White Paper

EMC VFCACHE ACCELERATES MICROSOFT SQL SERVER

EMC VFCache, EMC VNX, Microsoft SQL Server 2008

- VFCache dramatically improves SQL Server performance
- VNX protects data

EMC Solutions Group

Abstract

This white paper describes how EMC VFCache™ with EMC® VNX™ accelerates online transaction processing (OLTP) performance in a Microsoft SQL Server 2008 environment.

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EMC²

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Executive summary

Business case

In an increasingly competitive environment, businesses are being driven to optimize business processes and to improve service, while lowering IT costs. Meeting these new requirements has become critical to the financial success of many companies. Consequently, operational and revenue-generating applications are experiencing dramatic demands on performance, driven by:

- Growth in the numbers of active users
- Time-critical applications and escalating service level agreements
- Increased complexity of business processes and new analytic workloads
- Multiple databases with high concurrent access

Businesses need to consider new approaches to performance challenges in order to meet these demands cost effectively and without sacrificing data protection.

The storage performance challenge

The latest servers with multi-core processors represent a potential performance bottleneck for the storage subsystem. As processing capacity and heavier workloads are added, the storage system is challenged to keep pace with the growing I/O demands. While CPU performance improves 100-fold every decade, magnetic disk remains relatively flat, as shown in Figure 1.

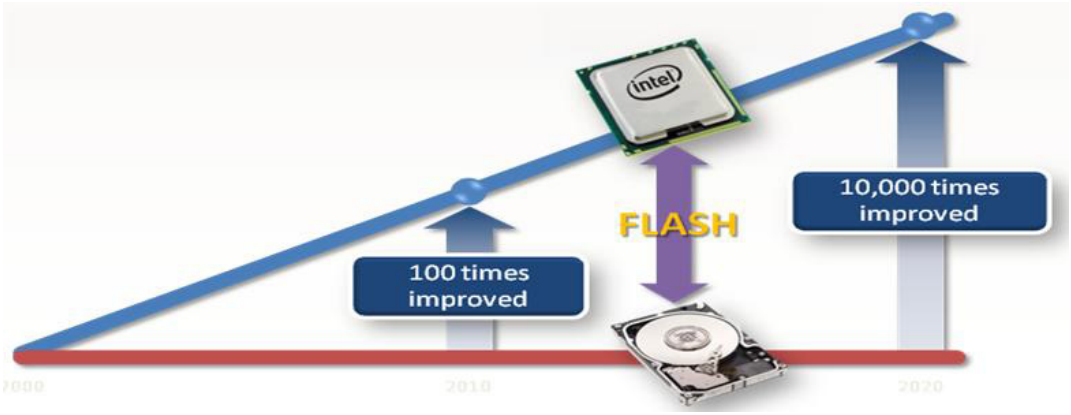

Figure 1. CPU performance versus disk drives

In a traditional architecture, as shown in Figure 2:

- Reads and writes are serviced by the storage array
- Performance varies depending on the back-end array's media, workload, and network

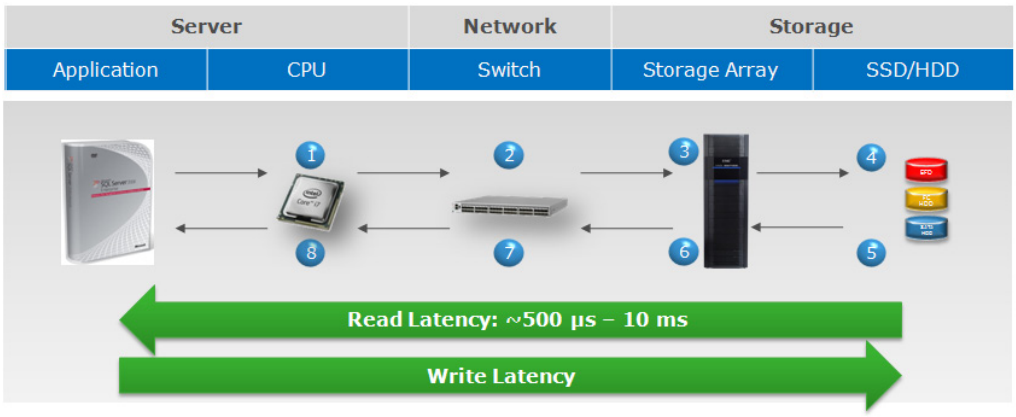

Figure 2. Traditional architecture

What if you could double your application performance by decreasing latency and increasing IOPS and transactions per minute?

The VFCache solution

Server-side Flash caching for maximum speed

EMC VFCache™ is a server Flash caching solution that uses intelligent caching software and PCIe Flash technology to reduce latency and increase throughput, which dramatically improves application performance.

VFCache software caches the most frequently used data on the server-based PCIe card, thereby putting the data closer to the application, as shown in Figure 3. This reduces the need to access data across the network from the storage array, which both decreases response time and increases performance.

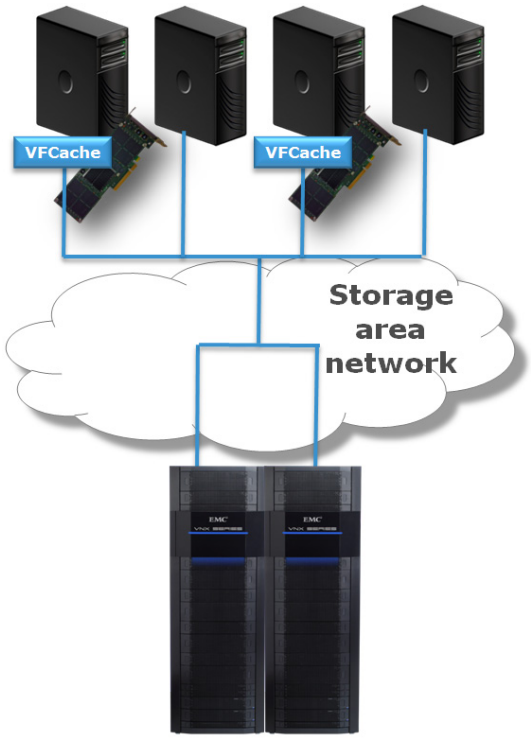

Figure 3. VFCache accelerates I/O performance within the server

The VFCache caching optimization automatically adapts to changing workloads by determining which data is most frequently referenced and promoting it to the server Flash cache. This means that the "hottest" data automatically resides on the PCIe card in the server for faster access.

As shown in Figure 4, the VFCache advanced architecture combines accelerated performance with data protection:

- Reads are serviced by VFCache for performance
- Writes are passed through to the storage array for protection

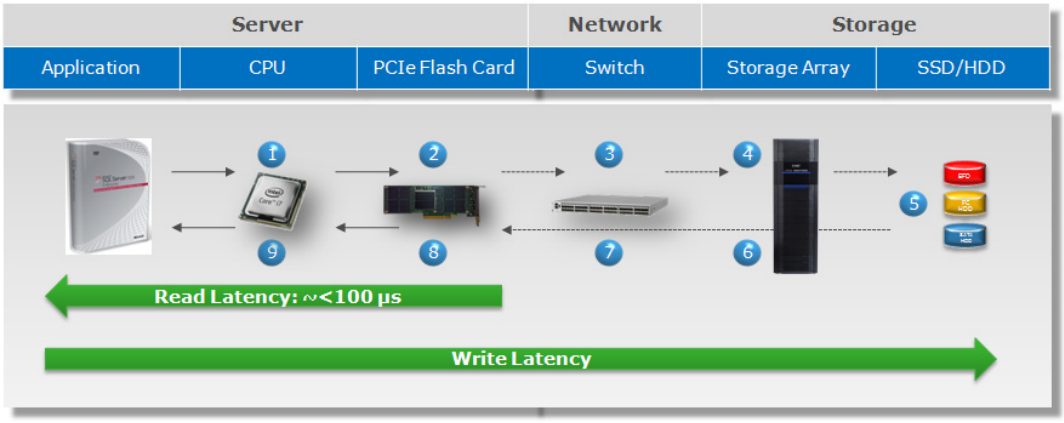

Figure 4. Advanced architecture with EMC VFCache

VFCache provides better performance for read-intensive applications. In this test, VFCache demonstrated a throughput improvement, measured in transactions per minute, of 260 percent and an 87 percent reduction in read latency. VFCache works with applications as diverse as databases, analytics, enterprise application servers, email, and web servers to give them the performance boost they need.

VFCache enhances both virtualized and bare-metal applications so you can smoothly migrate your data center to a private cloud at a pace that makes sense for your business[1].

Write-through caching to the array for total protection

VFCache protects data by using a write-through algorithm, which means that writes persist to the back-end storage array. EMC trusted networked storage, such as the EMC® Symmetrix VMAX™ and the EMC VNX™ family of storage arrays, protect data with advanced data services, which include high availability, data integrity, reliability, and disaster recovery.

Application agnostic

VFCache is transparent to applications, so no rewriting, retesting, or recertification is required to deploy VFCache in your environment.

While this white paper focuses on Microsoft SQL Server 2008, the VFCache architecture can directly enhance the performance of many other applications and

[1] VFCache is not supported in shared disk environments or active/active clusters.

indirectly enhance write-intensive applications that now have greater access to SAN resources.

Shareable and scalable

While directly enhancing the performance of read-intensive applications, VFCache can indirectly enhance write-intensive applications that now have greater access to SAN resources.

VFCache offloads much of the read traffic from the storage array, which allows it to allocate greater processing power to other applications. While one application is accelerated with VFCache, the array's performance for other applications is maintained or even slightly enhanced. As VFCache is installed on more servers in the environment, the result is a highly scalable I/O processing model. The environment as a whole, including the servers and the storage system, is capable of processing increasingly more IOPS.

For more information about EMC VFCache, see the white paper *Introduction to EMC VFCache*.

Solution architecture

Introduction

This section provides an overview of the physical architecture of this solution.

Physical architecture

Figure 5 shows the physical architecture for this solution.

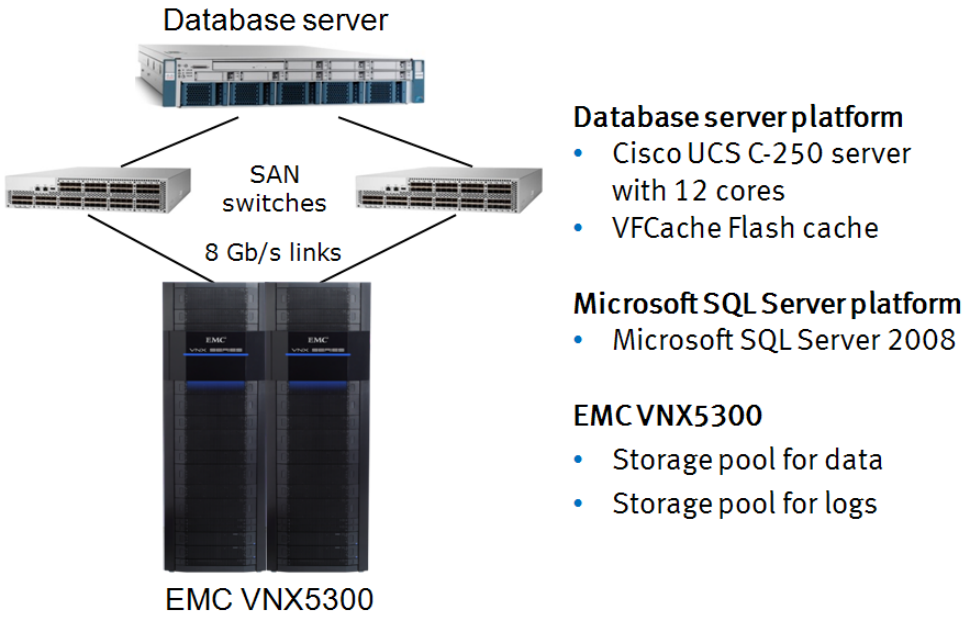

Figure 5. EMC VFCache with Microsoft SQL Server and VNX5300

The solution architecture consists of a Microsoft SQL Server 2008 R2, Cisco server, and a VNX storage array. The solution can be configured with various storage arrays, such as EMC Symmetrix VMAXe™ or VNX. In this solution, we used VNX5300. The server used for this test configuration was Cisco UCS C-250 rack mount with two Xeon processors and a total of 12 cores. The server configuration included the VFCache server-based Flash cache and two 8 Gb/s connections to the SAN switches.

EMC VNX

The EMC VNX family delivers industry-leading innovation and enterprise capabilities for file, block, and object storage in a scalable, easy-to-use solution. This storage platform combines powerful and flexible hardware with advanced efficiency, management, and protection software to meet the demanding needs of today's businesses.

The VNX series is designed to meet the high-performance, high-scalability requirements of midsize and large businesses.

VNX and EMC VNXe™ are supported by VFCache when used for block storage access.

VFCache technology with Microsoft SQL Server: testing and validation

Introduction

EMC tested the capabilities of VFCache to accelerate online transaction processing (OLTP) performance in a Microsoft SQL Server 2008 environment. This section presents the results of the testing.

Note Benchmark results are highly dependent upon workload, specific application requirements, and system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, this workload should not be used as a substitute for a specific customer application benchmark when critical capacity planning and/or product evaluation decisions are contemplated.

Workload profile

EMC testing used a standard TPC-E-like OLTP workload, with a 750 GB database and a 90/10 percent read/write mix. EMC took a performance baseline to validate the performance characteristics of the environment. EMC then enabled VFCache and took measurements of transactions per second and application-level transaction latency to demonstrate the performance contribution of VFCache to the application.

Recommended configurations

VFCache is enabled on all of the data LUNs. However, VFCache was not enabled on the log LUNs because they are dominated by writes.

No specific tuning was required for Microsoft SQL Server.

With this configuration, VFCache uses its caching algorithms to automatically maintain a copy of the hottest data for immediate access.

Performance characteristics

Figure 6 compares the overall system throughput (transactions per second) of the baseline and VFCache-enabled environments. The availability of the hot data in the server's VFCache resulted in a 260 percent improvement in transactions per second.

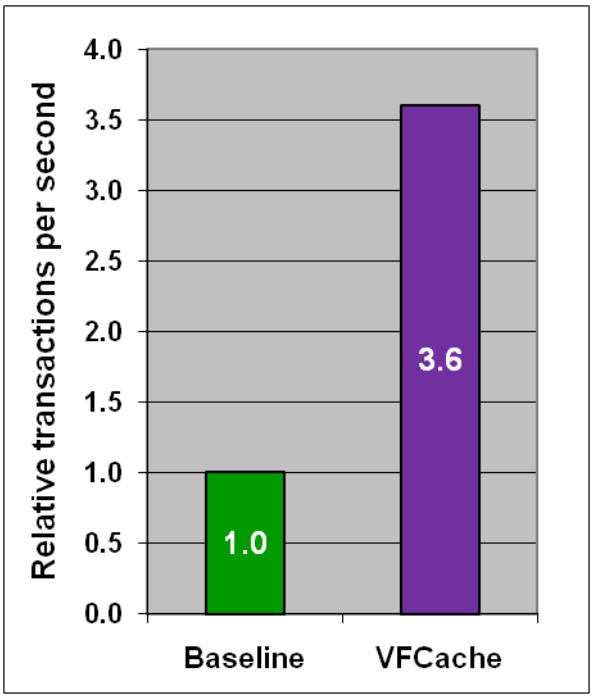

Figure 6. Relative OLTP transactions per second (TPS) improvement

As TPS performance improved by a factor of 3.6, there was an 87 percent reduction in read latency, as shown in Figure 7.

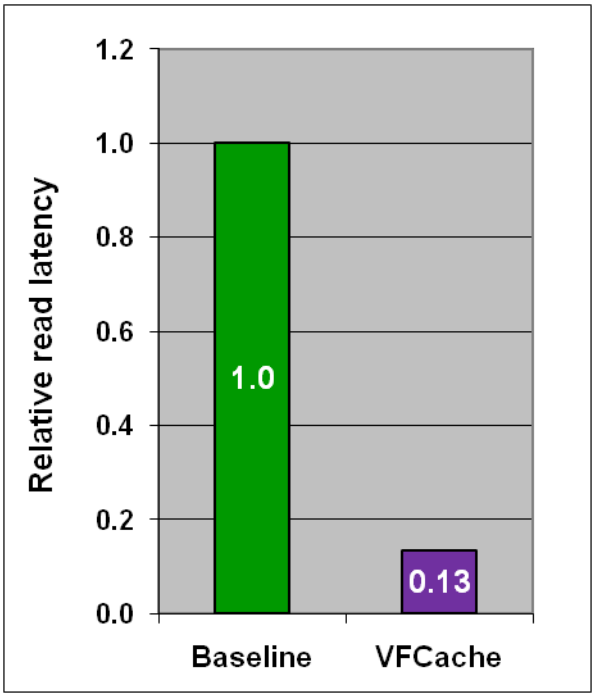

Figure 7. Impact on application-level latency

VFCache copies and stores the hottest read data on the PCIe card within the server. This data can be repeatedly read by the application without sending the I/O request to the back-end storage. In a workload with a 90/10 percent read/write mix, this results in an overall average transaction latency decrease of 87 percent.

It is important to note that individual customers might see different results. Improvements in application performance depend on a variety of factors, including:

- I/O read to write ratio
- Inherent scalability of the workload
- Existing constraints within the storage subsystem, before deploying VFCache
- Tuning of the database
- Sharing of VFCache with other applications

Conclusion

Our testing with a Microsoft SQL Server OLTP workload compared a system equipped with VFCache against a baseline configuration without VFCache. The VFCache-equipped server demonstrated the following performance advantages:

- System throughput, measured in transactions per second, was 3.6 times the throughput of the baseline, without any changes to applications.
- Overall transaction latency was 87 percent less than the baseline.
- VFCache maintained the integrity and protection of the data.

References

White papers

For additional information, see the white papers listed below:

- *Introduction to EMC VFCache*
- *EMC VFCache Accelerates Oracle - EMC VFCache, EMC VNX, EMC Fast Suite, Oracle Database 11g*
- *EMC VFCache Accelerates Oracle - EMC VFCache, EMC Symmetrix VMAX and VMAXe, Oracle Database 11g*
- *EMC VFCache Accelerates Virtualized Oracle - EMC VFCache, EMC Symmetrix VMAX and VMAXe, VMware vSphere, Oracle Database 11g*

Product documentation

For additional information, see the product documents listed below:

- *EMC VFCache* - Data Sheet
- *EMC VNX Family* - Data Sheet