The rapid growth of technology means that the amount of data available 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, business in the 21st century is demanding the tools to derive true value from their data.

Microsoft Data Warehouse Fast Track (DWFT) for SQL Server 2014 on System x3650 M5 (see Figure 1) is a solution from Lenovo® that improves time-to-value for your data warehouse (DW) needs with new, scalable reference architecture for Microsoft SQL Server 2014 Enterprise Edition.

This standard solution uses the high-performance System x3650 M5 server that is combined with 1300 GB Enterprise io3 Flash Adapter Storage to solve the data warehouse needs of a 20 TB SQL Server database.
Microsoft Data Warehouse Fast Track 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:

- Improve time to value with pretested hardware configurations.
- Reduce hardware testing and reduce tuning immediately.
- Reduce total cost of ownership through better price and performance, rapid deployment, and advanced hardware.
- Optimize performance with pretested System x3650 M5 hardware configurations.
- Consolidate storage and match IT investment-to-information-value with System x® High IOPS MLC adapters.

The configuration that is listed in this document has the following Microsoft certified performance rating:

- Fast Track RowStore rated I/O: 5,990 MBps
- ColumnStore throughput: 1,961 Queries/Hr/TB

The specifications of the configuration and test results are shown in Figure 2 on page 4.

The Lenovo reference configurations for DWFT for SQL Server bring together the right mix of technology and software. The configurations integrate the latest powerful System x rack and enterprise servers, robust IBM System Storage, and the data warehouse capabilities of SQL Server 2014 Enterprise Edition.

Each offering, from Basic (4 TB data warehouse) to Standard (10-40 TB data warehouse) to Advanced (>40 TB data warehouse), consists of the following components:

- Pretested System x server and in-server flash storage configuration, which are specifically balanced and optimized for warehousing
- Microsoft SQL Server 2014 Enterprise Edition for a scalable enterprise data warehouse platform

Enterprise data warehouse with faster time-to-value

DWFT for SQL Server 2014 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 just 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 4 - 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.
Better data compression and query time

The clustered column store index (CCI) in SQL Server 2014 is designed for use with data warehouses to deliver better data compression and subsecond query response time, which enables interactive analytics on the data. There is no need to pre-aggregate the data for the anticipated queries or reports.

CCI offers the following performance benefits:

- CCI is optimized for query performance. It gives 10x better query response time and 7x higher compression ratio.
- CCI can be updated, which allows two types of concurrent insert of new data while the query workload is running. This capability reduces the data latency from the time data is born to when it is available for querying.
- By using CCI, SQL Server 2014 delivers industry-leading TPC-H benchmark numbers for data warehouse workloads.

Powered by System x3650 M5 and Enterprise io3 Flash Adapters

System x M5 servers feature the latest Intel Xeon E5-2600 v3 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 v3 processors.

System x M5 servers include the following features:

- Two times the memory capacity of previous generation processors, with 24 DIMM sockets in the x3650 M5.
- Support for 64 GB TruDDR4™ LRDIMM; you can have up to 1.5 TB of memory in the x3650 M5.
- New storage technologies, such as the IBM 1300 GB Enterprise io3 Flash Adapter for System x, which closely align the performance of storage with the power of the processors.

DWFT for SQL Server 2014 features the System x3650 M5 with six IBM 1300 GB Enterprise io3 Flash Adapters that improve productivity through data consolidation, availability, performance, and scalability. These solid-state adapters simplify DWFT storage configuration and maintenance versus the use of a SAN, which has more parts to maintain and manage. The reference configuration is a 2-socket system that is rated for 25 TB and uses the DWFT V4 methodology.

The configuration features the following components:

- IBM System x3650 M5
- Two E5-2699 v3 18C 2.3 GHz 45 MB 2133 MHz 145 W
- 384 GB of DDR4 memory
- Six IBM 1300 GB Enterprise io3 Flash Adapters for data and tempdb
- Two 300 GB SAS HDDs for the operating system (RAID 1)
- Two 480 GB SSDs for log (RAID 1)
Figure 2 shows the reference architecture certification.

<table>
<thead>
<tr>
<th>DWFT Certification #2014-009</th>
<th>20 TB with IBM System x3650 M5</th>
<th>Report Date 10/15/2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWFT Rev. 5.4</td>
<td>DWFT Reference Architecture</td>
<td></td>
</tr>
</tbody>
</table>

**System Provider**

<table>
<thead>
<tr>
<th>System Name</th>
<th>Processor Type</th>
<th>Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM System x3650 M5</td>
<td>Intel Xeon E5-2699 v3 2.3 GHz (2/36/72)</td>
<td>384 GB</td>
</tr>
</tbody>
</table>

**Operating System**

<table>
<thead>
<tr>
<th>SQL Server Edition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows Server 2012 R2</td>
</tr>
<tr>
<td>SQL Server 2014 Enterprise Edition</td>
</tr>
</tbody>
</table>

**Storage Provider**

<table>
<thead>
<tr>
<th>Storage Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>6x 1300 GB Enterprise io3 Flash Adapters for data and tempdb</td>
</tr>
<tr>
<td>2x 300 GB SAS HDDs for OS (RAID 1)</td>
</tr>
<tr>
<td>2 x 480GB SSDs for log (RAID 1)</td>
</tr>
</tbody>
</table>

**Primary Metrics**

<table>
<thead>
<tr>
<th>Rated User Data Capacity (TB)</th>
<th>Row Store Relative Throughput (Queries/Hr/TB)</th>
<th>Measured Scan Rate Physical (MB/Sec)</th>
<th>Measured Scan Rate Logical (MB/Sec)</th>
<th>Measured I/O Throughput (MB/Sec)</th>
<th>Measured CPU (Avg.) (%)</th>
</tr>
</thead>
<tbody>
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<td>7,021</td>
<td>5,990</td>
<td>86</td>
</tr>
<tr>
<td>302</td>
<td>1,961</td>
<td>2,532</td>
<td>N/A</td>
<td>N/A</td>
<td>98</td>
</tr>
</tbody>
</table>

The reference configuration is a 2 socket system rated for 25TB using the DWFT V4 methodology

1 Assumes a data compression ratio of 5:1

2 Percent ratio of the throughput to the row store throughput of the reference configuration.

3 Percent ratio of the throughput to the column store throughput of the reference configuration.

Reported metrics are based on the qualification configuration which specifies database size and SQL Server memory.
Why System x from Lenovo for Microsoft SQL DWFT?

Lenovo offers a wide range of System x 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 System x rack and enterprise servers, robust Lenovo Storage options, and the data warehouse capabilities of SQL Server 2014 Enterprise Edition.

More information

For more information about the configuration that is described in this Solution Brief, contact Vinay Kulkarni at vkulkarni@lenovo.com and refer to solution reference number BDASQLRM43.

For more information about the System x3650 M5, see the following resources:

- System x3650 M5 product page: http://ibm.com/systems/x/hardware/rack/x3650m5

About the Author

Vinay Kulkarni is a Lenovo System x performance and x86 solutions engineer who works onsite at the Microsoft Redmond campus. He has over 15 years of experience in the industry. He has worked with Microsoft for over 12 years to optimize performance of System x servers that are 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 that are running software from Microsoft. He also works with IBM clients to tune the performance of System x and storage environments. He recently published leading TPC-H benchmarks and works closely with the System x marketing team to publish meaningful proof-points that are based on Microsoft Technologies. Vinay has worked with Microsoft to certify and publish SQL Data Warehouse Fast Track Reference Architectures for the past five years.

Thanks to the following people for their contributions to this project:

- Sadashivan Krishnamurthy, Principal Architect, Microsoft
- Jarupat Jisarajito, Software Engineer, Microsoft
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