WHITE PAPER

SanDisk® DAS Cache: OLTP Performance

SanDisk
a Western Digital brand

Western Digital Technologies, Inc.
951 SanDisk Drive, Milpitas, CA 95035

www.SanDisk.com

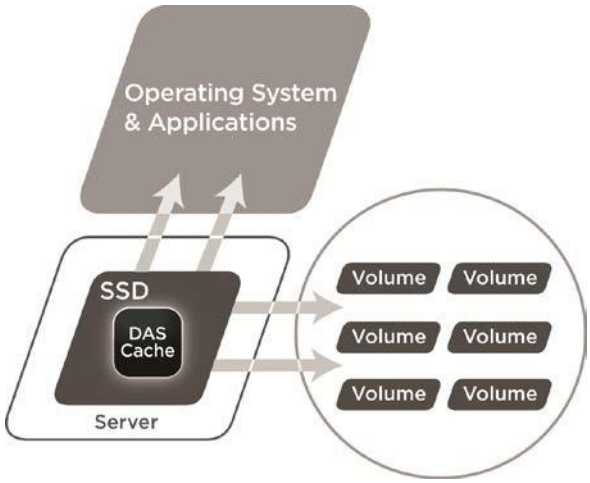
Table of Contents

Introduction

This document describes the performance capabilities of SanDisk DAS Cache measured using a typical OLTP workload based on the TPC-C benchmark test on Microsoft SQL Server. In this test, the SanDisk DAS Cache increased system performance nearly *eleven times* compared to the baseline configuration using only HDD-based storage.

Overview

SanDisk DAS Cache enables a solid-state device (SSD) to function as a cache for frequently accessed data in a server. The software is installed on the server and works in conjunction with the host operating system. By caching hot data on a high- speed SSD installed on the server, access times are reduced and applications spend less time waiting for read and write operations to complete.



Block diagram of SanDisk DAS Cache

Methodology

This performance test was conducted independently by SanDisk. A workload derived from the TPC-C benchmark test was used to provide a 400GB database to create a true OLTP workload simulating a network of 4,500 warehouses accessed by 64 concurrent, active users.

The test simulates a complete computing environment in which 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 test portrays the activity of a wholesale supplier, it 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.

The test was conducted multiple times; first, without SanDisk DAS Cache installed to establish baseline performance of the system using an all HDD storage backend. The same test was then conducted with SanDisk DAS Cache enabled using a 120GB cache – a capacity equivalent to 30% the size of the workload. Finally, it was run using the entire capacity of the SSD as a 1.8TB cache – large enough to contain the entire workload and demonstrate the maximum performance potential of the test system.

Summary of Tests

Test	Description	Configuration
Backend Storage (Baseline)	Baseline measurement of non-accelerated, direct-attached storage.	**8x** SAS 2TB 7.2K RPM HDD in RAID-5 configuration
SanDisk DAS Cache in write-back mode (Cache Size: 120GB)	Performance measurement of accelerated backend using SanDisk DAS Cache software. Cache = 30% size of workload.	**8x** SAS 2TB 7.2K RPM HDD in RAID-5 configuration **18x** SATA 200GB SSD in RAID-10 configuration
SanDisk DAS Cache in write-back mode (Cache Size: 1.8TB)	Performance measurement of accelerated backend using SanDisk DAS Cache software. Workload fits entirely within cache.	**8x** SAS 2TB 7.2K RPM HDD in RAID-5 configuration **18x** SATA 200GB SSD in RAID-10 configuration

System Configuration

Server

- Dell PowerEdge R730xd (13G beta)
- CPU: Xeon E5-2690 @ 2.6GHz, 2 sockets with 12 cores
- Memory: 64GB DDR-4 DIMM

Operating System / Software

- Windows 2012 R2 SP1
- SanDisk DAS Cache version 1.0

Storage / Cache

- RAID Controller: PERC H730P Mini
    - 18x SATA SSD 200GB 6Gbs (SanDisk SDLLEOD7M)
    - 8x SAS HDD 1.8TB 7.2K RPM 6Gbs (Seagate ST2000NM0023)
- 1x SAS HDD 3TB 10.6K RPM 6Gbs (Seagate ST300MM0006) for operating system only

Benchmark

- OLTP read-write workload
- 400GB dataset size

- TPC-C database schema
    - 4,500 warehouses
    - 64 concurrent users

Performance Test

The performance test was conducted on a system with 8 HDD and 18 SSD devices. The HDDs were configured using RAID-5 and the SSDs were configured using RAID-10. Two LUNs were created on the 8 disk HDD disk group – one for the database volume and one for logs. A single LUN was created on the 18 device SSD disk group for the cache. This LUN was resized as needed for the tests performed. A single direct-attached HDD contained the server operating system.

The PERC controller contains 2GB of cache on-board. The cache of the PERC controller was left enabled for this set of tests to match its typical default configuration as shipped. It is assumed the smaller size of the onboard PERC cache relative to the larger cache provided by SanDisk DAS Cache had negligible impact on the overall test results.

The full test was conducted three times – first to establish baseline performance of the HDD-only storage backend, then twice more with SanDisk DAS Cache enabled in write-back mode using different sized caches. Cache size was varied by resizing the LUN on the RAID for each test. In one test the cache capacity is set to 30% the size of the total workload. This represents typical operation of the cache. In the third test the cache capacity was increased to be larger than the entire workload. This shows the maximum performance potential of SanDisk DAS Cache for the cache used. To negate any negative impact on system performance the LUN for log files was also accelerated using SanDisk DAS Cache during the third test. The accelerated performance tests were run for 10,000 seconds (2.7 hours), which was determined to be long enough for the cache to be fully warmed.

Performance Measurements[1]

Test	tpmC	Read Ops	%hits	Write Ops	%hits
All HDD (baseline)	1,985	--	--	--	--
SanDisk DAS Cache (120GB) *(Data accelerated only)*	21,627	58,080,464	85.69%	35,153,797	86.72%
SanDisk DAS Cache (1.8TB) *(Data & Log accelerated)*	74,737	199,549,865	97.02%	147,889,899	71.63%

[1] 1. Based on internal testing by SanDisk. All measurements were made with the specified system and test configurations using identical OLTP workloads.

Conclusion

The performance test results indicate the performance gains that can be achieved using SanDisk DAS Cache compared to standard HDD storage. Due to the nature of caching, performance is influenced by the data being accelerated as well as the size of the cache relative to the workload. Nevertheless, this example of an OLTP database simulating a "real-life" computing environment accelerated by SanDisk DAS Cache only 30% the size of the workload, shows increased database transaction rates (tpmC) from 1,985 to 21,627 which is a nearly 11-fold increase in performance.