



# High Performance Microsoft SQL Server Solution with Lenovo System x Servers, VMware All-Flash Virtual SAN and SanDisk Enterprise SSDs

All of us are facing significant storage issues. According to a survey by IDC, the top three pain points of IT professionals are: meeting business Service Level Agreements (SLAs), troubleshooting storage issues, and limited budget increases to address those storage issues.<sup>1</sup> Meanwhile, demand for storage capacity is growing dramatically, and is expected to grow at 40% per year over the next two years.<sup>2</sup>

These facts lead to a number of storage management challenges including: the need to meet SLAs in the face of massive growth in both applications and storage demand, the need to be more agile with storage provisioning, and the need to reduce storage complexity.

VMware Virtual SAN was designed to help customers address these challenges by being simple to configure and manage while being highly cost-effective, enabling customers to cut their storage CAPEX costs by up to 50%.<sup>3</sup>

## All-Flash Virtual SAN

VMware Virtual SAN 6 was also designed to enable customers to achieve predictable, high performance with an all-flash configuration – that is, flash for caching as well as for primary storage capacity. In this solution, SanDisk's high performance, high endurance Optimus Ascend™ SSD is used for caching and SanDisk's 4TB\* Optimus MAX™ - that is certified for Virtual SAN 6 - is used for storage capacity. By combining Lenovo's powerful and versatile 2U two-socket System x3650 M5 servers with SanDisk SSDs and VMware all-flash Virtual SAN, organizations can now deploy an all-flash solution at a much lower cost than a traditional all-flash storage array. The consistent high performance of this all-flash Virtual SAN design is a compelling choice for running business-critical applications and databases at a lower cost basis compared to a traditional all-flash storage array.

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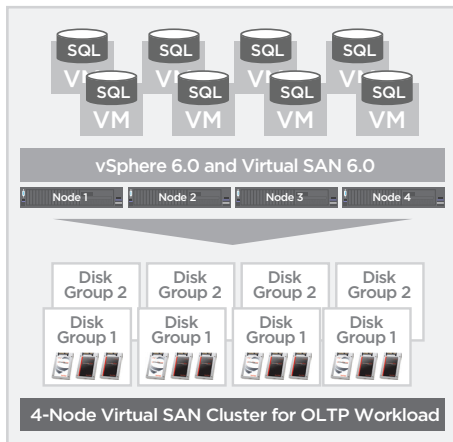
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## Performance and Scalability

High performance is key to executing business-critical applications successfully, but equally as important to business success is consistency of performance. The all-flash Virtual SAN running on Lenovo servers with SanDisk SSDs showcases excellent performance with high consistency. To measure performance, the HammerDB performance tuning and benchmarking tool was used to run a 5000 Warehouse workload on each VM in this 4-node configuration with SQL Server Database. This system delivered 14.1 million transactions per minute (TPM) and 3.08 million New Orders per Minute (NOPMs) using 8 VMs executing Microsoft SQL Server Standard Edition.

VM Name	HammerDB TPM	HammerDB NOPM
SQL Instance - 1	1,735,133	377,315
SQL Instance - 2	1,755,455	381,685
SQL Instance - 3	1,708,467	371,452
SQL Instance - 4	1,702,747	370,169
SQL Instance - 5	1,906,503	427,555
SQL Instance - 6	1,787,288	389,258
SQL Instance - 7	1,794,507	390,157
SQL Instance - 8	1,707,570	371,057
<b>Total</b>	<b>14,097,670</b>	<b>3,078,648</b>



The configuration used for the performance test is summarized below.

- Lenovo System x3650 M5 with E5-2650v3 processors and 384 GB system memory and M5210 RAID controller
- Two Virtual SAN disk groups each with:
  - Caching: One Optimus Ascend SAS SSD (800 GB)
  - Capacity: Two Optimus MAX SAS SSD (3.84 TB)
- Two VMs per server with 16 vCPUs and 96 GB of memory running two instances of DB server
- Ten disk files @ 1150 GB total for each VM
  - 120 GB for Windows 2012 R2
  - 1030 GB for SQL Server
- vSphere™ 6.0 Enterprise with Virtual SAN 6.0
- Windows Server 2012 R2 Standard Edition
- SQL Server 2014 Standard Edition

## Conclusion

The combination of VMware Virtual SAN 6.0 with Lenovo System x M5 servers, Optimus Ascend and Optimus MAX SSDs provides an all-flash shared storage solution which is integrated into the productive and well-understood vSphere environment. All-flash virtual SAN offers an alternative high-performance, shared storage solution without the need to buy an expensive purpose-built, all-flash array that may also require a complex storage network.

As shown in this solution brief with 5000 Warehouse workload, this all-flash storage configuration can deliver the predictable, high performance of flash storage at a much lower cost than traditional flash-based storage arrays and provides a very capable and suitable alternative for running business critical applications and databases.

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\* 1TB = 1,000,000,000,000 bytes. Actual user capacity less.

<sup>1</sup> Source: IDC, Storage Predictions 2014, January 2014, General Storage QuickPoll, #243511, n=307

<sup>2</sup> Source: IDC, Yezhkova, Worldwide Enterprise Storage Systems Forecast, November 2013, #244293

<sup>3</sup> VMware Virtual SAN 6.0 Datasheet

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