Evaluation of EMC VNX8000 and EMC XtremSW Cache

Evaluation report prepared under contract with EMC

Introduction

As enterprises consider the ever-growing demands for improved performance and lower latency of mission-critical applications, IT organizations are turning to the undeniable advantages provided by flash-based storage solutions. Flash-based storage solutions are maturing, providing greater performance and supporting larger numbers of host servers than ever before.

While adding SSD technology in one place in the infrastructure greatly improves performance, adding SSD technology in two places in the infrastructure, such as in the server and in the storage system, can provide additional benefits.

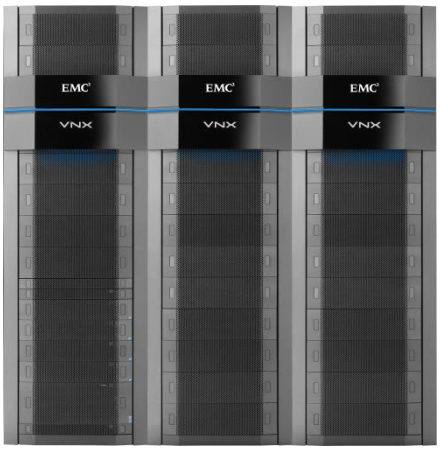
Combined with SSD technology in the array and in the server, the newest generation of EMC VNX Series provides a more robust solution and supports larger total workloads than ever before. EMC commissioned Demartek to evaluate the performance of its VNX8000 storage system with MCx (multi-core optimization) and SSD technology as primary storage, along with its server-side flash software EMC XtremSW Cache. This evaluation included these combinations of solutions.

- The EMC VNX8000 with SSDs as primary storage
- The EMC VNX8000 combined with XtremSW Cache

Executive Summary and Key Findings

The new EMC solutions provided outstanding performance in terms of database performance and reduced latency in both the primary storage SSD configuration and in the server-side caching configurations tested. These solutions provide this performance while maintaining the advanced features and support that enterprise IT organizations expect from a top-tier independent storage vendor.

EMC VNX8000 Storage System



The new EMC VNX8000 and the other members of the new generation of VNX storage systems have been re-architected with MCx to take full advantage of multi-core processors in the storage system, spreading the workload across all the cores evenly, and use the latest generation PCIe 3.0 bus architecture. This results in storage systems that support heavy mixed virtualized workloads found in large IT datacenters.

- The VNX8000 with SSDs deployed as primary storage achieved more than 730,000 IOPS in a heavily consolidated Microsoft SQL Server and Oracle Database environment.
- The VNX8000 configuration used 32 of its total 40 8Gb Fibre Channel host ports in our test configuration.

EMC XtremSW Cache

EMC XtremSW Cache (with EMC XtremSF PCIe flash card) provided an additional boost to application performance while offloading work from the VNX8000.

- The addition of XtremSW Cache deployed to the SQL Server servers (half of our test servers) provided a total of more than 950,000 total IOPS, an increase of 30% over the same configuration without XtremSW Cache.
- XtremSW Cache reduced the storage processor utilization from 98% without XtremSW Cache to 84% with XtremSW Cache while providing the increased IOPS performance noted above.
- SQL Server average transaction latency was reduced from 1.26 milliseconds (1260 microseconds) without XtremSW Cache to 0.44 milliseconds (440 µs) with XtremSW Cache deployed in the SQL Server hosts – a 65% improvement.

Test Configuration and Procedures

Several tests were conducted, and run separately and concurrently.

- Microsoft SQL Server online transaction processing (OLTP) workload
- Oracle Database online transaction processing (OLTP) workload
- Oracle Database data warehousing (DW) workload
- Combined SQL Server OLTP and Oracle OLTP workload
- Combined SQL Server OLTP and Oracle DW workload
- Combined SQL Server OLTP and Oracle OLTP workload with XtremSW Cache deployed on the SQL Server hosts
- Combined SQL Server OLTP and Oracle DW workload with XtremSW Cache deployed on the SQL Server hosts

Eight servers were configured with the Microsoft SQL Server workload.

- 8x Dell PowerEdge R710, 2x Intel Xeon X5670, 12 total cores, 2.93 GHz, 96 GB RAM
- EMC XtremSW Cache (with EMC XtremSF PCIe flash card)
- Emulex LPe16002B 16GFC HBA, dual port
- Microsoft Windows Server 2008 R2
- Microsoft SQL Server 2012

Eight servers were configured with the Oracle Database workload.

- 8x Dell PowerEdge R710, 2x Intel® Xeon X5670, 12 total cores, 2.93 GHz, 96 GB RAM
- Emulex LPe16002B 16GFC HBA, dual port
- VMware vSphere 5.1
- Guest O.S.: RedHat Enterprise Linux (RHEL) 6.4
- Oracle 11.2.0.3

The EMC VNX8000 included a combination of SSDs and HDDs.

- 96x 100 GB SLC SSD (for hosting the database data & indexes)
- 130x 600 GB 10K RPM SAS HDD (for hosting VM infrastructure, database log & temp)
- 32x 8Gb Fibre Channel host ports

Each of the 16 application servers were connected via the dual-port Emulex 16Gb Fibre Channel HBAs to two EMC Connectrix® B-Series (model DS-6510B) 16Gb Fibre Channel

switches. The EMC VNX8000 was connected via 32 of its 8Gb Fibre Channel host ports to both of the 16Gb Fibre Channel switches, with 16 ports per switch.

EMC Connectrix B-Series Fibre Channel switches provides connectivity for mission-critical workloads and highly virtualized environments. Based on years of successful deployment in enterprise data centers around the globe, Connectrix B-Series Fibre Channel SANs provides highly resilient, scalable, and simplified network infrastructure for storage.

The Connectrix B- 6500 series Fibre Channel switches enables networking solutions for flash storage, delivering better performance, infrastructure scalability, and availability. They combine low latency and high IOPS to maximize application performance with flash storage. Greater performance enables the deployment of more servers, desktops, and OLTP workloads without sacrificing reliability in the software defined data center.

Database Workloads

The database workload used in each of the eight SQL Server hosts consisted of an online brokerage application running on SQL Server. The database workloads used for the eight Oracle Database hosts included an online transaction processing application and a data warehousing application.

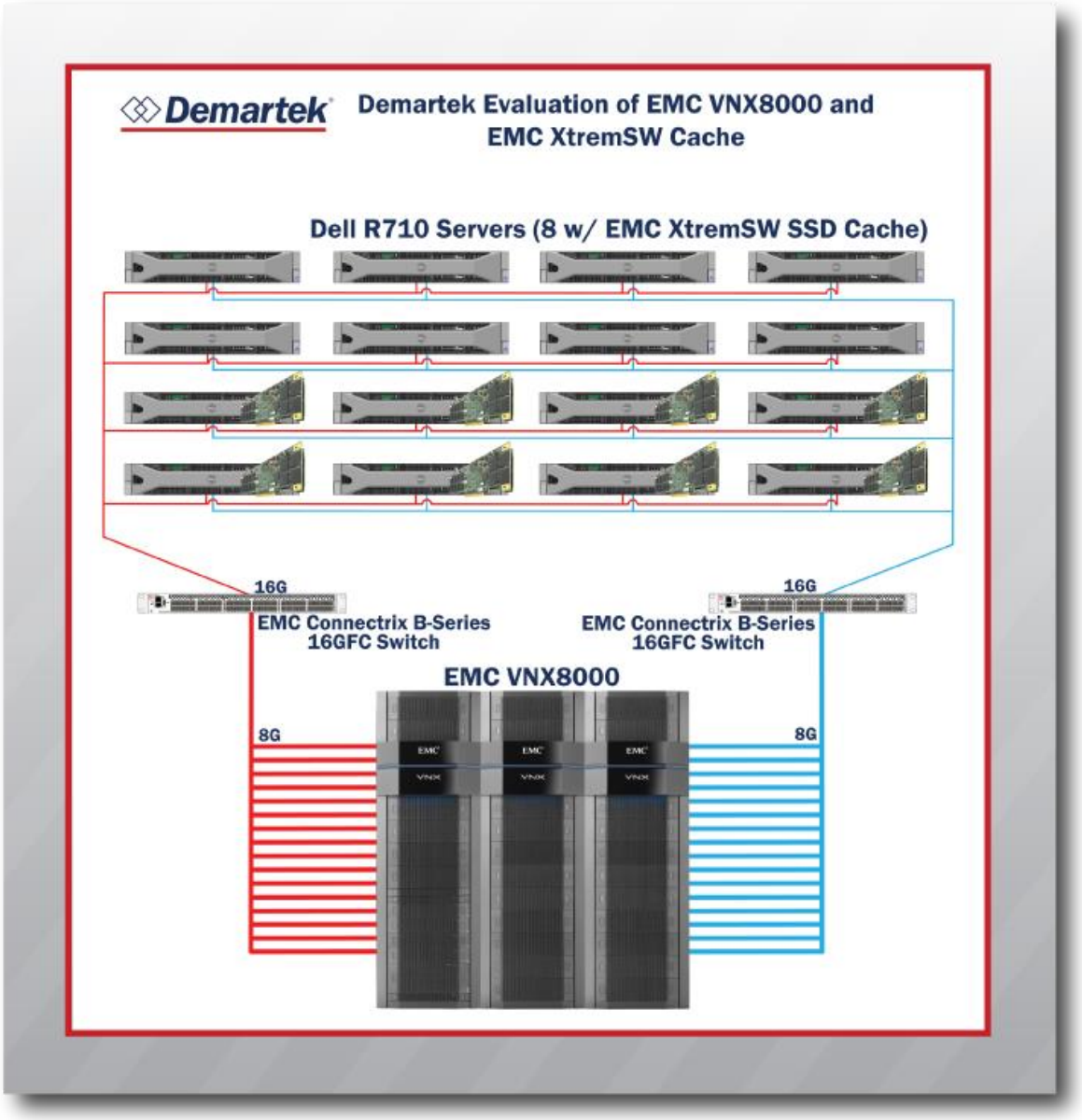
Identical configurations for database files were used for the eight hosts running SQL Server, and identical configurations for database files were used for the 8 VMs running Oracle Database.

SQL Server files

For each SQL Server host, the SQL Server database files were spread across four LUNs with a total of 440 GB allocated for data and indexes, with 88.9% of the capacity used. The allocated transaction log space was 25 GB with 5.9% of the capacity used. The TempDB files were spread across four different LUNs with a total of 120 GB allocated.

Oracle Database files

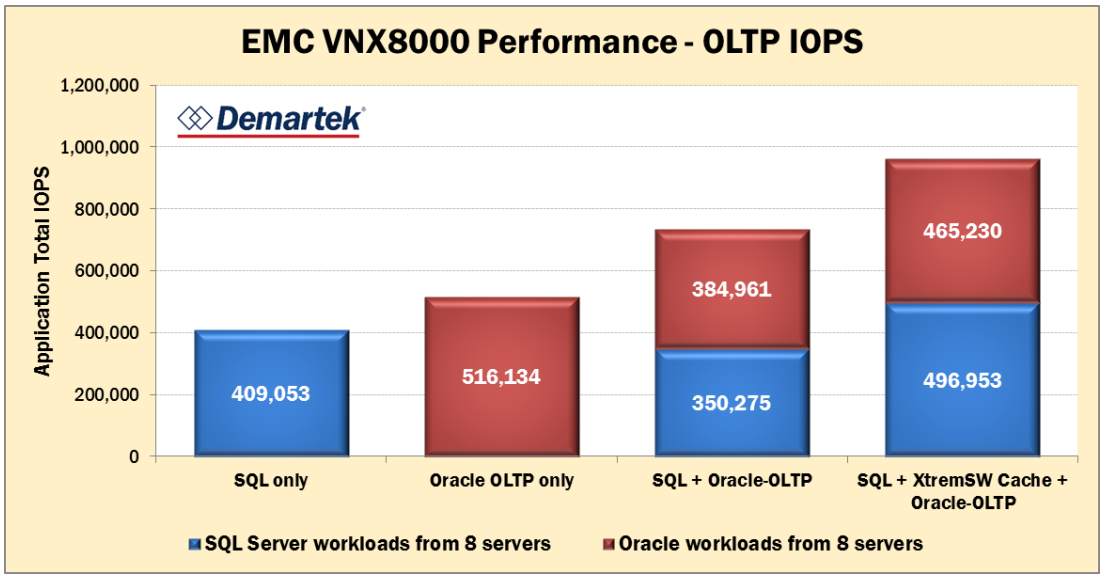
For each Oracle Database host virtual machine, the databases files were allocated 344 GB of which 90% was used.

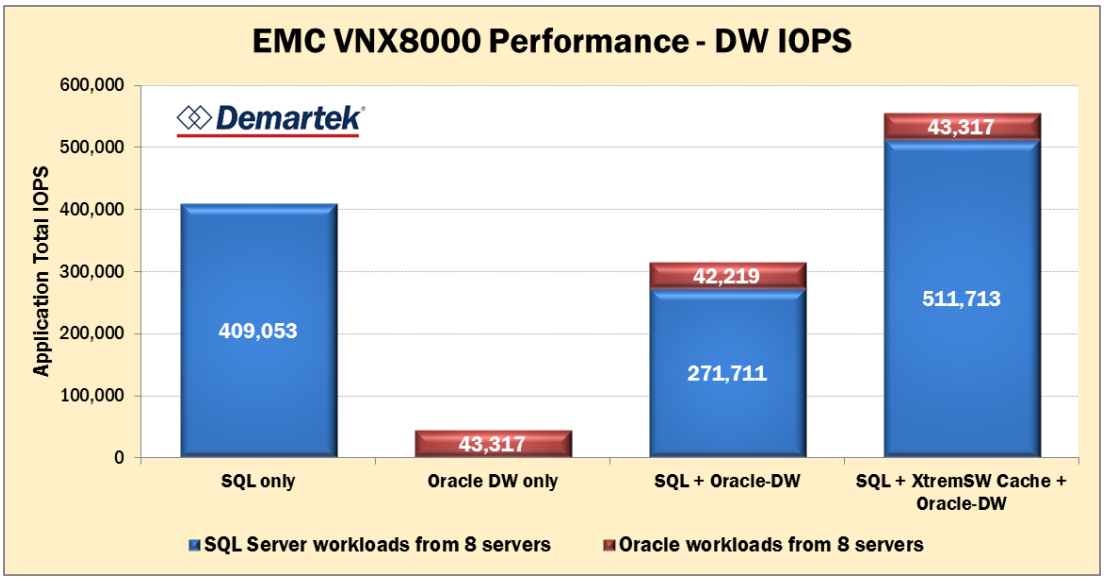

Demartek
Demartek Evaluation of EMC VNX8000 and EMC XtremSW Cache
Dell R710 Servers (8 w/ EMC XtremSW SSD Cache)
16G
EMC Connectrix B-Series 16GFC Switch
16G
EMC Connectrix B-Series 16GFC Switch
EMC VNX8000
8G
8G

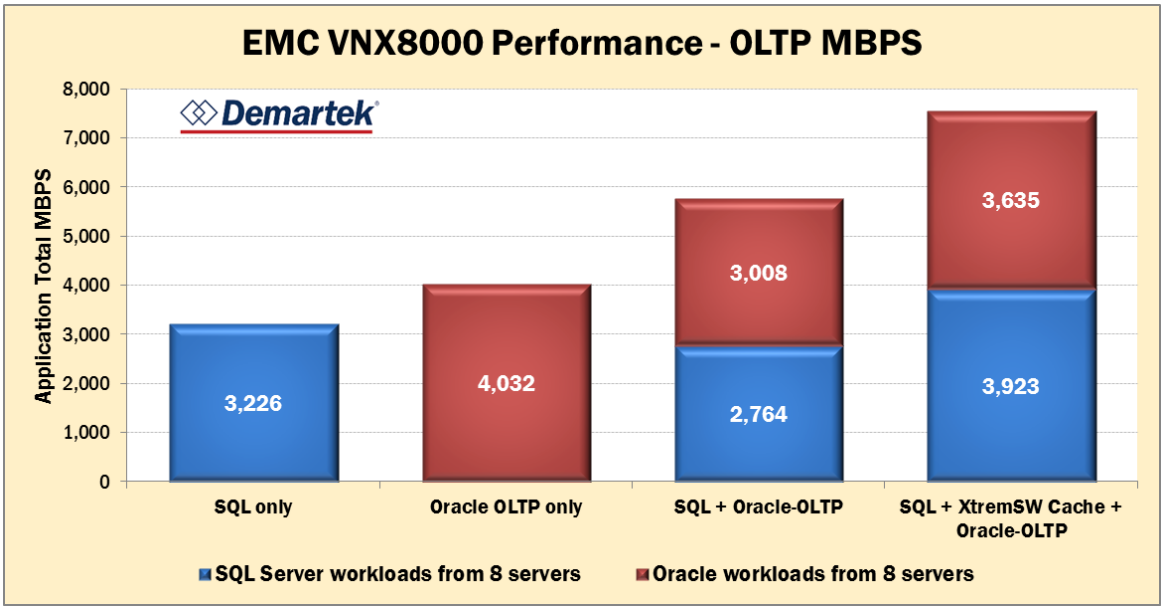
Performance Results

The VNX8000 performed very well with each of the individual workloads. It performed better with the combined workloads and obtained the best performance with the addition of XtremSW Cache in the servers, achieving almost 1 million IOPS for the OLTP workloads.

The SQL Server and Oracle workloads combined achieved more than either of these two workloads running separately. The VNX8000 supports mixed OLTP and DW workloads concurrently. XtremSW Cache accelerates the SQL OLTP workload regardless of the other workloads running.






EMC VNX8000 Performance - OLTP MBPS
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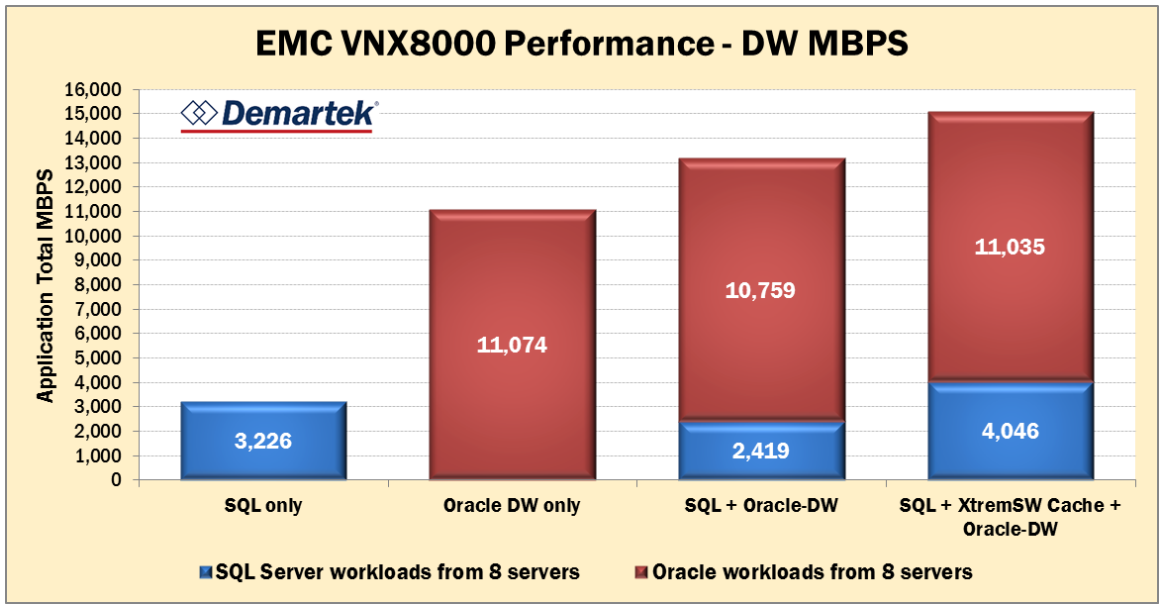
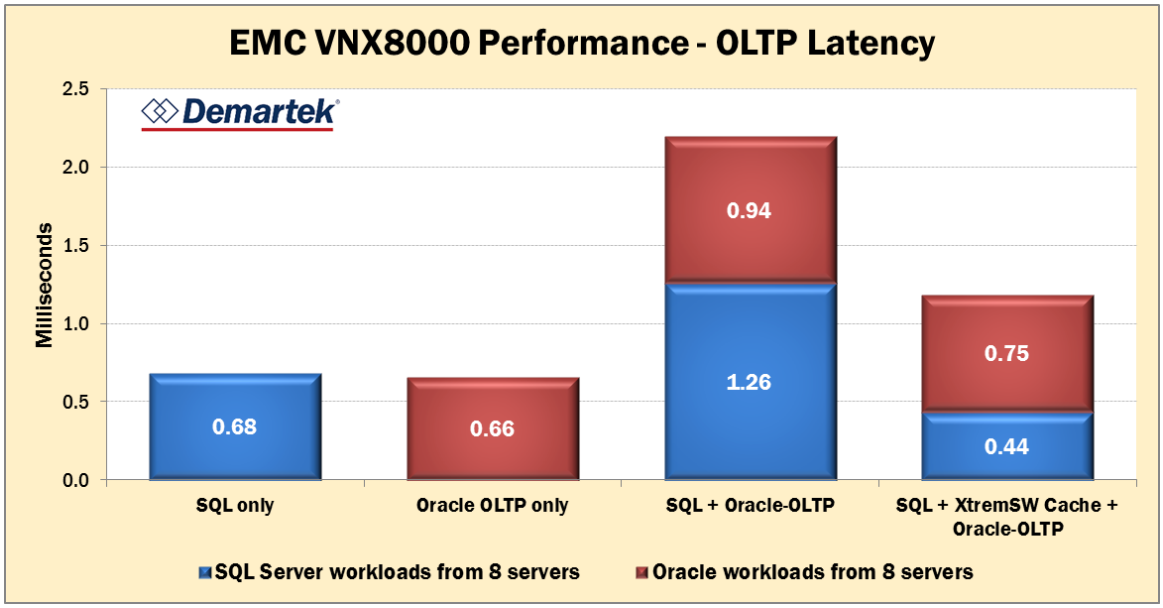
Application Total MBPS
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
3,226
4,032
3,008
2,764
3,635
3,923
SQL only
Oracle OLTP only
SQL + Oracle-OLTP
SQL + XtremSW Cache + Oracle-OLTP
SQL Server workloads from 8 servers
Oracle workloads from 8 servers


EMC VNX8000 Performance - DW MBPS
Demartek
Application Total MBPS
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
3,226
11,074
10,759
2,419
11,035
4,046
SQL only
Oracle DW only
SQL + Oracle-DW
SQL + XtremSW Cache + Oracle-DW
SQL Server workloads from 8 servers
Oracle workloads from 8 servers

Latency is a critical aspect of many workloads. The VNX8000 performed very well, especially for the OLTP workloads. XtremSW Cache not only significantly accelerated the SQL Server OLTP workload, but because of this offload effect the other workloads where XtremSW Cache was not directly applied were also improved.



Summary and Conclusion

The new generation of EMC VNX storage systems can handle heavier mixed virtualized workloads (both OLTP and DW) than ever before, and with the addition of XtremSW Cache server flash caching, can satisfy even higher requirements than the VNX alone.

- The VNX8000 with SSDs deployed as primary storage achieved more than 730,000 IOPS in a combined SQL Server and Oracle Database environment.
- XtremSW Cache deployed in the SQL Server servers (half of our test servers) provided a total of more than 950,000 total IOPS, an increase of 30% over the same configuration without XtremSW Cache.
- XtremSW Cache reduced the storage processor utilization by 14% providing more headroom on the VNX8000, enabling it to achieve higher performance on additional consolidated workloads.
- SQL Server average transaction latency was reduced from 1.26 milliseconds (1260 µs) without XtremSW Cache to 0.44 milliseconds (440 µs) with XtremSW Cache deployed in the SQL Server hosts – a 65% improvement.
- VNX8000 can easily scale to run OLTP and DW workloads at the same time.

The EMC VNX is a robust storage array, capable of handling mixed virtualized workloads from many servers. EMC XtremSW Cache provides strong acceleration for database workloads. The combination of the two provides outstanding performance for mission-critical applications, in virtual server and physical server environments.

The most current version of this report is available at http://www.demartek.com/Demartek_EMC_VNX8000_XtremSW_Cache_Evaluation_2013-09.html on the Demartek website.