Vinay Kulkarni

Lenovo Servers: The Ideal Platform to Run Microsoft SQL Server

Lenovo® enterprise System x® servers provide customers with an ideal platform for Microsoft SQL Server. With industry leading performance, leading reliability, and a portfolio that spans the entire range of customer needs, Microsoft SQL customers can benefit greatly by running their workloads on Lenovo servers.

Lenovo has worked with Microsoft to create SQL solutions—such as those for data warehousing—which not only will accelerate deployment, but because they are balanced, pre-tested configurations, will also lower the risk and cost of any implementation. This paper describes those solutions.

Overview

Microsoft SQL Server is a key business application in many medium- to large-sized enterprise environments that host critical organizational data. The volume of this data continues to increase as the business keeps growing. Capitalizing on this ever-growing resource is a big challenge.

Enterprise leaders must continually invest in new technology to process these massive amounts of data. By optimizing performance at both the hardware and application levels, these leaders can take advantage of the relevant and deployable solutions that have become available. System x servers from Lenovo are available in varying scale and form factors to provide a reliable, flexible, and intelligent platform for Microsoft SQL Server that is backed by advanced and proven technology and features. These servers range from low footprint “Pizza Box” 1U x3550 M5 to the powerful 2U x3650 M5 all the way up to 4U and 8U x3850 X6 and x3950 X6 servers at the top end of the line.

System x solutions tackle the most complex Microsoft SQL Server environments. Lenovo has worked closely with Microsoft to ensure that organizations running Microsoft products on System x servers continually operate smoothly. System x servers are ideally-suited for data center environments that require flexible, cost-effective, secure, and energy-efficient hardware. System x Data Warehouse solutions are available from Lenovo for a wide range of

customer needs from a 5TB solution on x3550 M5 for a small business to 20TB solution on the x3650 M5 for a medium business and a 60TB solution on the x3850 X6 for large enterprises.

The innovative design features of Lenovo System x servers include various hard disk drive (HDD) and solid state drive (SSD) storage options, Flash PCIe adapters, both on-board and PCIe network options, innovative modularity, and more. These features make it possible for IT leaders to reduce their total cost of ownership (TCO) and decrease their time to value (TTV), as these solutions can meet data center needs today and provide flexible expansion capabilities in the future. The scalable hardware features and the unprecedented power and cooling capabilities of the System x servers help data center professionals to optimize hardware and power utilization, minimize cost, and simplify the overall management of data centers.

Microsoft SQL Server solutions from Lenovo

Technology has evolved rapidly in an attempt to keep pace with the massive volumes of data being generated every day. This means that the amount of data available and the ability to collect that data has increased to a level unthinkable as little as five years ago. As the volume and velocity of data have increased, the extraction of meaningful, actionable insight in a timely manner has also become more complex.

Microsoft Data Warehouse Fast Track (DWFT) for SQL Server 2014

The Microsoft Data Warehouse Fast Track (DWFT) for SQL Server 2014 Program is designed to reduce the time necessary for enterprise leaders to build configurations that solve data warehousing issues. Lenovo has teamed with Microsoft to create DWFT solutions for Microsoft SQL Server, using not only its enterprise servers, but also a variety of System x servers to cover a wide range of data warehouse sizes. These solutions are designed to help companies with a variety of data warehousing needs to rapidly deploy and implement data warehouse solutions.

The Microsoft Data Warehouse Fast Track program makes it easy for IT leaders to reduce cost, save time, and alleviate risk with reliable, pretested hardware and documented preferred practices for data warehousing.

These solutions help in delivering the following benefits:

- Improved time to value with pretested hardware configurations.
- Reduced hardware testing requirements and less need for immediate tuning.
- Reduced total cost of ownership, thanks to better price and performance, rapid deployment, and certified performance rating from Microsoft and Lenovo.
- Optimized performance with pretested System x hardware configurations.

Lenovo offers three DWFT solutions, as listed in Table 1.

Table 1 Summary of Lenovo solutions for SQL Server 2014 DWFT

Solution size	Server	CPU	Memory	Storage	Performance score and throughput
5 TB	System x3550 M5	Intel Xeon E5-2650 v3 10-core 2.3 GHz	96 GB	► 2x 300 GB HDD for OS ► 6x 480 GB SSD for data ► 2x 480 GB SSD for log	► RowStore: 1,677 MB/s ► ColumnStore: 633 Queries/Hr/TB
20 TB	System x3650 M5	Intel Xeon E5-2699 v3 18-core 2.3 GHz	384 GB	► 2x 300 GB HDD for OS ► 6x 1300 GB ioMemory3 PCIe Flash for data ► 4x 480 GB SSD for log	► RowStore: 5,990 MB/s ► ColumnStore: 1,691 Queries/Hr/TB
60 TB	System x3850 X6	Intel Xeon E7-4890 v2 15-core 2.3 GHz	1500 GB	► 2x 300 GB HDD for OS ► 8x 2.4TB High IOPs PCIe adapters for data ► 6x 400 GB SSD for log	► RowStore: 10,338 MB/s ► ColumnStore: 3,156 Queries/Hr/TB

For details about these three solutions, see these documents:

- *Solution Brief: Microsoft SQL Server 2014 Data Warehouse Fast Track on System x3550 M5 with Micron M500DC Enterprise Value SATA SSDs*

  http://lenovopress.com/redp5172

  This document describes a cost effective basic 5 TB solution on System x3550 M5 for small businesses with data warehouses expected to grow in size up to 5 TB in the next few years.

- *Solution Brief: Microsoft SQL Server 2014 Data Warehouse Fast Track on System x3650 M5*

  http://lenovopress.com/redp5156

  A 20 TB standard solution on System x3650 M5 for medium-sized to enterprise-level businesses with data warehouses expected to grow in size up to 20 TB in the coming years.

- *IBM System x solution for MS Data Warehouse Fast Track for SQL 2014 on X6 (Solution brief-USEN) (IBM branded)*

  http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=SP&htmlfid=XSS03150USEN&appname=TAB_2_2_Appname#loaded

  A 60 TB advanced solution on System x3850 X6 for large enterprises with data warehouses expected to grow in size up to 60 TB in the next five years.

The Microsoft in-memory OLTP feature in SQL Server 2014

Microsoft SQL Server 2014 makes it easier and more cost effective to build high-performance, mission-critical applications, enterprise-ready Big Data assets, and business intelligence solutions that assist you in making better decisions faster. These solutions have the flexibility of being deployed on-premises, in the cloud or in a hybrid environment; they can be managed through a common and familiar tool set.

Microsoft SQL Server 2014 accelerates reliable, mission-critical applications with a new in-memory online transaction processing (OLTP) engine that can deliver, on average, ten times, and up to 30 times, in transactional performance gains compared to disk-based databases.

Table 2 shows the in-memory performance improvement realized using the in-memory OLTP feature on a Lenovo System x3850 X6 server.

Table 2 In-memory performance improvements compared to disk-based

Workload/metrics	Disk-based database	In-memory database
CPU utilization	15%	58%
Batch requests/second	42,694	279,010

As shown in Table 2, the number of batch requests/second increased from 42,694 to 279,010: more than a 6-fold increase.

System x has a compelling OLTP solution for clients with large Microsoft SQL Server transactional workload demands: The 4-socket System x3850 X6, which supports up to 6 TB of internal system memory. Another, still larger member of the portfolio, the 8-socket System x3950 X6, supports even more: Up to 12 TB of internal system memory. Microsoft Windows Server and SQL Server currently only support a maximum of 4 TB.

The results presented in the paper OLTP Performance Unleashed with IBM System x3850 X6 and Microsoft SQL Server 2014 show that System x3850 X6, combined with SQL Server 2014, offer breakthrough performance benefits for mission-critical transactional workloads. The paper is available for download from the following web page:

http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=WH&infotype=SA&appname=STGE_XS_IN_USEN&htmlfid=XSW03153USEN&attachment=XSW03153USEN.PDF

X6 servers are the ideal platform for SQL Server consolidation

The 4-socket System x3850 X6 and 8-socket System x3950 X6 servers -- the sixth generation of Enterprise X- Architecture (EXA) and the high end of the System x portfolio -- are designed for *high throughput from processor to memory to I/O*, making them ideal for consolidating a large number of established, mature SQL Server workloads running on individual servers. In some cases, these older servers are underutilized, not capitalizing completely on valuable data center resources, such as space, power, or cooling.

In addition to the possibility of up to 8-sockets, System x3950 X6 servers feature up to 120 physical cores (and up to 240 logical processors) and up to 12 TB of available memory, making them an excellent choice for today's space- and power-constrained data centers. X6 servers enable optimal performance for enterprise applications including

- Mission-critical databases
- Enterprise virtualization
- Enterprise resource planning (ERP), and customer relationship management (CRM)
- Analytics environments

The System x3850 X6 packs numerous fault-tolerant and high-availability RAS features into a high-density, 4U modular system that is designed to be serviced from either the front or back of the unit. This innovative modular design significantly reduces the space required to support massive network computing operations. It also simplifies servicing and upgrades. The System x3850 X6 supports up to four Intel Xeon E7-4800/8800 v2 high-performance processors and up to 6 TB of memory.

The System x3950 X6 shares the unique innovative design found in the System x3850 X6. It supports up to eight Intel Xeon E7-8800 v2 high-performance processors and up to 12 TB of memory.

An ideal consolidation platform for enterprise environments, both X6 servers feature:

- An innovative modular *bookshelf* design that includes modules (or books) that slide in an out of the chassis. There is one type of module associated with each of the three major subsystems in the server, so X6 systems contain: Compute Books, Storage Books, and I/O Books. The X6 modular design enables users to create the configurations that best fit their application and environment needs, which reduces acquisition costs while providing the flexibility to grow and modify configurations later. X6 design also delivers another benefit: ease-of-use. Subsystem upgrades are simpler, quicker to perform, and less impactful on other server operations than ever before.
- Front and rear access, which means that IT leaders can easily scale the system up by adding components without removing the entire server from the rack.

To learn more about the bookshelf design and see it in action, watch the walk-through video on the X6 servers:

- System x3850 X6:

  https://www.youtube.com/watch?v=zgPdi4BefwE
- System x3950 X6:

  https://www.youtube.com/watch?v=hO_jHsCHC8w

Learn more about X6 servers with the Lenovo Press Product Guides:

- System x3850 X6:

  http://lenovopress.com/tips1250
- System x3950 X6:

  http://lenovopress.com/tips1251

Record breaking I/O performance throughput on System x3950 X6

System x3950 X6, populated with eight Intel Xeon E7-8870 v2 processors, has 120 physical cores. With Hyper-threading, the server has 240 logical processors. The server also comes with 192 memory DIMM slots for a maximum configuration of 12 TB memory.

When consolidating workloads on these X6 servers, there is ample processing capacity and more than enough memory capacity for enterprise-grade databases. The hardware supports 12 TB of memory, even though current Windows and SQL Server versions only support up to 4 TB memory. This extra capacity allows for investment protection once greater memory capacities are supported by software.

The one component often neglected when sizing for server and workload consolidation is I/O. This is the slowest component in the configuration and can result in wasted compute and memory resources. The System x3950 X6 solves this problem by offering io3 PCIe Flash Adapters.

A System x3950 X6 server, populated with 16, 6.4 TB io3 Enterprise Flash PCIe adapters, can deliver a large sequential I/O throughput of over 34 GB/second. Large Sequential I/O is the typical I/O profile of a data warehouse workload.

Figure 1 shows large sequential I/O throughput as measured by an Iometer tool available from http://www.iometer.org/. The test was run with 512 K read profile, using two managers and 32 workers with 32 outstanding IOs. Compare this to the System x3850 M2 server, which had a limitation of 3.5 GB/second total large sequential I/O bandwidth for an impressive nine-fold improvement.

Our configuration was as follows:

- System x3950 X6 server
- 8x Intel Xeon E7-8890 v2 2.3GHz processors
- 192x 16GB DDR3 memory DIMMs for a total memory of 3TB (384 GB per processor)
- 16x io3 6400GB Enterprise Value Flash PCIe adapters

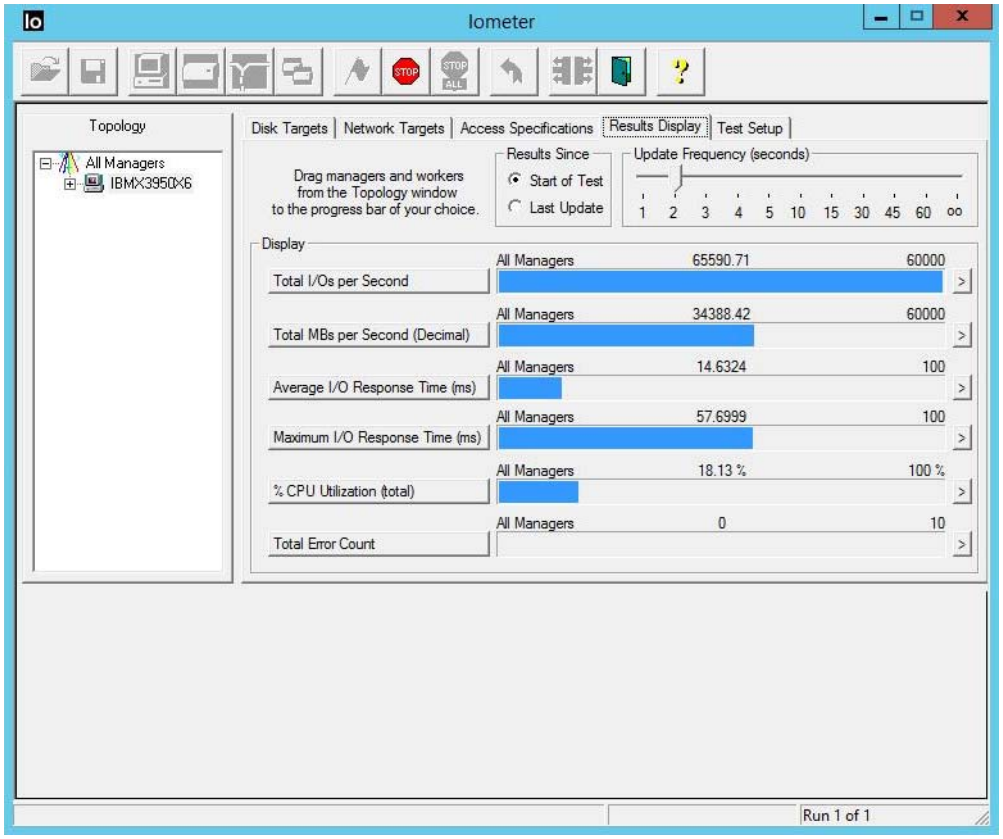

Figure 1 Record-breaking large sequential I/O read performance on the System x3950 X6, using the Iometer tool

System x M5 servers

System x M5 servers come in 1U and 2U form factors and are ideal for small and medium businesses that are looking for cost effective solutions.

System x3550 M5

Designed in a compact, versatile 1U two-socket rack server, the System x3550 M5 rack server fuels almost any workload from infrastructure to high-performance computing (HPC), to cloud or big data with leadership security, efficiency, and reliability. Integrated with up to two Intel Xeon processors from the E5-2600 v3 product family with faster, energy-efficient TruDDR4™ Memory, the System x3550 M5 delivers exceptional performance. Storage can include up to 12 drives in an impressive selection of sizes and types.

Learn more about the x3550 M5 with the Lenovo Press Product Guide:

http://lenovopress.com/tips1194

System x3650 M5

The powerful, versatile 2U two-socket System x3650 M5 rack server, allows IT managers to run even more workloads 24x7 and gain faster business insights. Integrated with the Intel Xeon processor E5-2600 v3 product family and industry-leading two-socket storage capacity, the System x3650 M5 is an excellent choice for high-performing databases. IT managers can select from an impressive array of storage configurations (up to 26 drive bays) that optimize diverse workloads from cloud to big data.

Learn more about the x3650 M5 with the Lenovo Press Product Guide:

http://lenovopress.com/tips1193

Summary

System x servers are an ideal platform for running SQL Server workloads. System x servers from Lenovo are available in varying scale and form factors to provide a reliable, flexible, and intelligent platform for Microsoft SQL Server that is backed by advanced and proven technology and features. Lenovo offers Microsoft SQL Server solutions on these servers ranging from 1U x3550 M5 to the powerful 2U x3650 M5 all the way up to 4U and 8U x3850 X6 and x3950 X6 servers at the top end of the line.

The low footprint and low cost of the System x M5 servers make them ideal for small and medium businesses. These servers based on Intel Xeon E5 v3 processors offer high performance in a small amount of rack space.

The superior performance of the X6 family servers with Intel Xeon E7 processors -- as well as the performance found in System x servers with E5 processors -- and the huge amount of memory, outstanding I/O and networking infrastructure, make System x platforms powerful enough to host the most demanding SQL Server workloads. With up to 240 cores and 12 TB of memory on the System x3850 X6 and System x3950 X6 servers, these systems are the ultimate platform for consolidating legacy SQL Servers and realizing significant savings in data center space, cooling, and power costs.

Learn about the entire portfolio of Lenovo industry standard servers

One server cannot meet the diverse needs of all customers. This is why Lenovo offers a full line of System x 1-, 2-, 4-, and 8-socket servers, ranging from value-priced single processor towers suitable for branch office and small departmental use, to powerful rack and tower units capable of handling most virtualization, cloud, and infrastructure workloads, to industry-leading 4- and 8-socket enterprise servers for the most demanding needs. Lenovo offers integrated Flex System™

Flex System

Flex System represents an entirely new generation of technology, with more performance and bandwidth, true integrated enterprise SAN storage, and far more capability to consolidate and virtualize than previous systems.

Businesses around the world have a timely opportunity to move forward beyond blade servers, transforming the data center by bringing together servers, networking, and storage, all under integrated management, with Flex System.

Businesses need an infrastructure solution with a flexible architecture to support today's demanding workloads, but also one designed to support multiple generations of future technologies. IT managers need simple, integrated management tools to keep operational costs down, and they require a no-compromise design with long-term investment protection.

Whether IT managers need to migrate an existing blade server infrastructure to simplify management and improve performance and flexibility, or to implement new workloads, a converged infrastructure such as Flex System can meet their needs.

ThinkServer

ThinkServer® systems, designed to be implemented rapidly without configuration, deliver exceptional value. ThinkServer combined with Windows Server 2012 and SQL Server 2014, provides the infrastructure needed for a wide variety of database workload requirements.

Lenovo ThinkServer systems running Intel Xeon E5 v3 processors and Microsoft Windows Server 2012 can increase performance up to five times when compared to platforms from 2007 running on Windows Server 2003.

Learn more about ThinkServer with the Lenovo Press Product Guides:

- ThinkServer RD650:

  http://lenovopress.com/tips1247

- ThinkServer RD550:

  http://lenovopress.com/tips1248

Resources

The following are useful references to supplement the information contained in this paper:

- OLTP Performance Unleashed with IBM System x3850 X6 and Microsoft SQL Server 2014

  http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=WH&infotype=SA&appname=STGE_XS_IN_USEN&htmlfid=XSW03153USEN&attachment=XSW03153USEN.PDF

- *Solution Brief: Microsoft SQL Server 2014 Data Warehouse Fast Track on System x3550 M5 with Micron M500DC Enterprise Value SATA SSDs*

  http://lenovopress.com/redp5172

- *Solution Brief: Microsoft SQL Server 2014 Data Warehouse Fast Track on System x3650 M5*

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- *IBM System x solution for MS Data Warehouse Fast Track for SQL 2014 on X6 (Solution brief-USEN) (IBM branded)*

  http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=SP&htmlfid=XSS03150USEN&appname=TAB_2_2_Appname#loaded

- Lenovo System x Solutions on Windows

  http://www.ibm.com/systems/x/os/windows/

About the Author

Vinay Kulkarni is a Lenovo System x performance and x86 solutions engineer working on-site at the Microsoft Redmond campus. He has over 15 years of experience in the industry. He has been working with Microsoft for over twelve years to optimize performance of System x servers running Microsoft Windows and SQL Server software. Vinay works closely with the Microsoft Windows and SQL Server performance teams to ensure good performance of IBM System x servers running software from Microsoft. He also works with IBM clients to tune the performance of System x and storage environments. He has published leading TPC-H benchmarks recently and works closely with System x marketing team to publish meaningful proof-points based on Microsoft Technologies. Vinay has been working with Microsoft to certify and publish SQL Data Warehouse Fast Track Reference Architectures for the past 5 years.

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