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White Paper

Microsoft SQL Application Acceleration with Flash Technology Acceleration from LSI Corp.

MS SQL Server Optimization with LSI® MegaRAID® CacheCade® Pro 2.0 Read and Write Caching Software and Solid State Disk (SSD) Technology

Abstract

Today's workload-intensive business applications are constrained by performance limitations of hard disk drives (HDDs). Solid state drives (SSDs) provide up to 1000 times more transactions per second, but at a much higher cost per gigabyte (GB).

A more economical approach is to mix both SSDs and HDD together, however administrators traditionally would need to configure performance-critical applications to access SSDs. CacheCade Pro 2.0 software (figure 1) intelligently and dynamically handles critical application acceleration and achieves data performance requirements without the need to monitor and configure applications to make the best use of SSDs, while at the same time enhancing HDD IO performance.

The ability to effectively scale storage performance to meet these new demands by utilizing SSD technology is critical to building a solid solution. This white paper will illustrate the performance benefits of using MegaRAID CacheCade Pro 2.0 data read and write caching software in Microsoft SQL server environments. (The MS SQL performance benefits discussed in this document are also applicable to other similar database and transactional applications.)

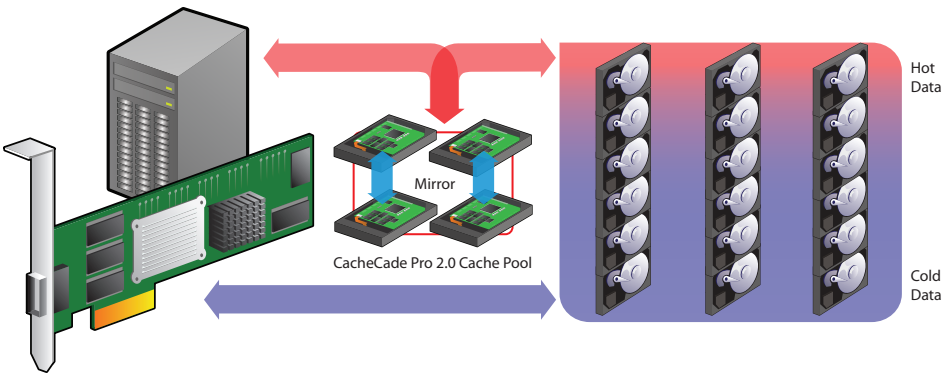
Benchmark and Testing Software Details

This study utilizes a database application benchmark which models and simulates a brokerage firm with one million users generating transactions related to trades, account inquiries, and market research. An industry-recognized Online Transaction Processing (OLTP) benchmark application was used with various CacheCade Pro 2.0 software SSD volume sizes assigned to a SQL database volume, with the objective of identifying the ideal SSD-to-data capacity ratio.

This document will discuss the following results and benefits of CacheCade Pro 2.0 data read and write caching technology:

1. By running the OLTP workload on an actual MS SQL database CacheCade Pro 2.0 software can demonstrate significant performance improvements – measured in transactions[1] per second.
2. Dramatically lower total cost of ownership can be achieved when deploying solutions with CacheCade Pro 2.0, resulting from lower power and cooling costs as CacheCade Pro 2.0 based solutions require much fewer hard disk drives and enclosures to attain comparable performance.
3. CacheCade Pro 2.0 can help maintain high performance when the underlying hardware is non-optimal (i.e. degraded arrays or during array rebuilds). Without CacheCade, database performance is significantly reduced while the array is suboptimal and rebuilding.
4. Also, CacheCade Pro 2.0 can decrease an array's time to optimal (TTO) by relieving the disk of host operations, allowing it to rebuild at a faster rate.

Figure 1
CacheCade Pro 2.0 software intelligently copies hot data to low latency, redundant SSD cache.



THE Smarter WAY TO FASTER™

CacheCade Pro 2.0 software is optimized to enhance read and write performance and also features advanced data hot spot detection and retention algorithms. As CacheCade Pro 2.0 identifies hot application data, it is quickly placed in the caching SSD storage and all subsequent hot data requests are serviced by the caching SSD storage. Once the SSD cache becomes completely full, cached read and write data will be replaced using intelligent policies designed to continuously track and retain hot spot regions as they change. This ensures the "hottest" of the hot data is always retained in the caching SSD storage. See Table 1 below for configuration details.

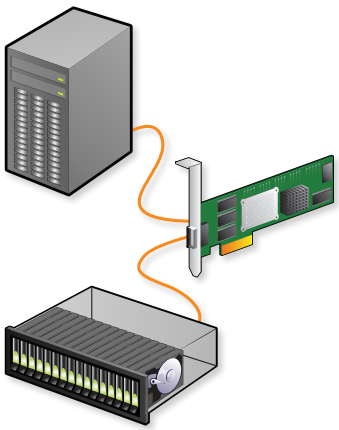
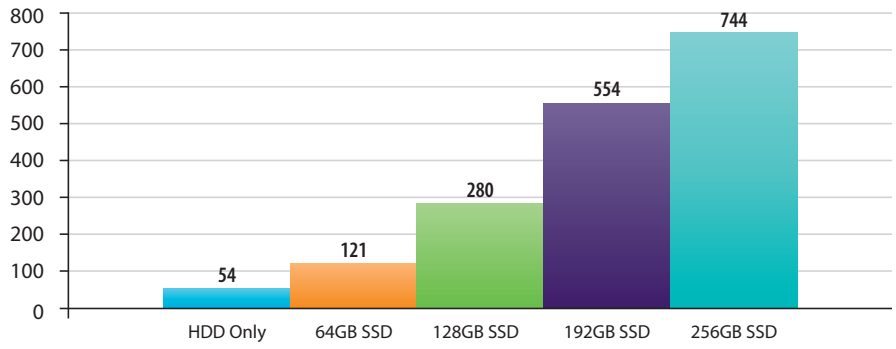


Table 1: Benchmark Configuration	
Server	• 2 Intel Xeon L5520, 4-cores each, 2.27GHz • 48GB PC3-10600 memory • LSI MegaRAID SAS 9280-8i - 2.130.03-1332 - Driver 4.35.0.64
Storage	• Small Form Factor (SFF) 10K RPM 146GB SAS drives • 1 to 4 64GB Intel X25E (SLC) SSDs configured in RAID 0 • Database Volume: 14 drive RAID 10 - 64KB stripe size - Write Through, No Read Ahead - Drive Write Caching Disabled - CacheCade Pro 2.0 data read and write caching enabled • Log File Volume: 5 drive RAID 5 - 64KB stripe size - Write Back, No Read Ahead, DIO - Drive Write Caching Disabled - CacheCade Pro 2.0 not enabled
Software	• Win2k8 R2, SQL Server 2008 SP1 • Industry Recognized SQL Benchmark • 600GB Database • 50K customers

Using a workload simulation of a dynamic brokerage application environment, LSI measured the performance benefits that CacheCade Pro 2.0 read and write caching software can offer for large SQL databases. **Our internal test environment results showed almost fourteen (14) times the transactions compared to no CacheCade software, while reducing the estimated cost per transaction by nearly half.** See table one below for performance details using various SSD capacity configurations. See Chart 1 below for benchmark results under various CacheCade Pro 2.0 capacities.

Chart 1

Transactions per Second



With CacheCade Pro 2.0, IT administrators can also achieve significantly reduced total cost of ownership (TCO). In order to meet the 744 TPS benchmark achieved with 256GB SSD CacheCade Pro 2.0 configuration, 192 10K RPM SAS HDDs would be needed, along with supporting infrastructure – including power and cooling costs over four years. With this brokerage application benchmark, CacheCade Pro 2.0 demonstrated an 82% lower TCO than a hard drive only solution that displayed similar performance characteristics. See Table-2 below for TCO details.

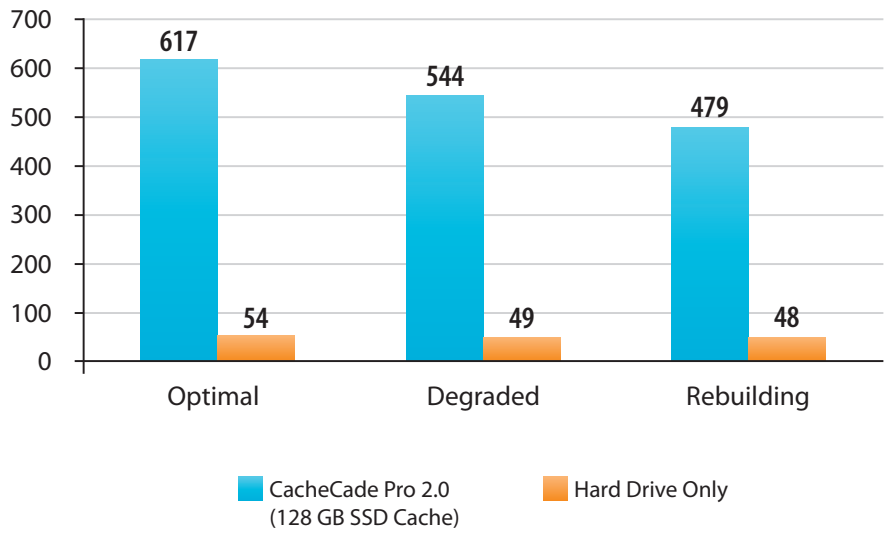
Achieving a 770 TPC-E Score (unaudited)	CC Pro 2.0 Solution Cost	HDD Solution Cost
System Base Cost	$15,000	$15,000
CacheCade License Cost	$175	$0
Opex (4 Year Power & Cooling Estimate For 192x HDDs)	$0	$80,000
Opex (4 Year Power & Cooling Estimate For 14x HDDs + 4x SSDs)	$6,200	$0
Eight 6Gb 24D SAS Enclosure	$0	$16,000
Four Intel 64GB X25E SSD Cost (MSRP)	$2, 720	$0
14 Seagate 73GB 10K RPM 6Gb SAS HDD (Model ST9300605SS)	$2,926	$0
192x Seagate 73GB 10K RPM 6Gb SAS HDD (Model ST9300605SS)	$0	$40,128
Total Estimated Solution Without CacheCade		$151, 128
Total Estimated Solution With CacheCade	$27,021	

82% TCO Savings!

An additional performance benefit of CacheCade Pro 2.0 is that it allows base HDD RAID volume to perform significantly better during sub optimal server conditions such as degraded HDD array and rebuild scenarios. See Chart 2, where a server employing CacheCade Pro 2.0 maintains nearly optimal transactional performance during while the array is degraded. During rebuilds, the transactional performance is slightly lower due to the additional rebuild overhead. Both advantages are the result of the fact that most of the hot data is serviced by the Flash storage.

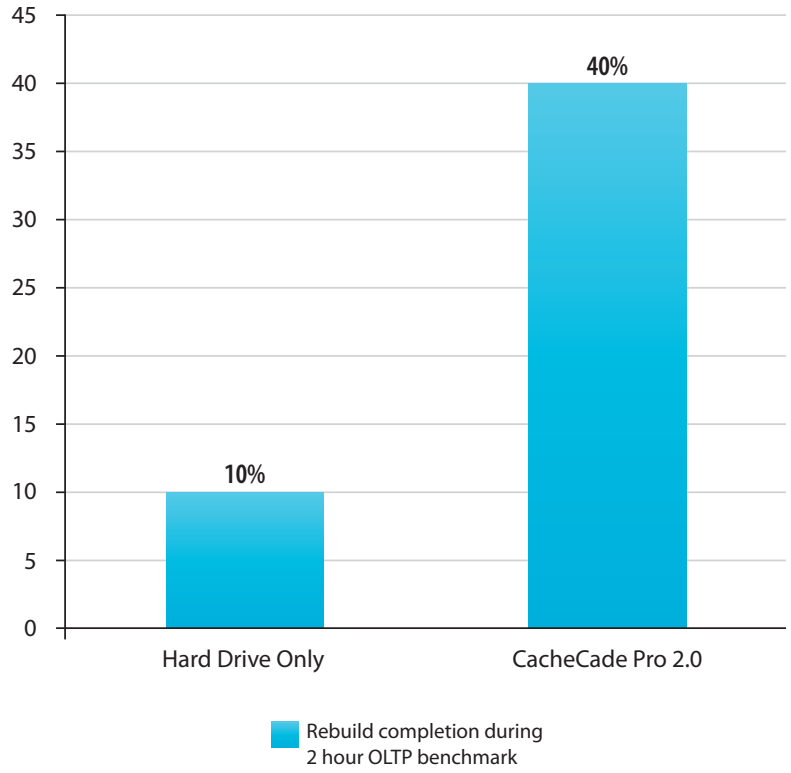
Chart 2

MY SQL application performance in sub-optimal (Units: Transactions per Second)



While the flash storage services active data, the hard drives are free to handle the rebuild of the failed drive. In Chart 3 Also, CacheCade Pro 2.0 can decrease an array's time to optimal (TTO) by relieving the disk of host operations, allowing it to rebuild at a faster rate. To illustrate the effectiveness of CacheCade Pro 2.0 software, a degraded array was rebuilt during a two-hour OLTP benchmark run. The array employing CacheCade Pro 2.0 software was able to rebuild four times faster than the baseline array.

Chart 3
Rebuild completion percentage during 2 hour OLTP benchmark



Conclusion

MegaRAID CacheCade Pro 2.0 software is designed to deliver performance scalability, reduced ownership costs and increase transactional efficiencies critical to meeting the demands of today's rapidly expanding transactional web 2.0 ecosystem.

CacheCade software provides a cost conscious option to integrate and realize SSD performance, reduce transactional cost, and improve overall application performance without extensive investment in SSDs. This is particularly evident in random read- and write-intensive workloads where adding a few SSDs to an existing SAS HDD array – or even replacing those with fewer SATA HDDs – is feasible while maintaining existing HDD capacity.

CacheCade Pro 2.0 software provides an additional advantage in that it does not require any migration of user data off of the existing HDD volume.

The results of this database simulation clearly show that CacheCade Pro 2.0 software improves overall database performance in both transaction throughput and query response latency measurements. It also illustrates how a database server can be optimized, using SSDs and CacheCade Pro 2.0 software to support significantly heavier workloads than was previously available in DAS server environments.

Further reading

For more information regarding LSI solutions, please visit, **www.lsi.com/acceleration**

1. TPC-E transactions are defined according to the TPC-E standard specification compared to the SQL Server transaction definition, which is based on a single logical unit of work. The SQL Server transaction definition is based on the atomicity, consistency, isolation, and durability (ACID) properties which the SQL Server database implements.

For more information and sales office locations, please visit the LSI web sites at: lsi.com lsi.com/contacts

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