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White Paper

Optimizing Database Performance

using LSI® MegaRAID® CacheCade® Pro 2.0 Read/ Write Caching Software

Abstract

Today's workload-intensive business applications are constrained by performance limitations of hard disk drives (HDDs). Solid state drives (SSDs) provide up to 1,000 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) is designed to intelligently and dynamically handle critical application acceleration, data performance requirements without the need to monitor and configure applications to make the best use of SSDs, while at the same time optimizing HDD IO traffic.

Scope

This document will demonstrate the significant performance benefits of CacheCade Pro 2.0 software in a database environment when compared to HDD-only database servers. (See chart 1.)

This document also explains how to achieve significant performance gains in your business database applications using LSI MegaRAID CacheCade Pro 2.0 caching software with SSDs acting as a tier of cache for frequently accessed, or 'hot', data. CacheCade Pro 2.0 software maximizes transactional I/O performance for applications such as online transaction processing (OLTP), data warehousing (DW), and data mining, without requiring complete replacement of existing hard disk drive (HDD) arrays.

Another key advantage for deploying CacheCade Pro 2.0 software for SSD caching is that it can be can be dynamically implemented into the infrastructure so there is no need to retune or "bounce" the database to implement data caching.

Advantages of using CacheCade Software

On-line Transaction Processing (OLTP) is a typical database application. OLTP applications have demanding requirements for short response times, which makes it difficult for database administrators (DBAs) to maintain these systems as the number of users grow and the amount of data increases. The network, the processor, and the storage devices can each cause a performance

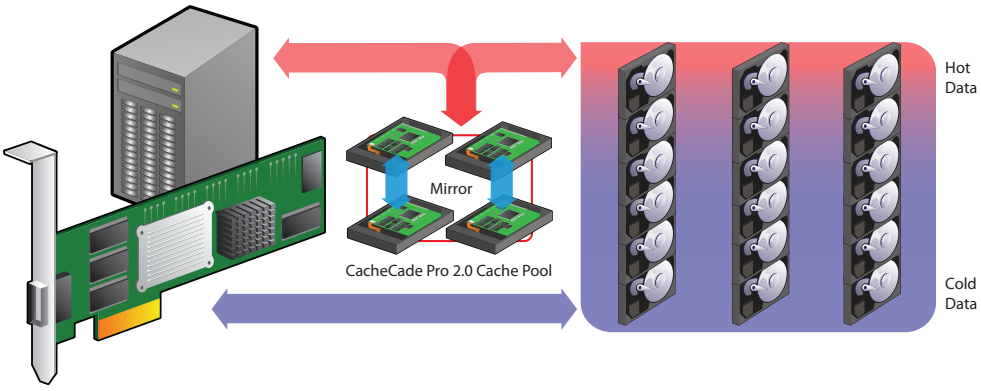

Figure 1

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

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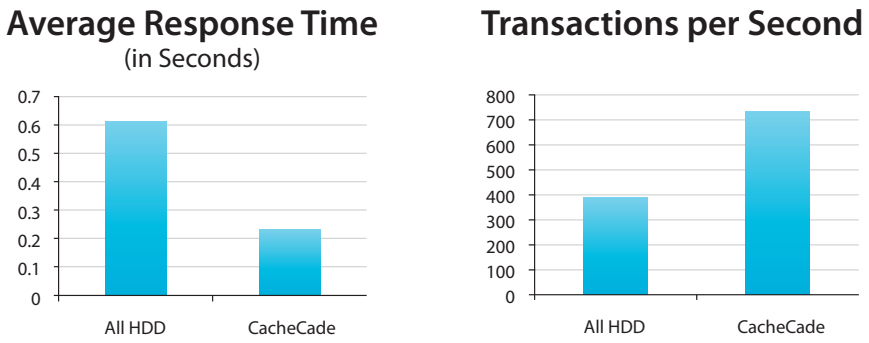
bottleneck during the application life cycle. SSDs provide a new tool for DBAs to solve their performance issues. For example, 5 milliseconds (ms) is the typical response time for a small data read from a hard disk drive. Flash-based devices can complete the same read in 0.05 ms, a double order-of-magnitude improvement in the response time.

Based on flash memory technology, solid state storage (SSS) provides performance levels that fall between hard disk drives and DDR3 memory. Initial implementations of SSDs were intended to replace a hard disk drive in direct attach storage (DAS) or RAID subsystems. By implementing CacheCade Pro 2.0 software, database performance significantly increases compared to using an HDD without caching.

Chart 1: OLTP Database Benchmark

These two charts demonstrate the performance gains in Response Time and in Transactions Per Second (TPS) when implementing CacheCade Pro 2.0 software. During internal testing, Average Response Time performance jumped almost 300% and TPS almost doubled using just one 32 GB Intel® X25-E SATA SSD, compared to an all-HDD baseline.



Benchmark Descriptions

Multiple benchmark tests were executed internally in LSI labs to show performance gains using CacheCade Pro 2.0 software compared to the baseline using all HDD.

In these tests, LSI ran OLTP simulated benchmarks and measured significant gains using CacheCade software compared to using all HDDs.

The TPC-C Benchmark is an OLTP benchmark involving multiple complex database transactions. TPC-C involves a mix of five concurrent transactions of different types and complexity either executed on-line or queued for deferred execution. The database is comprised of nine types of tables with a wide range of record and population sizes. TPC-C is measured in transactions per minute (tpmC).

The TPC-C Benchmark simulates a complete computing environment where a population of users executes transactions against a database. The benchmark is centered on the principal activities (transactions) of an order-entry environment. These transactions include entering and delivering orders, recording payments, checking the status of orders, and monitoring the level of stock at the warehouses. While the benchmark portrays the activity of a wholesale supplier, TPC-C is not limited to the activity of any particular business segment, but, rather represents any industry that must manage, sell, or distribute a product or service.

A 300 user load was used for the tests, with interval set to 200 for the transaction think time. This load resulted in a heavily accessed system both for CPU and for disk I/O.

Test System Description

This section describes the system LSI used to test the database performance improvements using CacheCade software. It also describes the results of the multi-stage test procedures to improve database performance.

Table 1: Test Configuration Details	
Server	• 2 Intel® Xeon E5640, 8-cores each, 2.67GHz • 48GB PC3-10600 memory • LSI MegaRAID SAS 9260-8i - FW: 2.130.03-1143-TEST-MAISH-055E - Driver version 5.40 - MSM v8.31.01
Storage	• 20 146GB 10K RPM SAS drives • 5 300GB 10K RPM SAS drives
Software	• Industry leading database application running on Linux® 5.5 - Quest Benchmark Factory Version 6.5 - Dedicated Windows® server
Database Settings	• Up to five (5) MegaRAID RAID 10 LUNs, each consisting of four (4) SAS HDDs for all database tablespaces • A RAID 10 LUN consisting of four (4) SAS disks for the online REDO logs. • 1 - SSD was used for the CacheCade software benchmark runs • SGA=7g • filesystemio_options=async • disk_async_io=TRUE • db_file_multiblock_read_count = 64 • 4GB online redo logs • 1 - 4 32GB Intel X25 SSDs
CacheCade Software Specifications	• CacheCade Pro 2.0 software • SSD: 30GB Intel X25-E configured in a RAID 0 • Write Policy – Write Back • Read Policy – Cached IO

Test Results

A baseline was established using all HDD VDs based on a five (5) RAID10 LUNs configuration. The database settings specified above were in place but no caching was enabled.

Statistics for the User Load				
User Load	TPS	kBPS	Avg. Response Time (sec)	Avg. Transation Time (sec)
300	383.08	163.510	0.614	0.626

Computed Maximum Qualified Throughput (MQTH) at Maximum User Load
10342.456 tpmC

The next test was performed with CacheCade software enabled using a 30GB SSD for caching. When comparing CacheCade software to the baseline benchmark using all HDD, CacheCade software was over 262% faster.

Statistics for the User Load				
User Load	TPS	kBPS	Avg. Response Time (sec)	Avg. Transation Time (sec)
300	733.89	313.320	0.234	0.244

Computed Maximum Qualified Throughput (MQTH) at Maximum User Load
19815.570 tpmC

These tests were replicated multiple times and the average statistics and results are displayed.

Conclusion

CacheCade Pro 2.0 software is a top choice if a user wants to protect costs, while at the same time get the best performance gains using caching at the storage array. It is also easier and faster to implement CacheCade Pro 2.0 software in the infrastructure because it is designed to work with all applications, not just databases.

Delivering the I/O performance of hundreds of traditional drives, CacheCade Pro 2.0 software helps enable the database to more efficiently meet your service level agreements for response times and throughput.

For more information, go to: **www.lsi.com/acceleration**

DISCLAIMER

LSI completed all of these system and storage modifications internally during testing in the LSI performance lab. Before implementing any of these modifications in your environment, be sure to test them completely to determine whether or not to use them in your environment. The information provided herein is based on internal LSI results. Use of any information contained herein is purely at your own risk and option. LSI Corporation makes no representations, warranties or guarantees regarding the compatibility or performance of specific hardware or software products. The information herein is provided "AS IS" without warranty of any kind express or implied for use at your sole risk. Without limiting the forgoing, the warranties of merchantability and fitness for a particular purpose are expressly disclaimed. This document is not warranted to be error-free. LSI Corporation has no responsibility to update the information herein and reserves the right to make changes to this document and to any of its products and services at any time without notice. LSI Corporation does not assume any responsibility or liability arising out of any reliance on or use of this information.

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