

EMC XTREMCACHE ACCELERATES VIRTUALIZED ORACLE

EMC XtremSF, EMC XtremCache, EMC Symmetrix VMAX and VMAX 10K, VMware vSphere, Oracle Database 11g

- XtremSF and XtremCache dramatically improve Oracle performance
- Symmetrix VMAX and VMAX 10K protects data

EMC Solutions Group

Abstract

This white paper describes the testing of EMC XtremCache with EMC Symmetrix VMAX and VMware vSphere to accelerate online transaction processing (OLTP) performance in a virtualized Oracle Database 11gR2 environment. Though the testing was performed on Symmetrix VMAX SE, the capabilities and benefits of XtremCache are applicable to Symmetrix VMAX 10K.

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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. Server virtualization provides far greater levels of cost-efficiency, but it is critical for IT organizations to explore new ways to access and deliver application data. A solution that delivers higher performance in virtualized applications, without any change to applications, can address these needs.

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.

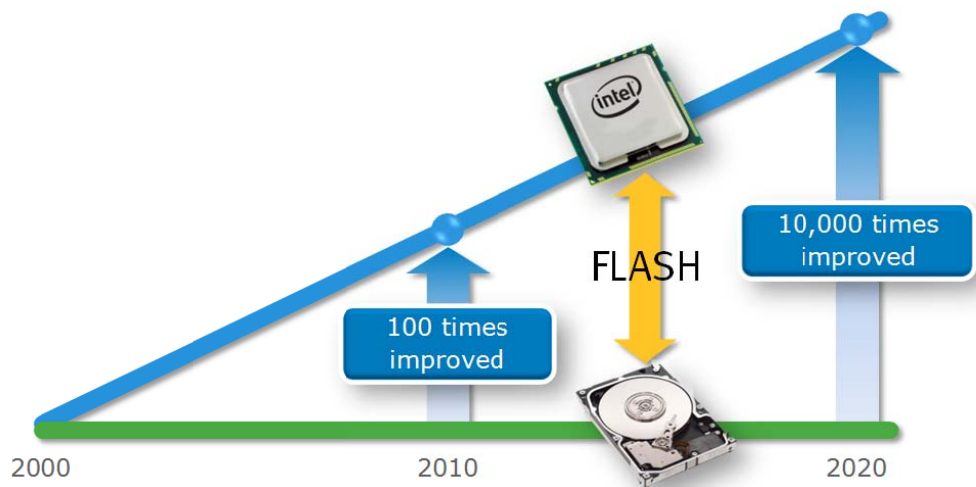


Figure 1. CPU performance versus disk drives

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

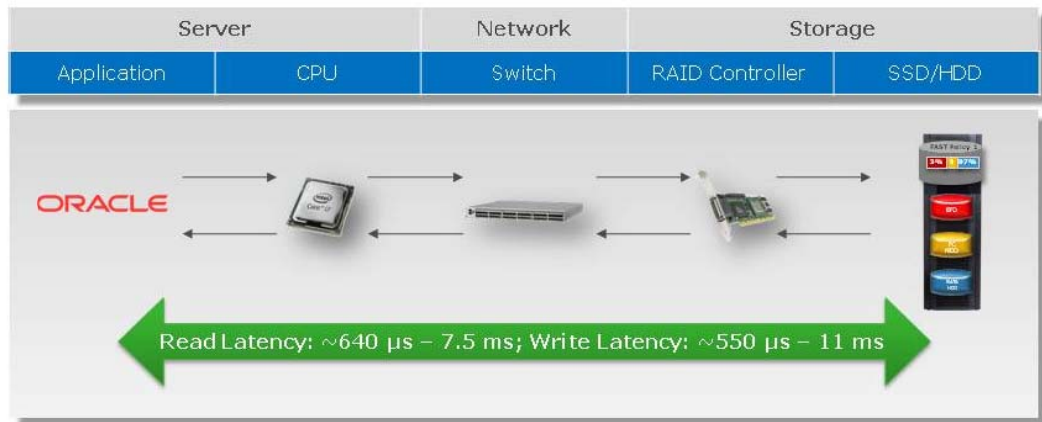


Figure 2. Traditional architecture

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

The XtremCache solution

EMC XtremCache™ 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.

XtremCache brings Flash memory performance into the server. The caching optimization within XtremCache automatically adapts to changing workloads by determining which data is most frequently referenced and promoting it to the server flash cache.

XtremCache 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.

When using XtremCache, the “hottest” data automatically resides on the PCIe card in the server, providing significantly faster access.

XtremCache 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 EMC® Symmetrix VMAX™ and EMC VNXT™ family of storage arrays, protect data with advanced data services, which include high availability, data integrity, reliability, and disaster recovery, as shown in Figure 3.

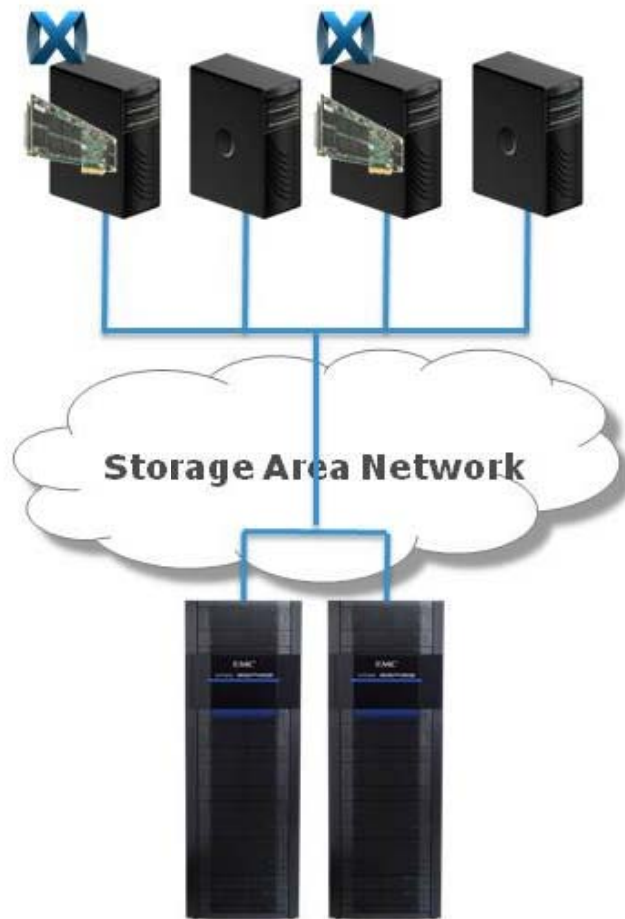


Figure 3. XtremCache accelerates I/O performance within the server

Note XtremCache is not supported in shared disk environments or active/active clusters.

XtremCache is transparent to applications. When XtremCache is present, they do not have to be rewritten, recertified, or retested.

As shown in Figure 4, XtremCache dramatically accelerates the performance of read-intensive applications:

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

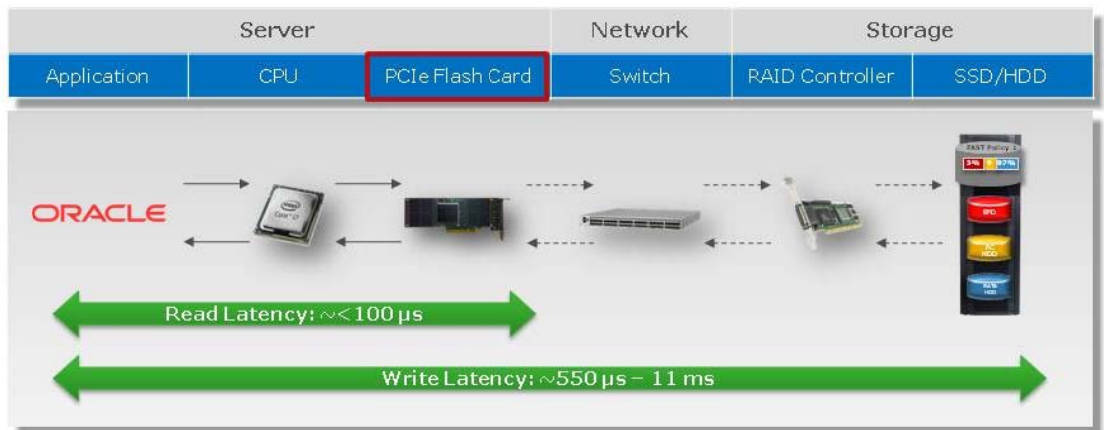


Figure 4. Advanced architecture with EMC XtremCache

While this white paper focuses on Oracle Database 11g, the XtremCache architecture can directly enhance the performance of many other applications and indirectly enhance write-intensive applications that now have greater access to SAN resources.

XtremCache software caches the most frequently used data on the server-based PCIe card, thereby putting the data closer to the application. By operating in the server on the PCIe bus, XtremCache reduces the need to access data across the network from the storage array. This decreases response time and increases performance.

XtremCache provides better performance for the applications that involve heavy read I/O. XtremCache works with applications as diverse as databases, analytics, enterprise application servers, email, and web servers to give them the performance boost they need.

XtremCache offloads much of the read I/O traffic from the storage array, which allows it to allocate greater processing power to other applications. While one application is accelerated with XtremCache, the array's performance for other applications is maintained or even slightly enhanced. As XtremCache 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 XtremCache, see *Introduction to EMC XtremCache*.

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.

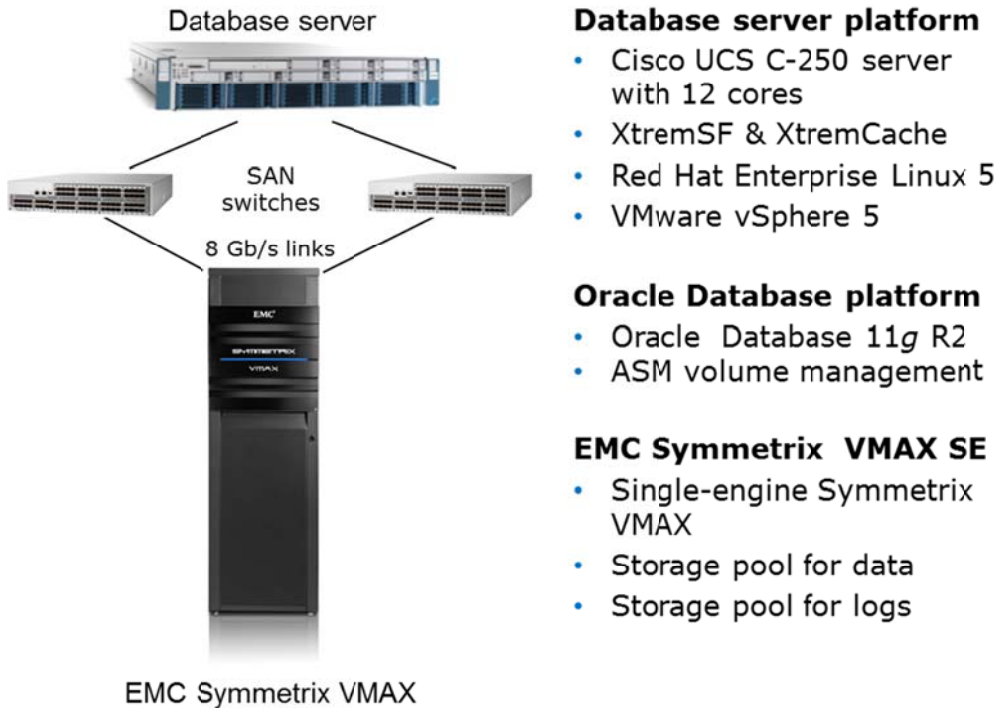


Figure 5. EMC XtremCache with virtualized Oracle Database and EMC Symmetrix VMAX SE

The solution architecture consists of an Oracle Database, Cisco server, and a Symmetrix storage array. The solution can be configured with a number of storage arrays, such as Symmetrix VMAX 10K or VNX. In this solution, we used Symmetrix VMAX SE. The server used for this test configuration was Cisco UCS C-250 rack mount with four Xeon processors and a total of 12 cores. The server configuration included the XtremCache server-based Flash cache and two 8 Gb/s connections to the SAN switches. The system was virtualized using VMware vSphere™ 5 and was run on Red Hat Enterprise Linux 5. The virtual machine had eight vCPUs and 32 GB of memory. Additional virtual machines, if configured, could share the same XtremCache Flash cache.

EMC Symmetrix VMAX

EMC Symmetrix VMAX storage arrays provide high performance and scalability for demanding enterprise storage environments. Built on the strategy of simple, intelligent, modular storage, the VMAX incorporates a highly scalable Virtual Matrix Architecture™ that enables it to grow seamlessly and cost-effectively from an entry-level configuration into the world's largest storage system. The VMAX supports Flash

drives, SAS drives, Fibre Channel (FC) drives, and SATA drives within a single array, as well as an extensive range of RAID types.

VMware vSphere

VMware vSphere uses the power of virtualization to transform data centers into simplified cloud computing infrastructures, and enables IT organizations to deliver flexible and reliable IT services. vSphere virtualizes and aggregates the underlying physical hardware resources across multiple systems and provides pools of virtual resources to the data center.

As a cloud operating system, vSphere manages large collections of infrastructure (such as CPUs, storage, and networking) as a seamless and dynamic operating environment, and also manages the complexity of a data center.

XtremCache technology with virtualized Oracle Database: testing and validation

Introduction

Virtual server environments represent an opportunity to increase server scalability and utilization while centralizing and streamlining system management.

EMC tested the capabilities of XtremCache to accelerate online transaction processing (OLTP) performance in a virtualized Oracle Database 11gR2 environment using VMware vSphere 5. This section presents the results of the testing.

Notes

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's testing employed a standard TPC-C-like OLTP workload, with a 1.2 TB database and a 70-30 percent read/write mix. EMC took a performance baseline to validate the performance characteristics of the environment. EMC enabled XtremCache and then took measurements of transactions per minute to demonstrate the performance contribution of XtremCache to the application. This is shown in Figure 8 on page 12.

This 1.2 TB database had approximately 250 GB of hot data.

Recommended configurations

In a virtualized environment, multiple virtual machines on the same server may share the performance advantages of a single XtremCache card. As shown in Figure 6, XtremSF resides on the server host, while XtremCache is installed on each of the virtual machines that will be accelerated by XtremCache. XtremCache VSI Plug-in, which resides on the vCenter client, is used to manage XtremCache.

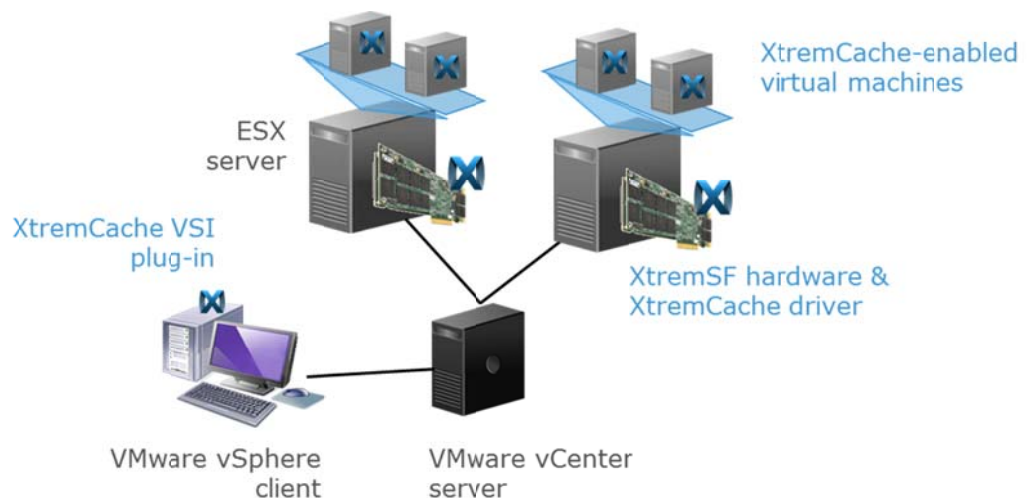


Figure 6. XtremCache implementation in a virtualized environment

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

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

No specific tuning was required for Oracle Database.

The virtual machine disk (VMDK) layout of the physical disks is shown in Figure 7. It is best to isolate the XtremCache VMDK to its own virtual Host Bus Adapter (vHBA).

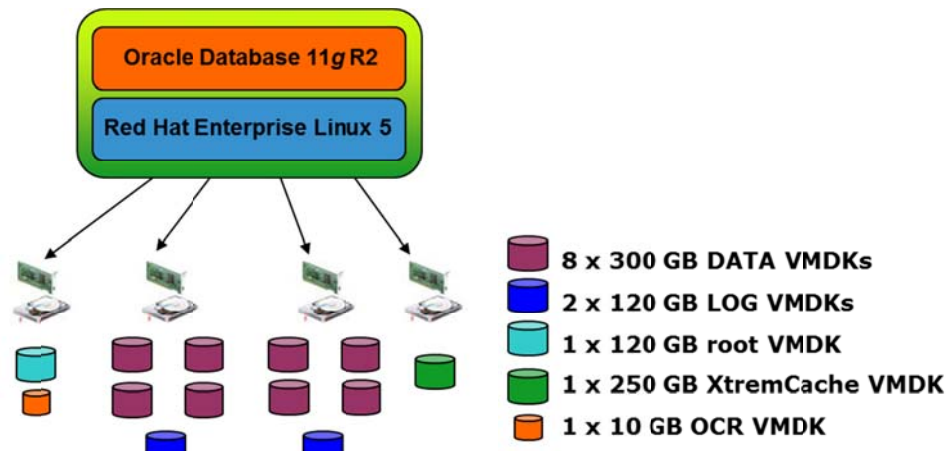


Figure 7. VMDK layout of physical disks

Performance characteristics

Figure 8 compares the overall system throughput (transactions per minute) of the baseline and XtremCache-enabled environments. The availability of the hot data in the server's XtremCache resulted in an 80 percent improvement in transactions per minute.

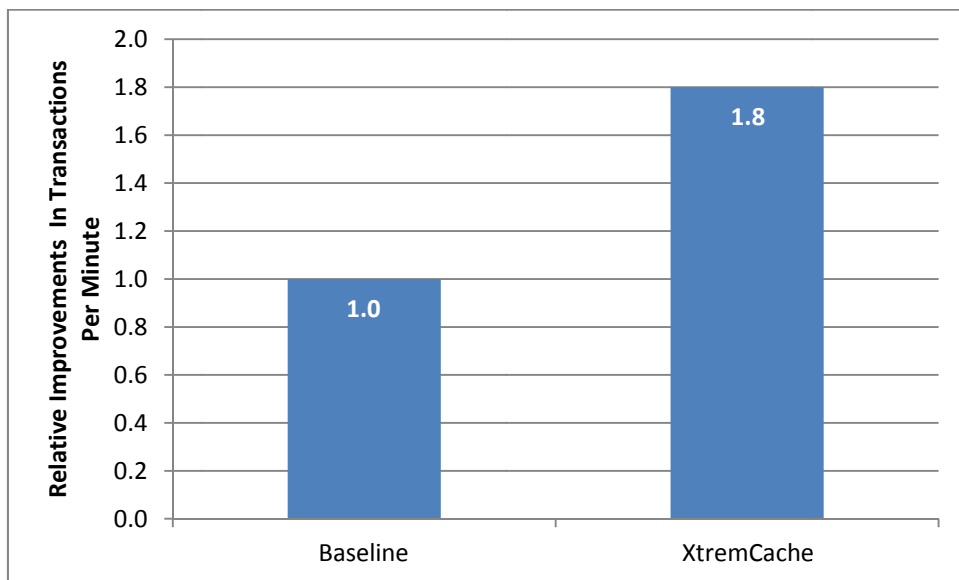


Figure 8. Relative OLTP transactions per minute (TPM) improvement

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

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

Conclusion

Our testing in an Oracle OLTP workload compared a system equipped with XtremCache against a baseline configuration without XtremCache. The XtremCache-equipped server delivered an 80 percent improvement in transactions per minute compared to the baseline configuration, without any changes to applications.

XtremCache maintains the integrity and protection of the data.

References

White papers

For additional information, see the white papers listed below:

- *Introduction to EMC XtremCache*
- *EMC XtremCache Accelerates Oracle—EMC XtremSF, EMC XtremCache, EMC Symmetrix VMAX and VMAX 10K, Oracle Database 11g*
- *EMC XtremCache Accelerates Oracle—EMC XtremSF, EMC XtremCache, EMC VNX, Oracle Database 11g*
- *EMC XtremCache Accelerates Microsoft SQL Server—EMC XtremSF, EMC XtremCache, EMC VNX, Microsoft SQL Server 2008*

Product documentation

For additional information, see the product documents listed below:

- *EMC XtremCache Data Sheet*
- *EMC Symmetrix VMAX Data Storage System Specification Sheet*
- *VMware vSphere 5 Data Sheet*