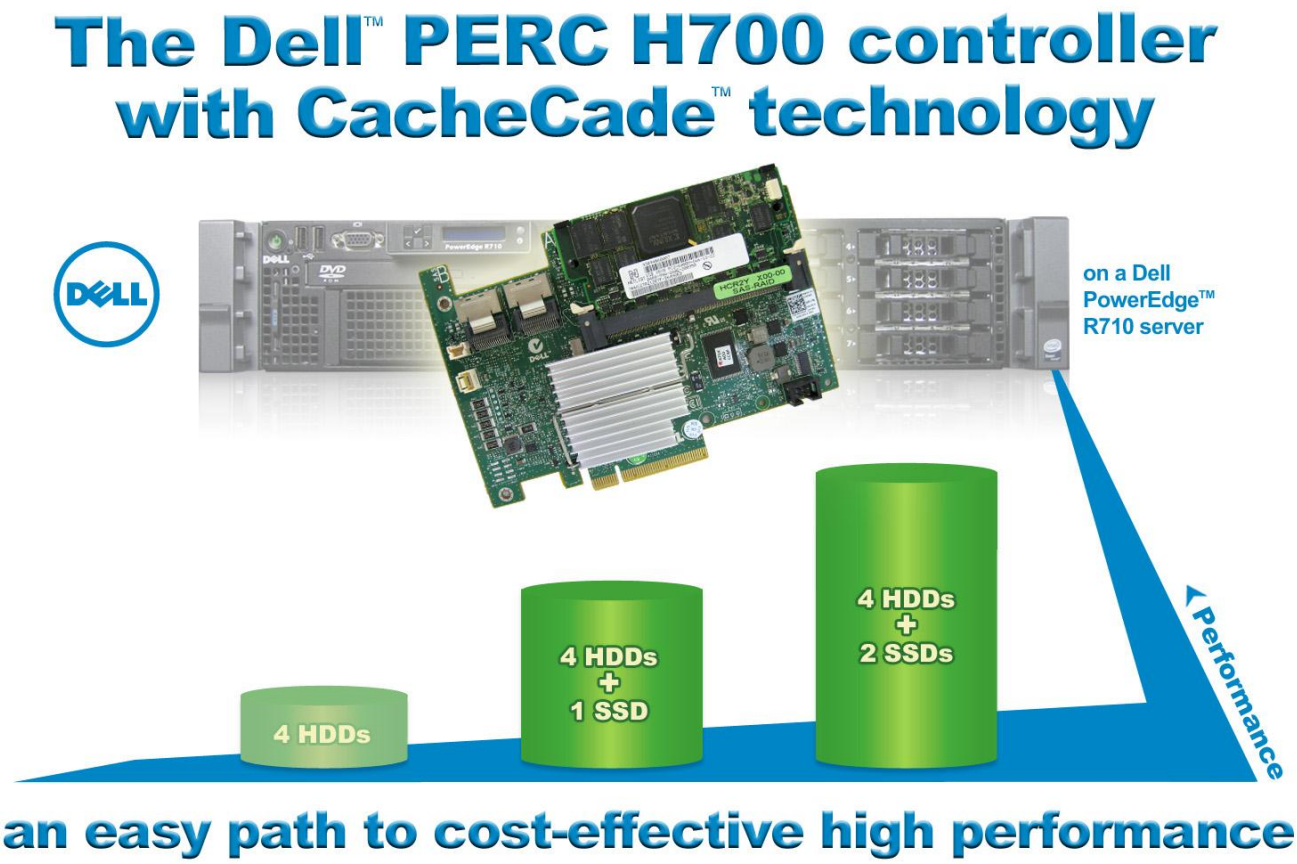
INCREASING DATABASE PERFORMANCE USING THE DELL PERC H700 WITH CACHECADE TECHNOLOGY



Companies want to get the best performance possible from their storage, but doing so involves tradeoffs. Solid-state drives (SSDs) provide maximum performance, but you pay top dollar and they lack the storage capacity of traditional hard disk drives (HDDs). The Dell PowerEdge RAID controller (PERC) H700 with CacheCade technology now gives you an easy-to-use, low-cost solution to bridge both worlds—great performance and high storage capacity.

We put the capabilities of the Dell PERC H700 (1GB Non-Volatile Cache) and CacheCade technology to the test, and found that adding a two-SSD CacheCade volume to a hard drive configuration increased database performance by a staggering 76 percent. Not only did we almost double the performance, we were able to reap the CacheCade performance benefits in no time at all—the solution was easy to install and use, taking only a few minutes to set up, and the only additional cost was for a pair of SSDs.

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A PRINCIPLED TECHNOLOGIES TEST REPORT
Commissioned by Dell Inc.

DELL PERC H700 WITH CACHECADE DELIVERS NO-HASSLE PERFORMANCE BOOSTS

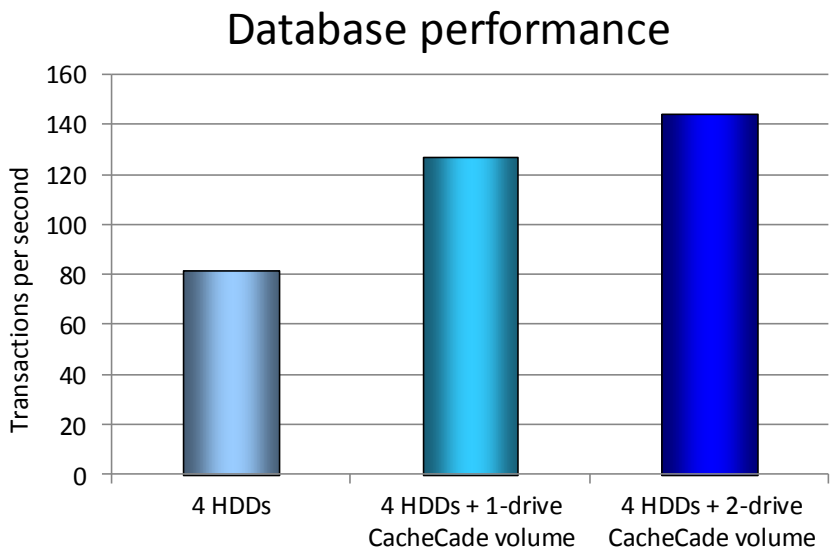
Simply creating a CacheCade volume on the Dell PERC H700 **increased database performance by 76 percent**, with no loss of existing drive space.

Everyone wants better drive performance, but not everyone can handle the cost and space limitations of SSDs. Creating a CacheCade volume with the Dell PERC H700 with one or two SSDs can increase your database performance dramatically while maintaining your storage capacity.

CacheCade uses the SSDs to enhance the performance of the drive system by caching frequently accessed or "hot-spot" data to SSDs. In this way, system applications can read important data much faster than if they were limited by the speed of HDDs alone. This tiered approach is automatic and results in significant system performance improvement. With CacheCade, only the size of the SSDs used limits cache size, meaning large amounts of important data are more quickly available than with an all-HDD configuration. Because CacheCade makes frequently read data easier to access, it shines in read-intensive environments such as database servers. Please note that CacheCade is a feature that is specific to the 1GB Non-Volatile (NV) Cache version of the Dell PERC H700 controller.

Figure 1 shows how CacheCade performance stacked up.

Figure 1. Adding CacheCade volumes with the Dell PERC H700 boosts performance. Adding one SSD as a CacheCade volume increased performance by **55 percent**, and adding two SSDs increased performance by **76 percent**.



We did **no tuning** whatsoever to get the 76% performance increase; **it literally took minutes**.

CacheCade is also easy to use. We merely placed one or two hot swap SSDs into the drive slots on the server, opened the configuration utility, and created the CacheCade virtual drive. We saw the database performance improvements immediately, with no other intervention. CacheCade automatically started working to determine which hot spots to copy to the SSDs while leaving logs and other more write-intensive areas alone. We did no tuning whatsoever to get the 76 percent performance increase; it literally took minutes.

To get such a high performance jump, you'd expect to spend significant dollars, but with the Dell PERC H700 with CacheCade technology this is not the case. With our 2-SSD CacheCade volume, we only spent a small amount of money compared to the large increase in performance. The only cost was for a pair of SSDs. If you were instead considering an all-SSD solution, you would need to purchase many more SSDs in order to maintain your storage capacity due to the small capacity of SSDs that are currently shipping.

WHAT WE TESTED

To demonstrate the database performance increase the Dell PERC H700 with CacheCade technology delivers, we used a Dell PowerEdge R710 server, created a MySQL database, and used the SysBench benchmark to test three drive configurations:

- Four HDDs
- Four HDDs plus one SSD as a CacheCade volume
- Four HDDs plus two SSDs as a CacheCade volume

SysBench tests various performance aspects of servers running databases, and specifically targets MySQL database systems (www.mysql.com). SysBench measures performance as the total number of transactions divided by the time in number of seconds, transactions per second (T/s). For more information about SysBench, visit www.sourceforge.net.

For each configuration, we configured the two drives for the operating system (OS) as RAID 1, and the remaining drives as RAID 10. We determined the thread count for each configuration by selecting the one that provided maximum performance while still maintaining an average response time less than 140 milliseconds (see Figure 2).

Configuration	Number of threads	Average response time (ms)
4 HDDs	10	122.08
4 HDDs + 1-drive CacheCade volume	15	117.61
4 HDDs + 2-drive CacheCade volume	20	138.08

Figure 2: Number of threads and average response time for the three storage configurations we tested.

See Appendix A for detailed configuration information, and see Appendix B for step-by-step instructions on how we tested.

WHAT WE FOUND

Dell PERC H700 with CacheCade technology is a **cost-effective** way to increase database performance.

As Figure 3 shows, using the Dell PERC H700 and adding SSDs as a CacheCade volume drastically increased performance of an HDD configuration.

Configuration	Transactions per second
4 HDDs	81.76
4 HDDs + 1-drive CacheCade volume	127.15
4 HDDs + 2-drive CacheCade volume	144.57

Figure 3: SysBench results, in transactions per second, for the storage configurations. Higher numbers are better.

We configured a Dell PowerEdge R710 server with the various drive configurations on the Dell Web site for pricing. The server, configured with all HDDs and an operating system, cost around $9,000. Each SSD increased the cost of the server by only around $1,000, making the Dell PERC H700 with CacheCade technology a cost-effective way to increase database performance.

WHAT THIS MEANS FOR YOU

Many solutions that give you great performance gains take significant IT efforts and training to configure. They can be expensive to acquire and to set up and can require occasional tuning to make sure they continue to deliver performance gains. The Dell PERC H700 with CacheCade is truly configure-and-forget technology. It allows you to increase your performance dramatically, and requires no large investments in IT time, effort, or money. If you're trying to balance future needs for low-cost capacity expansion with a present need for increased performance, just drop in an SSD or two and create a CacheCade volume with your Dell PERC H700. You need do nothing else—except to sit back and watch your performance climb.

APPENDIX A – SERVER CONFIGURATION INFORMATION

Figure 4 provides detailed configuration information for the test server.

System	Dell PowerEdge R710
Power supplies	
Total number	2
Vendor and model number	N870P-S0
Wattage of each (W)	870
Cooling fans	
Total number	5
Vendor and model number	San Ace60 9GV0612P1M041
Dimensions (h x w) of each	2.5” x 2.5”
Volts	12
Amps	1.5
General	
Number of processor packages	2
Number of cores per processor	6
Number of hardware threads per core	6
System power management policy	Balanced
CPU	
Vendor	Intel®
Name	Xeon®
Model number	E5520
Stepping	D0
Socket type	LGA 1366
Core frequency (GHz)	2.26
Bus frequency	5.86 GT/s
L1 cache	32 KB + 32 KB
L2 cache	1 MB (4 x 256 KB)
L3 cache	8 MB (shared)
Platform	
Vendor and model number	Dell PowerEdge R710
Motherboard model number	00W9X3
Motherboard chipset	Intel 5520
BIOS name and version	Dell 2.3.12 (2/1/2011)
BIOS settings	Default
Memory module(s)	
Total RAM in system (GB)	6
Vendor and model number	Hynix HMT112U7BFR8C-G7
Type	PC3-8500
Speed (MHz)	1066

System	Dell PowerEdge R710
Speed running in the system (MHz)	1,066
Timing/Latency (tCL-tRCD-tRP-tRASmin)	7-7-7-37.5
Size (GB)	1
Number of RAM module(s)	6 x 1 GB
Chip organization	Double-sided
Rank	Single
Operating system	
Name	Microsoft® Windows Server® 2008 R2
Build number	7600
File system	NTFS
Kernel	ACPI x64-based PC
Language	English
Graphics	
Vendor and model number	Matrox® G200eW
Graphics memory (MB)	8
Driver	Matrox 1.1.3.0 (7/27/2009)
RAID controller	
Vendor and model number	Dell PERC H700 1GB NV Cache (Note: CacheCade is a feature that is specific to the 1GB NV Cache version of the Dell PERC H700 controller.)
Firmware version	12.10.0.0025
Driver version	Dell 4.31.1.64 (8/9/2010)
Cache size (MB)	1,024
Internal storage	
HDDs	
Vendor and model number	Dell ST973452SS
Speed (Gbps)	6
Size (GB)	73
RPM	15,000
Type	SAS
SSDs	
Vendor and model number	Dell MCB4E50G5MXP-0VB
Speed (Gbps)	3
Size (GB)	50
Type	SATA
Ethernet	
Vendor and model number	Broadcom® BCM5709C NetXtreme® II GigE
Type	Integrated
Driver	Microsoft 4.8.4.1 (12/23/2008)

System	Dell PowerEdge R710
Optical drive(s)	
Vendor and model number	TEAV DV28SV
Type	DVD-ROM
USB ports	
Number	4
Type	2.0

Figure 4: System configuration information for the test server.

APPENDIX B - HOW WE TESTED

Installing Windows Server 2008 R2 Enterprise Edition

We used Microsoft Windows Server 2008 R2 Enterprise Edition for the operating system on the server.

To install Windows Server 2008 R2, complete the following steps:

1. Boot the server, and insert the Windows Server 2008 R2 installation DVD in the DVD-ROM drive.
2. At the Language Selection screen, click Next.
3. Click Install Now.
4. Select Windows Server 2008 Enterprise (Full Installation), and click Next.
5. Click the I accept the license terms check box, and click Next.
6. Click Custom.
7. Click Drive options (advanced).
8. Delete any existing partitions.
9. Ensure the first drive is selected, and click New.
10. Click Apply.
11. Click OK.
12. Click Next.
13. At the User's password must be changed before logging on warning screen, click OK.
14. Type your new password into both fields, and click the arrow to continue.
15. At the Your password has been changed screen, click OK.

Windows Server 2008 R2 settings

We installed all recommended and critical Windows updates through 2/03/2011. In addition, we downloaded and installed the latest drivers.

Installing and setting up MySQL Server 5.1.54

We used MySQL Server 5.1.54 to create our test database. To install and set up MySQL Server 5.1.54, complete the following steps:

1. Download mysql-essential-5.1.54-winx64.msi from http://dev.mysql.com/downloads/.
2. Double-click the mysql-essential-5.1.54-winx64.msi file to launch the MySQL Server 5.1 Setup Wizard.
3. Click Next.
4. Select Custom, and click Next.
5. Highlight MySQL Server Datafiles, and click Change…
6. Set the MySQL Server Datafiles directory as the RAID volume F:\, and click OK
7. Ensure that the Destination Folder is C:\Program Files\MySQL\MySQL Server 5.1 and the Date Folder is F:\ and click Install.
8. Click Next.
9. Click Next.
10. At the Wizard Completed screen, click Finish. The MySQL Server Instance Configuration Wizard automatically launches.

Configuring MySQL Server 5.1.54

After you have installed and set up MySQL Server 5.1.54, configure it by completing the following steps:

1. At the Welcome to MySQL Server Instance Configuration Wizard 1.0.16.0 screen, click Next.
2. At the MySQL Server Instance Configuration screen, select Reconfigure Instance, and click Next.
3. Select Detailed Configuration, and click Next.
4. Select Dedicated MySQL Server Machine, and click Next.
5. Select Transactional Database Only, and click Next.
6. To change the InnoDB Tablespace Settings RAID volume, click Modify, and in at the Are you sure you want to change the InnoDB datafile path? pop-up window, click Yes.
7. Click the … button, select the RAID volume target, and click Open.
8. Note that the drive drop-down menu under InnoDB Tablespace Settings changed to F:\, and click Next.
9. Select Online Transaction Processing (OLTP), and click Next.
10. Select Enable TCP/IP Networking, type `3306` for the Port Number, select Enable Strict Mode, and click Next.
11. Leave the default Standard Character Set, and click Next.
12. Select Install As Windows Service and Include Bin Directory in Windows PATH, and click Next.
13. Select Modify Security Setting, type password1 in the New root password and Confirm boxes, and check Enable root access from remote machines. Click Next.
14. To complete the configuration, click Execute.
15. When the wizard finishes, click Finish.
16. Open MySQL Command Line Client.
17. At the Enter password prompt, type `password1` and press Enter.
18. Type `show databases` and press Enter.
19. Type `create database sbtest` and press Enter.
20. Type `show databases` and press Enter.
21. Type `use sbtest` to switch MySQL to use the SysBench (sbtest) database, and press Enter.
22. Type `\q` to close the MySQL Command Line Client.

Building the SysBench test database

We used SysBench to create a 400,000,000-row (90GB) MySQL database and executed a batch of online transaction processing (OLTP) transactions against that data. Each run lasted one hour, performing 74 percent reads and 26 percent writes to simulate a standard database workload. To build the SysBench database, complete the following steps:

1. Run the SysBench "prepare" phase to build a 90GB database using the following parameters:

```
sysbench --debug=off --mysql-host=localhost --mysql-user=root --
mysql-password=Password1 --test=oltp --oltp-table-size=400000000
prepare
```

2. Make a backup copy of the database on an external storage volume before running SysBench.

Running SysBench

1. Ensure you have a fresh copy of the database copied over to the target volume.
2. To run the benchmark, open a command prompt, and type the following command:

```
sysbench --debug=off --mysql-host=localhost --mysql-user=root --
mysql-password=Password1 --test=oltp --oltp-table-size=400000000 --
num-threads=10 --max-time=3600 --max-requests=10000000 run
```

3. After the benchmark completes, refer to the command prompt window to review the results.
4. Repeat steps 2 and 3 to conduct three more runs without restoring the database or rebooting the server. The first run allows for data caching as would occur in a real-world environment. The following runs provide the stable performance results of the testing.
5. Report the median score.
6. Repeat steps 1 through 5 for each drive configuration.

ABOUT PRINCIPLED TECHNOLOGIES

Principled Technologies, Inc.
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We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.