

Lenovo X6 Servers Shatter Industry Performance Records

System x X6 servers continue a history of industry-leading performance innovations

Executive Overview

Since the introduction of enterprise X-Architecture (EXA) in 2001, Lenovo's System x¹ EXA servers have led the industry in performance, achieving dozens of world record results. These records span the breadth of workload types, from data warehousing and online transaction processing to virtualization, decision-support, and more.

When the sixth generation of EXA (X6) debuted in January 2014, the trend of setting new world records continued, with eight more #1 results in 2014 and early 2015, for TPC-E², TPC-H³, SPECvirt_sc2013⁴, 2-tier SAP SD⁵, and SAP BW-EML⁶—some of them for both 4-socket and 8-socket performance.

Now, incorporating the new Intel Xeon E7 v3 series of processors (codenamed Haswell), System x X6 servers have shattered even more 4-processor performance world records:

- **TPC-E⁷** — Measures online transaction processing (OLTP) performance. The Lenovo System x3850 X6 achieved a score of 6964.75 tpsE, **24%** faster than the previous record.
- **TPC-H⁸ @ 3000GB** — A decision-support benchmark designed to have industry-wide relevance. The System x3850 X6 scored 700,392.4 Queries per hour H (QphH) @ 3000GB, at a price of \$0.99 USD/QphH @ 3000GB, **51%** faster than the previous record.
- **SPECvirt_sc2013⁹** — Measures the performance of the hardware, software, and application layers in a virtualized environment. The System x3850 X6 scored 2655 @ 147 VMs, **27%** faster than the previous record.
- **2-tier SAP SD (running Windows)¹⁰** — Measures the maximum number of supported users satisfying a specified average dialog response time in an SAP Sales and Distribution environment. The x3850 X6 achieved 30,501 SAP SD benchmark users, **22%** faster than the previous record.¹¹
- **SAP BW-EML scale-out @ 1 billion records¹²** — Measures real-time database and ad-hoc reporting capabilities of data warehouses. The x3850 X6 achieved 1,992,570 nav steps/hr @ 1 billion records, **29%** faster than the previous record.
- **SAP BW-EML scale-out @ 10 billion records¹³** — Measures real-time database and ad-hoc reporting capabilities of data warehouses. The x3850 X6 achieved 269,960 nav steps/hr @ 10 billion records, the first server ever to use 10 billion initial records.
- **ANSYS Fluent x86 R16¹⁴** — Fluent software provides the physical modeling capabilities needed to model flow, turbulence, heat transfer, and reactions for a wide range of industrial applications. The System x3850 X6 achieved the highest performance rate ever for a single x86 server on the fluidized_bed_2m benchmark with a score of 4035.5, **19%** faster than a similarly configured previous-generation system baselined by Intel. (New benchmark; no previous R16 record.)

These results prove that X6 servers continue to be the premiere performance servers across a wide range of workloads, encompassing both rack and converged infrastructure/blade form factors. So what innovations set these servers apart from all the other servers using similar processors, memory, and storage? Several notable Lenovo exclusives:

- **eXFlash DIMMs** — Memory slots in X6 servers equipped with DDR3 memory can be used for eXFlash memory-channel storage. Connecting flash storage directly to the memory bus via DIMM slots eliminates arbitration and data contention on the I/O hub, so data access is nearly instantaneous. With up to 12.8TB of eXFlash DIMM storage in 32 DIMM slots (system-specific), *each* 400GB eXFlash DIMM can produce 140,000 4KB random read operations with up to 636MBps data transfer rate.¹⁵ This makes it ideal for either high-speed data caching or in-memory database storage.
- **eXFlash SSD storage** — eXFlash SSD storage addresses the ever-growing demand for I/O by offering tremendous storage density, reliability, energy savings, and prodigious IOPS (I/O operations per second) throughput. By combining eight 1.8-inch solid-state drives (1.6TB total) with an SSD-optimized controller housed in a modular eXFlash pack, eXFlash offers significantly higher IOPS performance than enterprise HDDs (or even standard SSDs) for I/O-intensive applications like databases and business analytics, with up to 240,000 random read IOPS and 2GBps of sustained read throughput per pack. (One, two, or four packs are supported per server; model-specific.) eXFlash DIMMs and eXFlash SSD storage can be combined for even more flash storage and performance.
- **3.84TB 6Gb SAS Enterprise Capacity SSDs** — We all know how much faster SSD storage is than HDDs. Until now capacity and cost were limiting factors. But with this new generation of SSDs, superior performance and huge capacity combine to drive OpEx and CapEx costs down and performance up, by potentially replacing hundreds or thousands of HDDs with a handful of SSDs. Just one of these new SSDs in an x3850 X6 or x3950 X6 can replace thirteen 300GB 15K

SAS drives for capacity, with far greater performance.¹⁶ The x3850 X6 and x3950 X6 support up to 8 or 16 of these drives, respectively.

World-Class Performance Starts with World-Class Hardware

Performance only helps when the server is up and running. Fortunately, System x servers from Lenovo also provide the quality and reliability your solutions demand:

- System x servers (including Flex System) are **#1** in x86 reliability, according to the latest ITIC survey¹⁷
- System x servers are **#1** in customer satisfaction overall for the 13th quarter out of the last 15 (including **#1** in Product Satisfaction, **#1** in Service Satisfaction, and **#1** in Sales Responsiveness), according to the latest TBR survey.¹⁸ In fact, System x servers were outright **#1** in 7 of the 12 categories, and tied for **#1** in the other 5.

X6 Servers

Introducing the X6 servers:

The 4-socket-capable 4U **System x3850 X6** server (center image, at right) uses a modular “book” design that lets you slide resources in and out of the front or back of the system like books on a shelf. Each Compute Book contains one Intel Xeon E7 v3 series processor and 24 DIMM slots. The x3850 X6 supports up to four Compute Books (two standard) with 6TB of memory in 96 DIMM slots (either DDR3 or DDR4 slots, depending on the Compute Book ordered). In addition, up to *three* I/O Books are supported, with up to nine PCIe Gen 3 adapter slots and a mezzanine slot for a NIC. And the Storage Book supports either 2.5-inch hot-swap HDDs or SSDs, or 1.8-inch hot-swap eXFlash SSDs, and two RAID adapters. In addition, some Compute Books support up to eight eXFlash DIMMs (in place of memory DIMMs) for lightning-fast storage (up to 12.8TB with four Compute Books).



The x3850 X6 allows you to start small to keep your entry costs low, with only two Compute Books, one I/O Book, and the Storage Book, and then add more Compute and I/O Books later, as your needs and budget dictate. In all, the x3850 X6 supports up to 11 high-performance PCIe slots (plus the mezzanine slot), and either 9.6TB of HDD storage or 30.7TB of SSD storage, plus 12.8TB of eXFlash DIMMs. Compute Books and I/O books can be swapped from one system to another. And when a newer (faster) generation of processor and memory technology becomes available, Compute Books can be replaced with newer ones instead of having to replace the entire system.¹⁹

The 8-socket-capable 8U **x3950 X6** server (right image, above) is similar to the x3850 X6, but with double nearly all the system resources (including Compute Books, I/O Books, Storage Books, PSUs, and fans). It supports 8 Compute Books containing 8 processors, 192 DIMM slots (up to 12TB of memory), 22 PCIe slots (plus two mezzanine NIC slots), and up to either 19.2TB (HDDs) or 61.4TB (SSDs) of drive-bay storage, plus 12.8TB of eXFlash DIMM storage—enough for the toughest workloads.

The 4-socket **Flex System x480 X6** Compute Node (left image, above) starts as a 2-socket full-width blade server (node) that supports two Xeon E7-4800 v3 series processors and 48 DIMM slots, for up to 3TB of DDR3 memory. The x480 X6 can then be scaled up to *two* compute nodes, doubling the system resources available to a single system image. This means four sockets and 6TB of memory in 96 DIMM slots—just like the x3850 X6, but in a smaller package. The 2-node x480 X6 also supports four hot-swap HDDs or SSDs, or 16 high-IOPS eXFlash SSDs, *plus* up to 24 eXFlash DIMMs (in standard memory DIMM slots). If you find that you need more power than this, the **Flex System x880 X6**, the industry’s only 8-socket Xeon processor-based blade server, offers double the resources of the x480 X6. It, too, starts as a single node and can grow to two or four nodes. (A 2-socket-only version, the x280 X6, is also available. It’s similar to the single-node x480 X6, but uses E7-4800 v2 processors.)

Summary

If your organization needs heavy-duty workload-crushing power for any of a wide range of jobs, X6 servers from Lenovo are your best bet. They’re the fastest at OLTP, decision support, virtualization, data warehousing, physical modeling, and more. Plus, they’re the most reliable x86 servers, and with the highest customer satisfaction in the industry.

For more information about Lenovo X6 servers contact your Lenovo representative, an authorized Lenovo Business Partner, or go to <http://shop.lenovo.com/us/en/systems/servers/mission-critical>.



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- ¹ Lenovo acquired the full line of System x servers from IBM in October 2014.
- ² #1 TPC-E as of 2/16/14 (**4P x3850 X6**) and again as of 11/25/14 (**8P x3950 X6**). See <http://www.tpc.org/4067> and <http://www.tpc.org/4071> for details. Result published on 2/16/14 was before Lenovo completed the purchase of System x from IBM.
- ³ #1 @1,000GB non-clustered TPC-H as of April 15, 2014 (**4P x3850 X6**) and #1 @10,000GB non-clustered TPC-H as of April 6, 2015 (**8P x3950 X6**). See <http://www.tpc.org/3299> and <http://www.tpc.org/3312> for details. Result published on April 15, 2014 was before Lenovo completed the purchase of System x from IBM.
- ⁴ #1 4P SPECvirt_sc2013 as of February 18, 2014. The x3850 X6 scored 2081 @ 116 VMs. Result available at http://www.spec.org/virt_sc2013/results/specvirt_sc2013_perf.html.
- ⁵ #1 **4P** 2-tier SAP SD (Windows). The **x3850 X6** achieved 25,000 SAP SD benchmark users with 0.98 seconds average dialog response time. The SAP certification number is 2014004. Results published on February 18, 2014. #1 **8P** 2-tier SAP SD. The **x3950 X6** achieved 49,000 SAP SD benchmark users with 0.85 seconds average dialog response time. The SAP certification number is 2014024. Results published on June 16, 2014. All SAP benchmark details can be found at www.sap.com/benchmark.
- ⁶ #1 4P @ scale-out 1 billion records. The x3850 X6 netted a record load of 1,542,060 ad-hoc navigation steps on 1 billion rows of input data. The SAP certification number is 2015007. Results published on March 16, 2015. Results can be found at www.sap.com/benchmark.
- ⁷ #1 4P TPC-E as of May 5, 2015. See <http://www.tpc.org/4072>. Availability: July 31, 2015. Details of the previous best 4P TPC-E performance result can be found at <http://www.tpc.org/4067>.
- ⁸ #1 @3000GB non-clustered TPC-H as of May 5, 2015. Also, #1 price/performance @3000GB non-clustered TPC-H as of May 5, 2015. See <http://www.tpc.org/3313>. Availability: May 26, 2015. Details of the previous best TPC-H @3000GB non-clustered performance result can be found at <http://www.tpc.org/3297>.
- ⁹ #1 4P SPECvirt_sc2013 as of May 5, 2015. Result summary available at http://www.spec.org/virt_sc2013/results/res2015q2/virt_sc2013-20150430-00025-perf.html. Availability: May 26, 2015. Previous record result available at http://www.spec.org/virt_sc2013/results/res2014q4/virt_sc2013-20140929-00018-perf.html.
- ¹⁰ #1 4P 2-tier SAP SD (Windows). Results published on May 5, 2015. The SAP certification number is 2015010. Results can be found at www.sap.com/benchmark. For previous record results, see Footnote 5, above.
- ¹¹ All SAP 2-tier SD benchmarks were run on Windows Server, IBM DB2 10 and SAP enhancement package 5 for SAP ERP 6.0. All SAP BW-EML benchmarks were run on SUSE Linux Enterprise Server 11, SAP HANA 1.0 and SAP NetWeaver 7.40. For previous record results, see Footnote 6, above.
- ¹² #1 4P scale-out @ 1 billion records. Results published on May 5, 2015. The SAP certification number is 2015011. Results can be found at www.sap.com/benchmark.
- ¹³ #1 4P scale-out @ 10 billion records. Results published on May 5, 2015. The SAP certification number is 2015018. Results can be found at www.sap.com/benchmark.
- ¹⁴ #1 4P Fluent x86 R16 single-server result as of May 5, 2015. Using Lenovo System x3850 X6 with four Xeon E7-8890 v3 processors (2.5GHz, 72 cores, 144 threads), 512GB TruDDR4 memory, and one 400GB SAS HDD, running RHEL 6.6; compared to a similarly configured system baselined by Intel, with four Intel Xeon E7-4890 v2 processors (2.8 GHz, 60 cores, 120 threads) and 512GB DDR3, running RHEL 6.4. Availability: July 31, 2015.
- ¹⁵ 140K IOPS for 4K random read operations; 65K IOPS for 4K random writes. 636MBps sustained for 64K sequential read operations; 515MBps for sequential writes.
- ¹⁶ Read perf.: 14.32 IOPS/GB (SSD) vs. 1.28 IOPS/GB (HDD); Write perf.: 2.6 IOPS/GB (SSD) vs. 1.28 IOPS/GB (HDD); Mixed (60/40) perf: 9.64 IOPS/GB (SSD) vs. 1.28 IOPS/GB (HDD).
- ¹⁷ ITIC 2014-2015 Reliability Survey, May 2014; <http://public.dhe.ibm.com/common/ssi/ecm/en/xsl03126usen/XSL03126USEN.PDF>.
- ¹⁸ TBR Customer Satisfaction Survey, January 2015; http://www.lenovo.com/images/products/server/pdfs/whitepapers/systemx_top_customer_service.pdf.
- ¹⁹ In both scenarios, swapping and upgrading, all Compute Books in a system must use matching processor and memory technology.