to a level unthinkable as little as five years ago. As the volume and velocity of data increased, compute, memory and storage requirements to process that data have increased significantly. Therefore, servers are running at high utilization and transaction response times have multiplied. To compete, businesses in the 21st century are demanding the tools to process their data.

This Microsoft Online Transaction Processing (OLTP) configuration for SQL Server 2017 improves time-to-value for transactional needs with a new scalable architecture. This highly available solution in the Lenovo portfolio uses the Lenovo ThinkSystem SN550 servers in a blade form factor combined with Lenovo ThinkSystem DS6200 all-flash storage to solve SQL database transactional needs of up to 20 TB in size and 3 million transactions per minute (TPM) based on Hammerdb TPC-C testing results.

Enterprise data warehouse with faster time-to-value

OLTP for SQL Server 2017 for Lenovo solution offerings are methodically tested and tuned to save you months of configuration, setup, testing, and tuning. With these offerings from Lenovo, you can now complete the following tasks:

- Buy all the hardware that you need from only one vendor including servers, storage, and networking
- Pre-optimized system tuned and tested with Microsoft certification and deploy with confidence for your demanding transactional database performance needs
- Select from different levels of performance, scalability, and price to suit your business needs
- Run mission critical transactional workloads with small random IOPs with low latency requirements
- Eliminate bottlenecks with optimized rapid data reads and query aggregations

Highlights

- Reduce time to value with pretested hardware configurations
- Lenovo pre-tested solution with detailed performance data
- Reduce TCO through better performance, rapid deployment and advanced hardware
- Optimize performance with pretested and optimized ThinkSystem SN550 hardware configurations
- Consolidate storage and match IT investment-to-information-value with the Lenovo ThinkSystem DS6200 Storage Array



MICROSOFT SQL SERVER 2017

SQL Server 2017 represents a major step towards making SQL Server a platform that gives you choices of development languages, data types, on-premises or cloud, and operating systems by bringing the power of SQL Server to Linux, Linux-based Docker containers, and Windows.

SQL Server 2017 includes many new Database Engine features, enhancements, and performance improvements:

- Resumable online index rebuild resumes an online index rebuild operation from where it stopped after a failure (such as a failover to a replica or insufficient disk space), or pauses and later resumes an online index rebuild operation.
- The IDENTITY_CACHE option for ALTER DATABASE SCOPED CONFIGURATION allows you to avoid gaps in the values of identity columns if a server restarts unexpectedly or fails over to a secondary server.

- A new generation of query processing improvements that will adapt optimization strategies to your application workload's runtime conditions. For this first version of the adaptive query processing feature family, we have three new improvements: batch mode adaptive joins, batch mode memory grant feedback, and interleaved execution for multi-statement table valued functions.
- Automatic database tuning provides insight into potential query performance problems, recommends solutions, and can automatically fix identified problems.

Microsoft SQL Server 2017 Standard Edition. This solution uses Standard Edition of SQL Server 2017. The Standard edition has scale limits listed below:

- Compute: Limited to lesser of 4 sockets or 24 cores
- Memory: Memory is limited to 128 GB the Intel® architectures.

This configuration features the following main components:

- Servers: 2x Lenovo ThinkSystem SN550
- Processor: Intel Xeon Platinum 4110 8C 2.1GHz
- Memory: 128 GB of TRUDDR4 memory
- Storage:
 - OS Storage: Two 300GB SAS 15K rpm internal HDDs for the operating system (RAID 1)
 - Lenovo ThinkSystem DS6200 with four 16Gb FC SFP ports
 - Twenty 3.84TB SSDs for data and tempdb (Raid 5)
 - Logging: Four 800 GB SAS SSDs for log (RAID 10)
- Software:
 - Microsoft Windows Server 2016 Standard Edition
 - Microsoft SQL Server 2017 Standard Edition

This OLTP solution with Microsoft SQL Server 2017 Standard Edition features the Lenovo ThinkSystem DS6200 storage

The ThinkSystem DS6200 offers connectivity choices and impressive storage capacities. Choose between 12Gb SAS, 8/16Gb Fibre Channel, or 1/10Gb iSCSI to integrate into your existing network. The DS6200 can hold up to 24x 2.5-inch HDDs and SSDs internally, and supports up to 240 drives total. Both large form factor and small form factor enclosures are supported in the same array and up to nine expansion units can be added to the DS6200 for greater capacity.



Lenovo ThinkSystem DS6200 storage array is engineered for small and medium businesses looking for great price for performance in a cost-effective design

Best practices for MS SQL OLTP solutions from Lenovo

For a balanced and optimized OLTP configuration:

- Update to latest firmware & driver levels on servers and all components
- Configure UEFI settings to set Operating mode to Maximum performance
- Configure high availability for the OS with 2-disk Raid-1
- Configure high availability for the log drive with 2-disk Raid-1 or Raid-10 with more disks based on performance needs
- Configure high availability for data files using Raid10 or Raid5 volumes based on capacity or performance needs
- Spread data and tempdb files evenly across all data drives for optimal performance
- Set the power plan in Windows to high performance: Control Panel > System & Security > Power Options > High Performance
- Enable lock pages in memory option using Windows Group policy tool to prevent paging of data.
- If the server is dedicated to current workload:
 - Set processor affinity for SQL Server to use all the processors in the system
 - Set SQL Server Maximum Server Memory to 90% of the total memory available on the server
- Optionally add -T834 to SQL Server Startup parameters to set the trace flag to enable large pages for SQL Server buffer pool.



Lenovo ThinkSystem Flex System chassis with ThinkSystem SN550 server and Lenovo ThinkSystem DS6200 Storage Array

Solution Benefits

- **Highly Available 20 TB SQL OLTP solution from Lenovo**
- **Balanced and optimized configuration**
- **Features Lenovo ThinkSystem DS6200 storage**
- **Pre-tested solution from Lenovo**
- **Reduced time to value**



Bill of materials		
Feature code	Description	Quantity
8721HC2	Chassis1 : Lenovo Flex System Enterprise Chassis w/CMM2	1
ASUS	Lenovo Flex System Enterprise Chassis w/ CMM2	1
A1EH	Lenovo Flex System FC5022 16Gb SAN Scalable Switch	1
A0UC	Flex System Enterprise Chassis 2500W Power Module Standard	2
6292	2m, 16A/100-250V, C19 to IEC 320-C20 Rack Power Cable	2
A1EP	Flex System FC5022 16Gb SAN Scalable Switch (Upgrade 1)	1
ASPT	Lenovo Flex System Chassis Management Module 2	1
5641PF3	Software1 : XClarity Pro for Chassis w/3 Yr SW S&S	1
1337	Per Managed Chassis with 3 year SW Subscription and Support XClarity Pro Chassis-3Y	1
7X16CTO1WW	Node1 : ThinkSystem SN550 - 3yr Warranty	2
AUXP	Lenovo ThinkSystem SN550 Server	2
AXQK	Intel Xeon Silver 4110 8C 85W 2.1GHz Processor	4
AUNB	ThinkSystem 16GB TruDDR4 2666 MHz (1Rx4 1.2V) RDIMM	32
AUYR	ThinkSystem RAID 530-4i 2 Drive Adapter Kit for SN550	2
5978	Select Storage devices - configured RAID	2
AUYN	Lenovo ThinkSystem Server Fabric Connector	2
AVCX	ThinkSystem Emulex LPm16004B-L Mezz 16Gb 4-Port Fibre Channel Adapter	2
A2K7	Primary Array - RAID 1	2
AULV	ThinkSystem 2.5" 300GB 15K SAS 12Gb Hot Swap 512n HDD	4
AV2U	Lenovo ThinkSystem Server Rear CPU Heatsink	2
AUY3	Lenovo ThinkSystem SN550 Server Air Baffle	2
AV2Q	Lenovo ThinkSystem SN550 Server WW packaging - Standard	2
AULQ	ThinkSystem 1U CPU Performance Heatsink	2
2302	RAID Configuration	2
B0ML	Feature Enable TPM on MB	2
7008	Primary Array 2 HDDs	2
AWAE	Microsoft SQL Server 2016 Standard 2 Core Additional License	2
AWAJ	SQL Svr Standard Edtn 2016 Downgrade to 2014 - English	2
AW9U	Microsoft SQL Server 2016 Standard 8 core - English	2
5731W16	Software2 : Windows Server 2016	2
V2N2BG	Per 2 Processor Server W2016StgSvStd ML NoPreinst	2
4619HC2	Storage1 : Lenovo ThinkSystem DS6200 SFF Chassis	1
AU32	Lenovo ThinkSystem DS6200 SFF Chassis	1
AUDH	Lenovo Storage 800GB 10DWD 2.5" SAS SSD	4
AVPA	Lenovo Storage 3.84TB 1DWD 2.5" SAS SSD (PM1633a)	20

HammerDB Configuration, Parameters and Performance

HammerDB Configuration and Parameters

HammerDB is an open source load testing and benchmarking tool for databases available at: <http://www.hammerdb.com/>. It offers workload tools for 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](http://www.tpc.org). A TPC-C workload was used to perform testing for this paper. Here are some details of the testing and results:

Database	MS SQL Server
Benchmark	TPC-C
# of Warehouses	800
# of Virtual users	56
Rampup time	10 minutes
Test duration	30 minutes
Virtual users	400
User delay	1 ms
Repeat delay	1 ms

HammerDB Test Performance

SQLIO – 8K 70/30 R/W	180,000 IOPs
TPM	3 million
SQL Svr batch requests/sec	50000
CPU utilization	0.65

Lenovo ThinkSystem SN550 Servers and DS6200 Storage Array for a high availability, high performance OLTP solution in a blade architecture

Powered by the Lenovo ThinkSystem SN550 Server and DS6200 Storage Array

This configuration with the Lenovo ThinkSystem SN550 server and DS6200 storage array yields 180,000 8K random IOPs with a read/write ratio of 70/30 and up to 50,000 batch requests per second tested using the Hammerdb TPC-C workload profile. By employing over 70TB of all-flash storage in the DS6200 storage array, this solution provides the required database performance for transactional database growth up to 20TB leaving enough room for tempdb, backup and other non-critical data. At the core of this solution is the Lenovo ThinkSystem SN550 server in blade form factor and ThinkSystem DS6200 Storage Array intended for mid-range businesses.

Connected with Lenovo Networking

Lenovo Flex System Ethernet and Fibre Channel switches provide unmatched scalability and performance to help address a number of networking concerns today and providing capabilities that will help you prepare for the future. For this solution the full range of Lenovo Flex System Ethernet switches may be utilized to connect the SN550 servers to the data center network. The Lenovo Flex System also features a broad range of Fibre Channel switches that may be utilized to connect ThinkSystem SN550 servers to the DS6200 storage array.



Why Lenovo

Lenovo is a leading provider of x86 servers for the data center. Featuring rack, tower, blade, dense and converged systems, the Lenovo server portfolio provides excellent performance, reliability and security. Lenovo also offers a full range of networking, storage, software, solutions, and comprehensive services supporting business needs throughout the IT lifecycle. With options for planning, deployment, and support, Lenovo offers expertise and services needed to deliver better service-level agreements and generate greater end-user satisfaction.

For More Information

To learn more about Lenovo Database Configuration for Microsoft SQL Server OLTP on Flex System with DS6200, contact your Lenovo Business Partner or visit: www.lenovo.com/systems/solutions

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