SMART Storage Systems XceedStor SSD Evaluation

Evaluation report prepared under contract with SMART Storage Systems Corporation

Introduction

SSD technology is transforming the computing environment and enterprise SSDs are bringing high performance storage to the datacenter environment.

SMART Storage Systems commissioned Demartek to evaluation its XceedStor 500S server-grade SSDs in its lab and compare these SSDs to an Intel 320 SSD.

Evaluation Summary

We found that the SMART Storage System's XceedStor 500S SSD outperformed the Intel 320 SSD, in some cases by a wide margin. We believe that the XceedStor 500S SSD makes an excellent choice for SSD storage for read-intensive server and cloud computing applications.

Introduction

Like their spinning hard drive counterparts, enterprise SSDs are different than consumer-grade, or client SSDs, in two important areas: reliability and performance. Some of these differences are explained in the following table.

SSD	Client	Enterprise
Daily Use	8 Hours per Day	24 Hours per Day
Device Address Activity	Localized Areas	Entire Capacity
Pricing Strategy	Optimized for Cost	Highest Levels of Reliability, Availability and Data Integrity

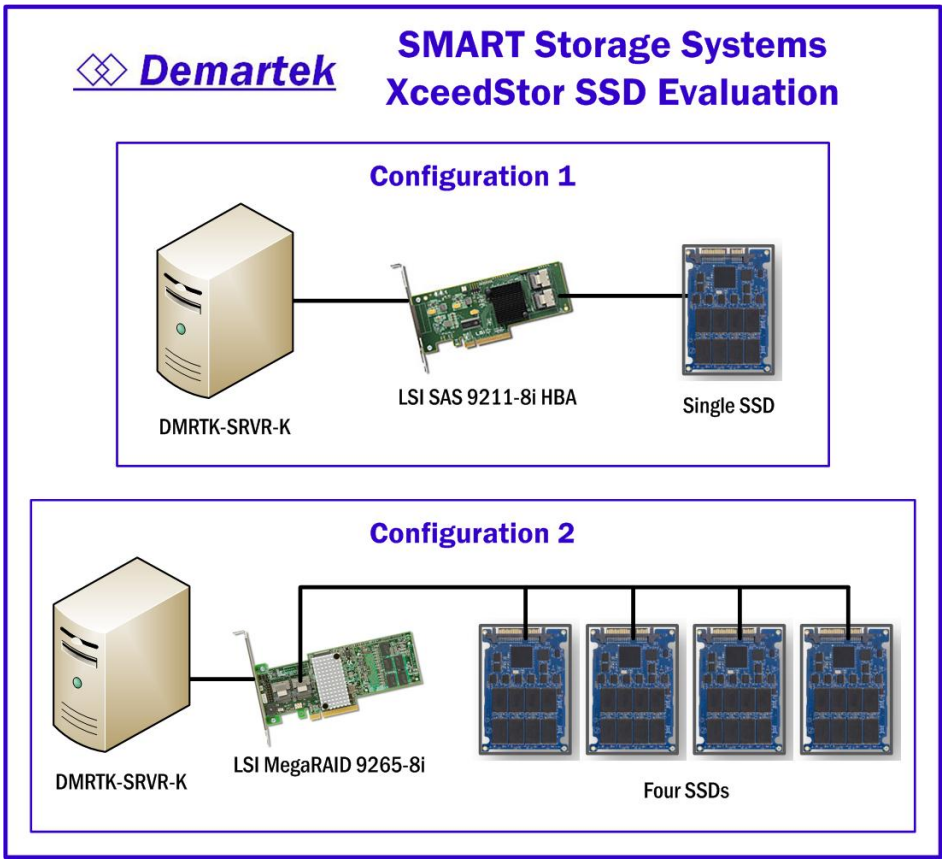
The SMART Storage Systems XceedStor 500S SSDs are enterprise-grade SSDs that use enterprise-level flash controllers from SandForce with enterprise code enabled. These SSDs provide good read performance and have some data optimization features not found in consumer-grade SSDs.

Performance Test Results

We conducted a series of tests running various workloads with different configurations of the SMART Storage Systems XceedStor 500S and Intel 320 SSDs. The configurations included the following:

- A single drive connected to an LSI SAS 9211-8i host bus adapter
- Four drives connected to an LSI MegaRAID 9265-8i RAID controller

The LSI host bus adapters and RAID controllers were used to ensure that we were able to get maximum throughput to the drives. Both of these LSI adapters run at 6Gb/sec.



SSD Pre-conditioning

SSDs based on NAND-flash technology can have different performance when they are first received as new devices from the manufacturer than they do after they have been in use for some time. This is because of the way that NAND-flash media works due to the program/erase cycle.

To get to what is known as "steady state" performance, NAND-flash SSDs must be "preconditioned" by performing a large number of sequential writes over a period of time. For these tests, we ran a preconditioning workload long enough to overwrite all the available capacity of each drive three times before running the tests described in the following sections.

Single Drive Tests

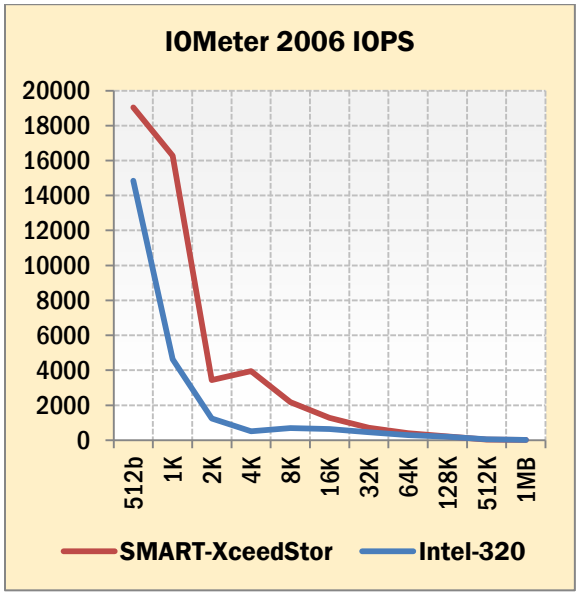
The single drive tests included running IOmeter 2006 and IOmeter 2008 workloads for one of each of the brands of SSDs. We ran these tests at various block sizes and various queue depths. As the load increased, the SMART XceedStor 500S SSD outperformed the Intel 320 SSD.

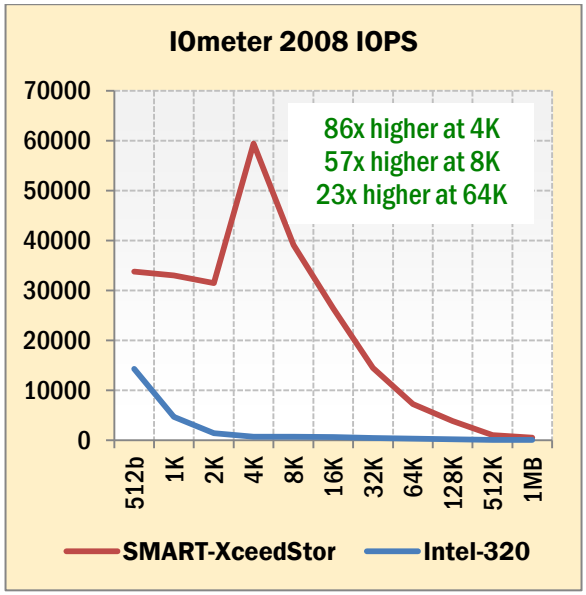
IOmeter 2006 and IOmeter 2008 write different data patterns to their test files. These patterns are shown on the Demartek Benchmark Output File Formats web page. The basic difference is that IOmeter 2008 uses repeating data patterns in its file. The SMART XceedStor 500S SSDs have been engineered to optimize their I/O activity when repeating data patterns are present. This optimization is especially noticeable in the IOmeter 2008 results.

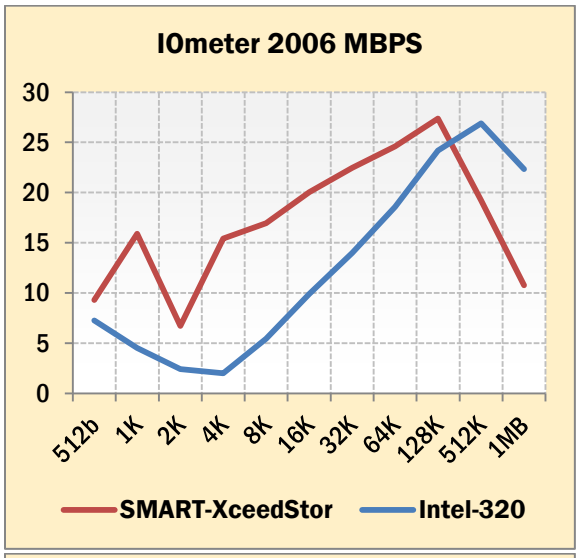
For these tests, the SMART XceedStor 500S SSDs generally performed better than the Intel 320 SSD for IOmeter 2006 at most block sizes, but performed significantly better for IOmeter 2008, which uses repeating data patterns. This performance difference was observed for IOPS and throughput measurements.

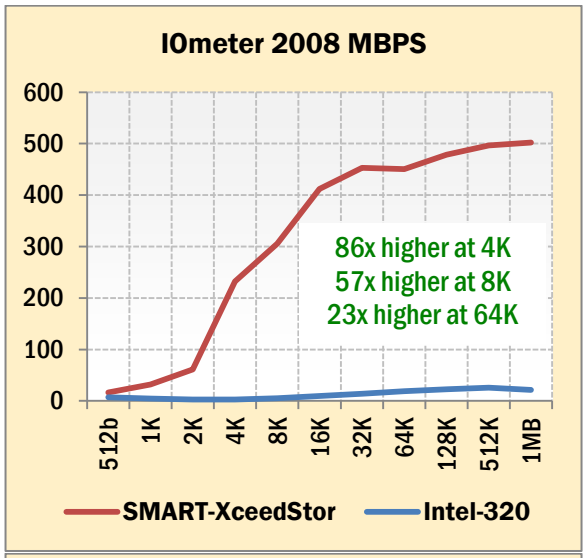
Results for 100% random write with queue depth (number of outstanding I/O requests) equal to 32 are shown below for both IOmeter 2006 and IOmeter 2008. Note that the scale for IOPS and throughput are different for IOmeter 2008, scaling higher than for the IOmeter 2006 tests.

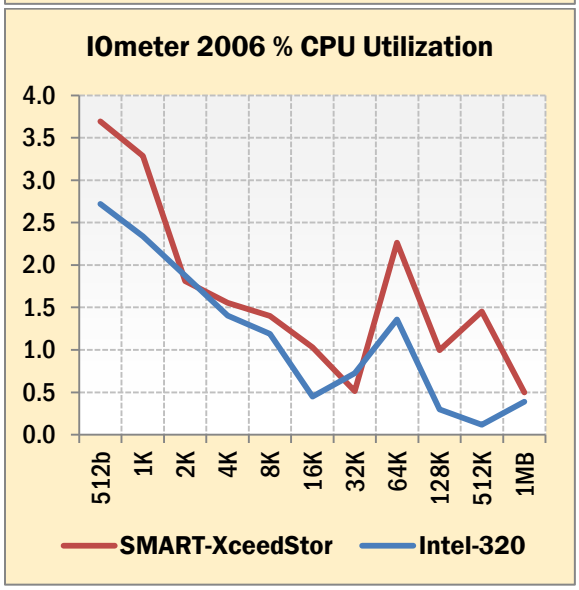
I/O profile: 100% random write, queue-depth=32

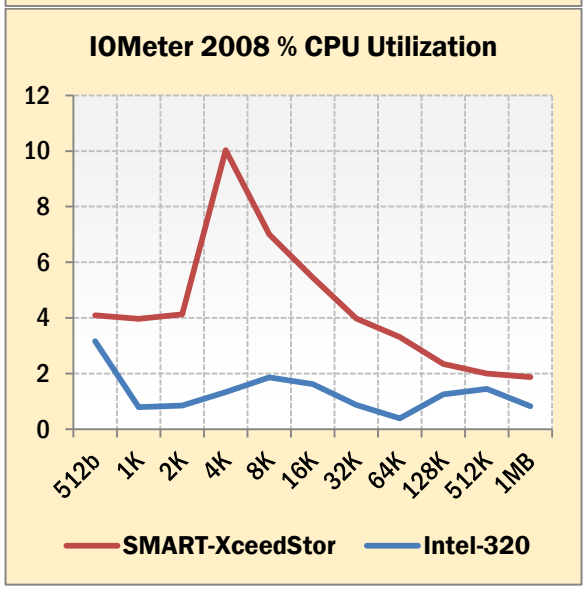





IOmeter 2006 MBPS
30
25
20
15
10
5
0
512b
1K
2K
4K
8K
16K
32K
64K
128K
512K
1MB
SMART-XceedStor
Intel-320


IOmeter 2008 MBPS
600
500
400
300
200
100
0
86x higher at 4K
57x higher at 8K
23x higher at 64K
512b
1K
2K
4K
8K
16K
32K
64K
128K
512K
1MB
SMART-XceedStor
Intel-320


IOmeter 2006 % CPU Utilization
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
512b
1K
2K
4K
8K
16K
32K
64K
128K
512K
1MB
SMART-XceedStor
Intel-320


IOMeter 2008 % CPU Utilization
12
10
8
6
4
2
0
512b
1K
2K
4K
8K
16K
32K
64K
128K
512K
1MB
SMART-XceedStor
Intel-320

Four Drive Tests

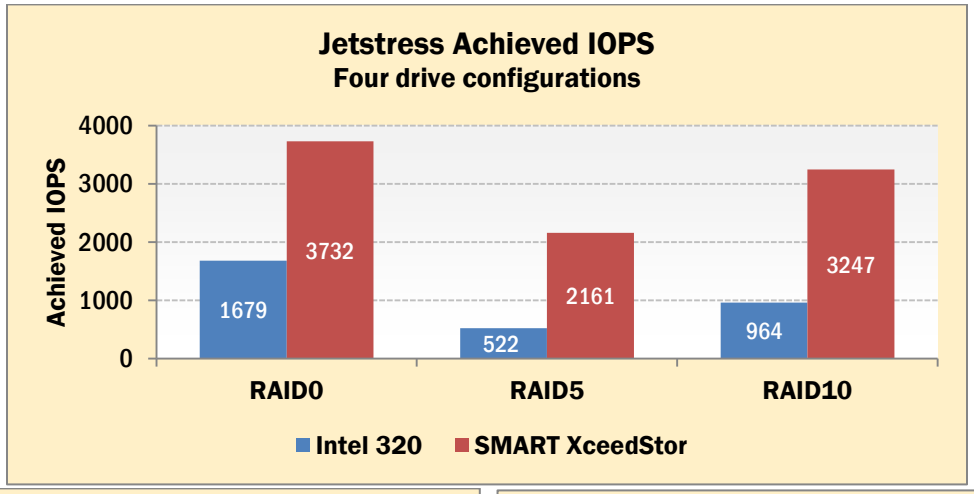
Enterprise applications usually require more than one drive for their data storage needs. We ran two sets of tests in the four drive configuration:

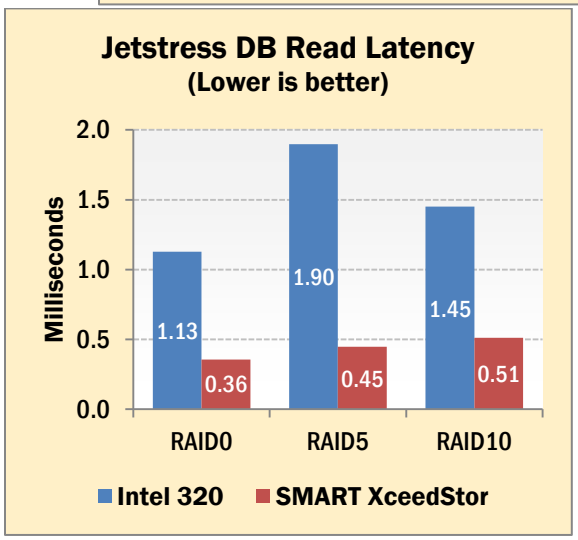
- Exchange Jetstress 2010 with a mailbox profile
- TPC-C like workload with Microsoft SQL Server

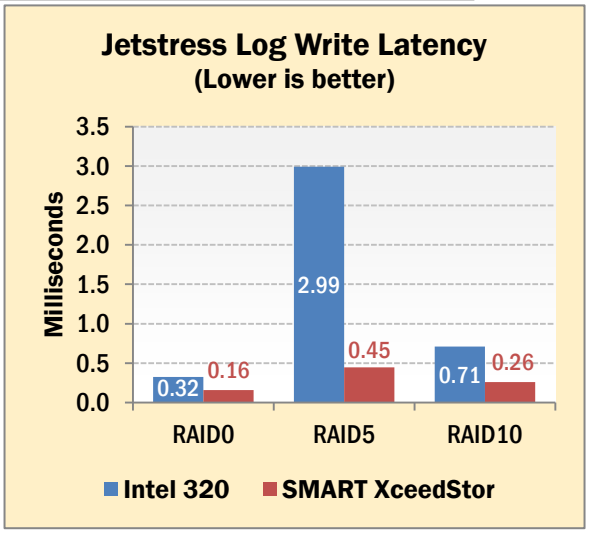
For Exchange Jetstress 2010, the three key metrics are achieved IOPS, database read latency and log write latency. For achieved IOPS, higher numbers are better. For the latency results, lower numbers are better.

Each of the four-drive tests were run in three configurations: RAID0, RAID5 and RAID10. Because each RAID configuration results in a different available capacity, the Jetstress tests were run with similar parameters except for the number of mailboxes.

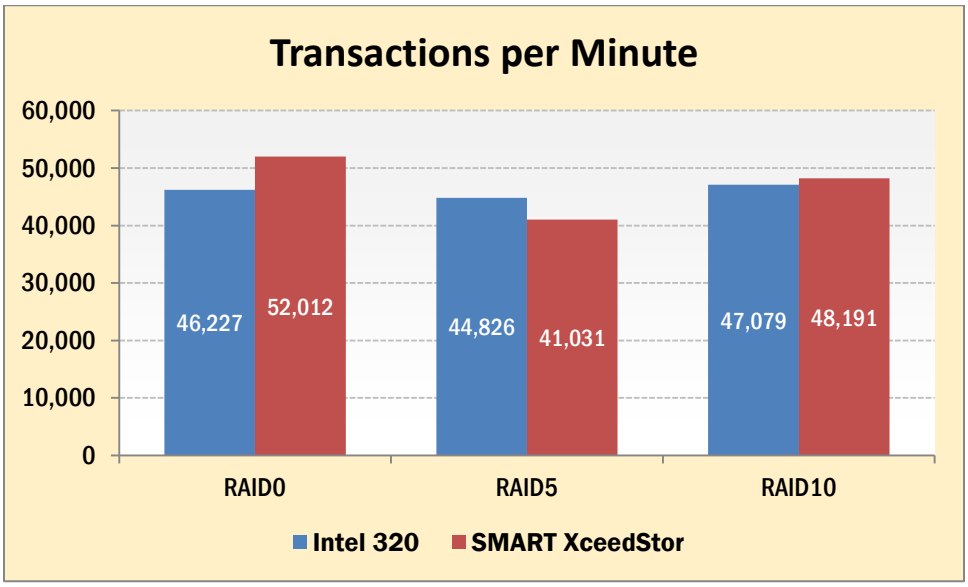
For these tests, the SMART XceedStor 500S SSDs outperformed the Intel 320 SSDs.







The TPC-C like workload measures transactions per minute and is a measure of database throughput.



Conclusion

The SMART Storage Systems XceedStor 500s SSD performed very well in our tests, showing that they take advantage of data optimization for various applications as well as provide excellent performance. This was reflected in the single-drive IOmeter 2008 performance for the 100% random write for queue-depth=32. We also observed higher performance and significantly lower latency in the multiple-drive Microsoft Exchange Jetstress configurations.

Appendix – Evaluation Environment

All the tests were run in the Demartek lab in Colorado, and were run on a single server.

Server

- Single Intel Xeon E3-1280, 3.5GHz, 4 cores, 8 threads ("Sandy Bridge")
- 32GB RAM
- PCI-Express 2.0 slots
- Windows Server 2008 R2
- Boot drive: SSD connected to a motherboard 6Gb SATA port

Host Adapters

- LSI SAS 9211-8i, 6Gb SAS (for the single drive tests)
- LSI MegaRAID 9265-8i, 6Gb SAS (for the four-drive tests)

SSDs Under Test

- Intel 320, 300GB
- SMART Storage Systems XceedStor 500S, 240GB

This report is available at www.demartek.com/XceedStor on the Demartek web site.