

# Lenovo Database Configuration for Microsoft SQL Server 2016 – 6TB

## Data Warehouse Fast Track Solution

### Data Warehouse problem and solution

The rapid growth of technology means that 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.

This Microsoft Data Warehouse Fast Track (DWFT) configuration for SQL Server 2016 improves time-to-value for data warehousing needs with a new scalable architecture. This solution in the Lenovo portfolio uses the cost-effective System x3550 M5 server combined with Micron M500DC Enterprise Value SATA solid-state drives (SSDs) to solve SQL database warehouse needs up to 6 TB in size.

The Microsoft Data Warehouse Fast Track (DWFT) program makes it easy to reduce costs, save time, and reduce risk with reliable, pretested hardware and best practices for data warehousing. This solution features the following highlights that help organizations to:

- Reduce time to value with pretested hardware configurations.
- Reduce hardware testing and reduce tuning immediately.
- Reduce total cost of ownership through better price and performance ratio, rapid deployment, and lower risk because of validation by Microsoft.
- Optimize performance with a pretested Lenovo System x3550 M5 high performance server configuration.
- Realize a low-cost storage solution with new Micron M500DC Enterprise Value SATA SSDs.

The configuration listed in this document has a Fast Track RowStore rating of I/O: 1,667 MBps and ColumnStore throughput: of 551 Queries/Hr/TB.

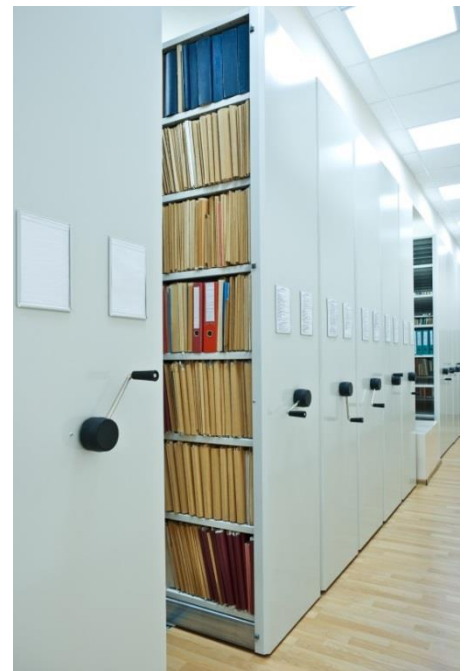
### Enterprise data warehouse with faster time-to-value

DWFT for SQL Server 2016 for System x 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.
- Build, tune, and deploy with confidence by using established data warehouse best practices.
- Select from different levels of performance, scalability, and price to suit your business needs.
- Choose from 4 to up to 120 Intel Xeon processor cores.
- Run targeted query workloads that are patterned for large sequential data sets rather than small random transactions.
- Eliminate bottlenecks with optimized rapid data reads and query aggregations

### HIGHLIGHTS

- Basic 6 TB SQL DWFT solution from Lenovo
- Balanced and optimized configuration
- Cost-effective Lenovo solution for DWFT
- Certified by Microsoft
- Reduced time to value



## CONFIGURATION BRIEF

### Lenovo Database Configuration for Microsoft SQL Server 2016 – 6TB



## Microsoft SQL Server 2016

Microsoft® SQL Server 2016 has made significant improvements in data warehousing technologies and performance, including column-store features as well as many other improvements. Column-store indices offer great advantages over traditional row stores for analytics and data warehousing queries. They are ideally suited for the star schemas, and tables with billions of rows which are commonly seen. Among their advantages for analytics are:

- **Up to 10X compression in data size** - Data warehouses are very large by nature, and the compression offered by column store index technologies offers both space and cost savings, but also significantly increased performance, due to the dramatically reduced IO requirements given by the compression, coupled by the ability to only scan the specific columns required by each query. Compression also reduces the amount of memory required to hold a given number of rows from the source data warehouse.
- **Additional Indices** - SQL Server 2016 adds the capability to add additional (B-Tree) indices to column store-based tables, which enables efficient single-row lookup.

In addition to these architectural features, query processing in column-store indices is further optimized in the following ways:

- **Operator Pushdown** - Pushdown refers to moving both filter and aggregation query operations closer to the data, so that many of the filters and calculations can be done in the scan operators, dramatically reducing the volume of data which needs to be handled further on in query processing.
- **Batch Mode Processing** - SQL Server 2016 includes enhancements in batch-mode processing which processes many rows at a time rather than serially doing calculations on each individual row. These batch operations are further optimized by leveraging Single Instruction Multiple Data (SIMD) vector processing CPU instructions in the Intel® architectures.

## Configuration tested and certified

This configuration features the following main components:

- Server: Lenovo System x3550 M5
- Processor: One E5-2630 v4 10C 2.2 GHz
- Memory: 128 GB of TruDDR4 Memory
- Storage: Six Micron M500DC 480 GB Enterprise Value SATA SSDs for data and tempdb
- OS Storage: Two 300 GB SAS HDDs for the operating system (RAID 1)
- Logging: Two Micron M500DC 480 GB Enterprise Value SATA SSDs for log (RAID 1)

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#### Powered by System x3550 M5 with cost effective Enterprise SATA SSDs

Lenovo System servers such as the System x3550 M5 server, features the latest Intel Xeon E5-2600 v4 series processors. With more cores and more memory, the new M5 family is fast. The greatly increased processing power is provided by the latest Intel Xeon E5-2600 v4 processors. Lenovo System x3550 M5 servers include the following features:

- Twice the memory capacity of previous generation processors, with 24 DIMM sockets in the x3550 M5.
- Support for 64 GB TruDDR4 Memory LRDIMMs, up to 1.5 TB of memory in the x3550 M5.
- New storage technologies, such as the Micron M500DC Enterprise Value SATA SSDs for Lenovo System servers which provide performance and reliability at low cost.

Micron's M500DC Enterprise Value SATA SSDs include the following features:

- Lower total cost of ownership (better performance, lower acquisition and ownership costs)
- Micron's XPERT feature set: Enhanced Performance, High Reliability & Quality, Optimized Endurance, and High Capacity
- Industry-standard Form Factors

DWFT for SQL Server 2016 features the Lenovo System x3550 M5 with eight 480 GB Enterprise Value SATA SSDs that provide reliability and performance at relatively low cost. These SATA SSDs in the Lenovo x3550 M5 simplify DWFT storage configuration and maintenance versus the use of a SAN, which features more parts to maintain and manage. The reference configuration is a 2-socket system that uses the DWFT V4 methodology.

#### Best practices for Data Warehouse Fast Track

For a balanced and optimized Data Warehouse configuration:

- Configure UEFI settings to set Memory mode to Independent.
- 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.
- Data files and tempdb can be on Raid 0 drives. Spread data and tempdb files evenly across all data drives for even performance.
- Configure more than one tempdb files; at least one file per data drive.
- Enable lock pages in memory option using Windows Group policy tool to prevent paging of data.
- If the server is dedicated to data warehousing,
  - 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.
  - Add –E and optionally –T834 to SQL Server Startup parameters.



Lenovo System x3550 M5 High Performance Rack Server with Micron M500DC solid-state drives



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### Reference Architecture Certification

DWFT Certification #2016-002	<b>Lenovo 6TB with System x3550 M5</b>		Report Date: 6/6/2016		
DWFT Rev. 5.4	DWFT Reference Architecture				
<b>System Provider</b>	<b>System Name</b>	<b>Processor Type</b>		<b>Memory</b>	
	Lenovo System x3550 M5	Intel Xeon E5-2630 v4 2.2 GHz (1/10/20)		128 GB	
<b>Operating System</b>			<b>SQL Server Edition</b>		
Windows Server 2012 R2			SQL Server 2016 Enterprise Edition		
<b>Storage Provider</b>	<b>Storage Information</b>				
	6x 480 GB Enterprise Value SATA 2.5" SSDs for data and tempdb 2x 300 GB SAS HDDs for OS (RAID 1) 2x 480 GB SSDs for log (RAID 1)				
<b>Primary Metrics</b>					
Rated User Data Capacity <sup>1</sup>	Row Store Relative Throughput <sup>2</sup>	Column Store Relative Throughput <sup>3</sup>	Maximum User Data Capacity <sup>1</sup>		
(TB)			(TB)		
6	57	85	9		
<b>Row Store</b>					
Relative Throughput <sup>2</sup>	Measured Throughput	Measured Scan Rate Physical	Measured Scan Rate Logical	Measured I/O Throughput	Measured CPU (Avg.)
	(Queries/Hr/TB)	(MB/Sec)	(MB/Sec)	(MB/Sec)	(%)
57	62	1,449	1,885	1,667	82
<b>Column Store</b>					
Relative Throughput <sup>2</sup>	Measured Throughput	Measured Scan Rate Physical	Measured Scan Rate Logical	Measured I/O Throughput	Measured CPU (Avg.)
	(Queries/Hr/TB)	(MB/Sec)	(MB/Sec)	(MB/Sec)	(%)
85	551	1,078	N/A	N/A	78
<p>The reference configuration is a 2 socket system rated for 25TB using SQL Server 2014 and the DWFT V4 methodology</p> <p><sup>1</sup>Assumes a data compression ratio of 5:1</p> <p><sup>2</sup> Percent ratio of the throughput to the row store throughput of the reference configuration.</p> <p><sup>3</sup>Percent ratio of the throughput to the column store throughput of the reference configuration.</p> <p>* Reported metrics are based on the qualification configuration which specifies database size and SQL Server memory.</p>					

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#### Bill of materials

Feature code	Description	Quantity
8869-AC1	6TBDWFT: Lenovo System x3550 M5	1
A5A0	Lenovo System x3550 M5 10x 2.5-inch HS HDD Kit	1
5977	Select Storage devices; no IBM configured RAID required	1
ATKR	Lenovo System x3550 M5 10x 2.5-inch Base Chassis	1
A5AX	Lenovo 550 W High Efficiency Platinum AC Power Supply	1
9206	No Preload Specify	1
ATCA	16 GB TruDDR4 Memory (2Rx4, 1.2 V) PC4-19200 CL17 2400 MHz LP RDIMM	8
ATL3	System Documentation and Software-US English	1
ATLW	Intel Xeon Processor E5-2630 v4 10C 2.2 GHz 25 MB Cache 2133 MHz 85 W	1
AT89	300 GB 10K 12 Gbps SAS 2.5" G3HS HDD	2
AT8T	480 GB SATA 2.5-inch MLC G3HS Enterprise Value SSD	8
6311	2.8 m, 10A/100-250V, C13 to IEC 320-C14 Rack Power Cable	1
A3YZ	ServerRAID M5210 SAS/SATA Controller	1
A5FW	Lenovo System Gen-II Universal Slides Kit	1
A5AW	Lenovo System x3550 M5 WW Packaging	1
A596	PSU BLANK	1
ARZ6	System Level code	1
A5AM	Rear PCI Filler	1
A599	Riser 2 Butterfly 2x LP Bracket	1
ATKT	Lenovo System x3550 M5 Planar	1
A59E	Lenovo System x3550 M5 Label GMB	1
A59B	Riser 1 LP Bracket	1
A59D	FAN FILLER	2
01GX-366	null : 3YR Tech Install Parts 24x7x4	1



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High Performance at low cost with  
Lenovo x3550 M5 servers and Micron  
M500DC solid-state drives



#### Why M500DC Enterprise Value SATA SSDs from Micron

The Micron M500DC Enterprise Value SATA SSD offers optimal performance and value, meeting the persistent demands of data center enterprise storage applications like Microsoft's SQL Server 2016 Data Warehouse. The M500DC strikes the perfect balance by offering outstanding random write performance, enhanced endurance, and robust features: All offered at a competitive price from Lenovo. Supporting a wide variety of Enterprise applications, the Micron M500DC Enterprise Value SATA SSD is available in industry-standard form factors and capacities up to 800 GB.

#### Why Lenovo System servers for Microsoft SQL DWFT

Lenovo offers a wide range of servers and options. The Lenovo reference configurations for DWFT for SQL Server bring together the right mix of technology and software. The configurations integrate the latest powerful Lenovo System rack and enterprise servers, robust Lenovo Storage options, and the data warehouse capabilities of SQL Server 2016 Enterprise Edition.

#### 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 the Lenovo Database Configuration for Microsoft SQL Server 2016 – 6TB solution, contact your Lenovo Business Partner or visit:

<http://shop.lenovo.com/us/en/systems/solutions/database/>



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