



Virtualizing SQL Server 2008 Using  
EMC VNX Series and Microsoft  
Windows Server 2008 R2 Hyper-V

Reference Architecture

EMC Unified Storage Solutions



Copyright © 2011 EMC Corporation. All rights reserved.

Published February, 2011

EMC believes the information in this publication is accurate as of its publication date. The information is subject to change without notice.

The information in this publication is provided “as is”. EMC Corporation makes no representations or warranties of any kind with respect to the information in this publication, and specifically disclaims implied warranties of merchantability or fitness for a particular purpose.

Use, copying, and distribution of any EMC software described in this publication requires an applicable software license.

For the most up-to-date listing of EMC product names, see EMC Corporation Trademarks on [EMC.com](http://EMC.com).

All other trademarks used herein are the property of their respective owners.

Part number: h8164

## Table of Contents

---

Reference architecture overview.....	4
Solution architecture .....	7
Key components .....	9
Validated environment profile.....	11
Hardware and software resources .....	13
Conclusion.....	14

---

## Reference architecture overview

---

### Document purpose

EMC's commitment to consistently maintain and improve quality is led by the Total Customer Experience (TCE) program, which is driven by Six Sigma methodologies. As a result, EMC has built Customer Integration Labs in its Global Solutions Centers to reflect realworld deployments in which TCE use cases are developed and executed. These use cases provide EMC with an insight into the challenges currently facing its customers.

This document describes the reference architecture of the Virtualizing SQL Server 2008 Using EMC® VNX™ Series and Microsoft Windows Server 2008 R2 Hyper-V solution, which was tested and validated by the EMC Unified Storage Solutions group. The architecture provides a known starting point for the development of a customer implementation and also provides guidelines on how to apply best practices in real world.

---

### Introduction to the EMC VNX series

VNX series delivers uncompromising scalability and flexibility for the midtier while providing market-leading simplicity and efficiency to minimize total cost of ownership. Customers can benefit from the new VNX features such as:

- Next-generation unified storage, optimized for virtualized applications
- Extended cache using Flash drives with FAST Cache and Fully Automated Storage Tiering for Virtual Pools (FAST VP), which can be optimized for the highest system performance and lowest storage cost simultaneously on both block and file.
- Multiprotocol support for file, block, and object with object access through Atmos™ Virtual Edition (Atmos VE).
- Simplified management with EMC Unisphere™ for a single management framework for all NAS, SAN, and replication needs.
- Up to three times improvement in performance with the latest Intel multicore CPUs, optimized for Flash.
- 6 Gb/s SAS back end with the latest drive technologies supported:
  - 3.5" 100 GB and 200 GB Flash, 3.5" 300 GB, and 600 GB 15k or 10k rpm SAS, and 3.5" 2 TB 7.2k rpm NL-SAS
  - 2.5" 300 GB and 600 GB 10k rpm SAS
- Expanded EMC UltraFlex™ I/O connectivity—Fibre Channel (FC), Internet Small Computer System Interface (iSCSI), Common Internet File System (CIFS), Network File System (NFS) including parallel NFS (pNFS), Multi-Path File System (MPFS), and Fibre Channel over Ethernet (FCoE) connectivity for converged networking over Ethernet.

The VNX series includes five new software suites and three new software packs, making it easier and simpler to attain the maximum overall benefits.

#### Software suites available

- VNX FAST Suite—Automatically optimizes for the highest system performance and the lowest storage cost simultaneously (FAST VP is not part of the FAST Suite for the VNX5100™).
- VNX Local Protection Suite—Practices safe data protection and repurposing.
- VNX Remote Protection Suite—Protects data against localized failures, outages, and disasters.
- VNX Application Protection Suite—Automates application copies and proves

- compliance.
- VNX Security and Compliance Suite—Keeps data safe from changes, deletions, and malicious activity.

#### **Software packs available**

- VNX Total Efficiency Pack—Includes all five software suites (not available for the VNX5100).
- VNX Total Protection Pack—Includes local, remote, and application protection suites.
- VNX Total Value Pack—Includes all three protection software suites and the Security and Compliance Suite (the VNX5100 exclusively supports this package).

---

#### **Solution purpose**

The purpose of this reference architecture is to build a unified storage solution using EMC VNX series with Microsoft Hyper-V for Microsoft SQL Server 2008, and describe the solution benefits in an online transaction processing (OLTP) database environment. This reference architecture validates the performance of all aspects of the solution and provides guidelines to build similar solutions.

This reference architecture is not intended to be a comprehensive guide to every aspect of the solution.

---

#### **The business challenge**

Databases are an ever-present and ever-growing component of any modern business system. Databases contain critical data and are the backbone of most corporate information systems. They are updated and upgraded regularly to meet constantly changing and ever-increasing user requirements. Surveys on customer environments indicate that reliable, high-performance storage, and appropriate resource utilization are the key areas of concern.

Databases typically use spinning disk media as the destination for their production data. Most people think of disks in terms of the data that can be stored on them. This refers to the storage capacity of the disk. The growth of data in gigabytes (GB) and terabytes (TB) is a measurement of the required storage capacity of the underlying disk system. However, another constraint in the design of storage systems is how quickly the data can be accessed. This refers to the performance capacity of the disk. Because the performance capacity of the disk directly translates into user experience, this constraint often exhibits challenges in planning and maintaining any production system.

Traditionally, storage administrators add both performance and storage capacities to a system by adding disk spindles and various volume management techniques to harness the limits of the system. This method, while functional, is inefficient. It often leads to “short-stroking,” where only a small portion of the storage capacity of the drive is used, while drawing its entire performance capacity. This leaves the additional storage capacity on the drive essentially inaccessible without negatively impacting the performance of the database residing on it.

Database servers are almost always considered to require the best and fastest hardware in addition to a lot of resources. In many cases this is true. But, in some cases, the database server may have excess capacity. When combined with the virtualize-everything mantra that is common in data centers, it presents compelling reasons to consider virtualizing a SQL server. Any change to a core infrastructure

element such as a database server is a major undertaking, which should be approached with appropriate planning, and consideration for all of the implications of such a change.

---

**The technology solution**

This reference architecture depicts a validated solution using an EMC VNX platform and demonstrates the benefits of EMC VNX series along with Microsoft Windows Server 2008 R2 Hyper-V for Microsoft SQL Server in an OLTP environment. The solution includes the virtualization of SQL Server using Hyper-V, but many elements of this solution are applicable in a nonvirtualized environment.

---

**Solution benefits**

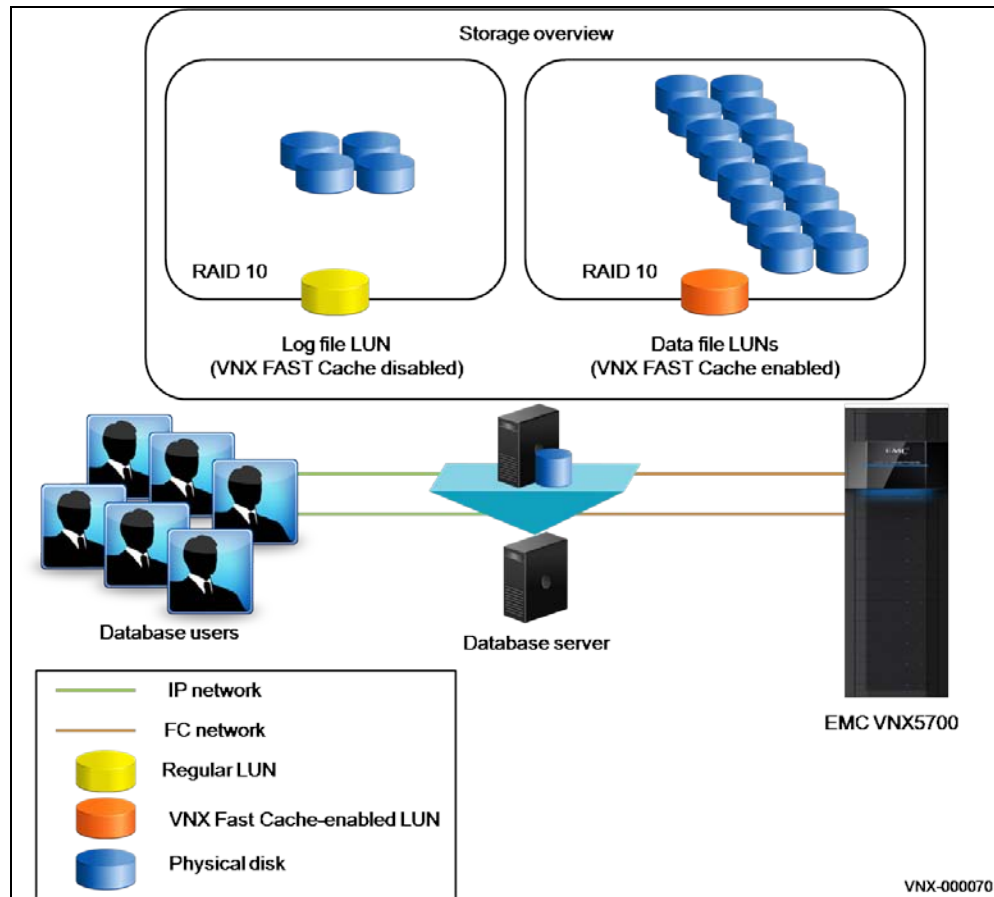
The solution provides the following benefits to an OLTP database environment:

- Efficient use of disk spindle resources
  - Lower power consumption
  - Faster response time
-

## Solution architecture

### Architecture diagram

The following diagram shows the overall architecture of the solution. VNX FAST Cache technology is an optional component of the solution.



### Reference architecture overview

This reference architecture contains a single Microsoft SQL server running on an EMC storage array. The simplicity of the setup helps to clearly illustrate the performance of the system. In practice, this solution can be used with many other databases concurrently, as long as the planning considers that each database will contribute to the overall workload of the system. It is a best practice to plan each database separately and to provision dedicated storage resources to achieve predictable performance.

### Storage layout overview

For testing purposes, the database was created using LUNs from a RAID 10 group for the database files, and LUNs from another RAID 10 group for the transaction log. The allocation of these LUNs followed the applicable best practices for the optimal number of data files with regard to the number of processor cores. In a realworld environment, these LUNs are sized based on the expected workload of the system.

**Network layout  
overview**

The Internet Protocol (IP) and Fibre Channel (FC) networks shown in the architecture diagram are configured based on the relevant best practices and are architected for high availability. This requires redundant links between all the system components and no single point of failure in the design. The networks are sized so they can easily handle the projected traffic of the test workload.

---

## Key components

---

### Introduction

This section briefly describes the key components of this solution.

- Microsoft SQL Server
- EMC VNX series
- VNX FAST Cache
- Microsoft Windows Server 2008 R2 Hyper-V
- EMC PowerPath®

The “[Hardware and software resources](#)” section on page 13 provides details on all the components that make up the solution.

---

### Microsoft SQL Server

Microsoft SQL Server is a relational database management system (RDBMS) that is commonly used in many business-critical applications to store, retrieve, and manage application data. It is sometimes considered an application, but is more appropriately considered an application environment. Each individual business application has a dedicated set of database tables and associated query patterns that comprise the workload on the system as seen from a SQL server.

While each application has a unique workload, there are common classifications of workload based on the type of data they are using. From these common classifications, benchmark standards are calculated. These standards can be used to compare the performance of the systems. While these standards are not a substitute for a detailed analysis of the actual workload, they can help start the planning process.

The solution presented here targets an OLTP workload consisting of many small transactions that are random in nature. The test workload is based on the TPC-C benchmark standard.

---

### EMC VNX series

EMC VNX series is a dedicated network server optimized for file and block access, delivering high-end features in a scalable and easy-to-use package.

For high scalability, EMC VNX series uses:

- The innovative EMC VNX for block storage platform, delivering best-in-class availability and data protection.
- The EMC VNX for file storage platform's availability, performance, and ease of management.

The VNX series delivers a single-box block and file storage solution, which offers a centralized point of management for distributed environments. This makes it possible to dynamically grow, share, and cost-effectively manage multiprotocol file systems and provide multiprotocol block access. Administrators can take advantage of simultaneous support for the NFS and CIFS protocols by using VNX for file's file-locking mechanisms to allow Windows and Linux/UNIX clients to share files. In addition, they can use iSCSI or FC for high-bandwidth or latency-sensitive applications. EMC VNX provides five 9s (99.999 percent) availability through advanced failover, high availability, and fault-tolerant networking options.

---

**VNX FAST  
Cache**

The VNX FAST Cache feature makes it possible to dramatically expand the read and write cache available on the storage array by using EMC Enterprise Flash Drive (EFD) devices as a cache location. Testing has shown that random access to data on EFDs is much faster than accessing data using a similar FC disk spindle.

---

**Microsoft  
Windows  
Server 2008 R2  
Hyper-V**

Windows Server 2008 Hyper-V is an integral feature of Windows Server 2008 R2 and enables users to implement server virtualization with ease. Hyper-V enables users to make the best use of the server hardware investments by consolidating servers and enabling a high-performance virtual environment. It eases IT infrastructure management and reduces costs while retaining and enhancing competitive advantages such as flexibility, reliability, scalability, and security.

Windows Server 2008 R2 Hyper-V supports hot plug-in and hot removal of storage. By supporting the addition or removal of virtual hard disk files and pass-through disks while a virtual machine is running, Hyper-V makes it possible to reconfigure virtual machines quickly to meet changing workload requirements.

In a Hyper-V virtualized environment, storage can be provisioned to a SQL Server database in different ways including virtual hard disks (VHD) and pass-through disk.

**VHD** – The mapped LUNs on the physical Microsoft Windows Server 2008 Hyper-V are formatted as VHDs. Virtual disks are provisioned on these file systems and presented to the virtual machine as ready-to-use drives.

**Pass-through disk** – A Hyper-V host disk can be exposed to the guest virtual machine without putting a volume on it by using a pass-through disk. Hyper-V allows the users to “bypass” the host’s file system and access a disk directly.

---

**EMC  
PowerPath**

PowerPath is a server-resident software solution designed to enhance performance and application availability. PowerPath combines automatic load balancing, path failover, and multiple I/O capabilities into one integrated package. PowerPath enhances application availability by providing load balancing and automatic path failover and recovery functionality.

---

## Validated environment profile

### Profile characteristics

The solution was validated with the following environment profile.

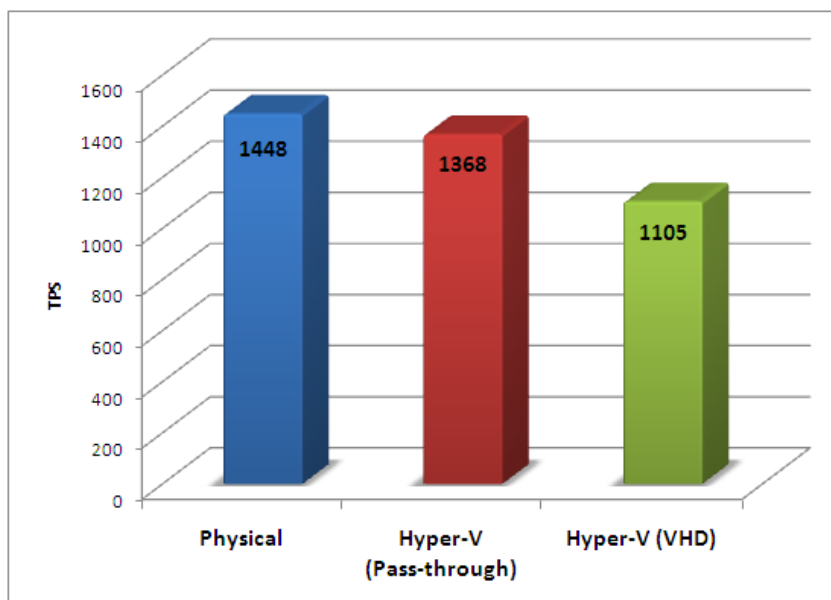
Profile characteristic	Value
SQL database size	400 GB
Instances and databases	Single instance and single database
Number of database files	Four files, each on a different LUN
Workload	OLTP (TPC-C-like)
Storage for SQL database	FC storage
RAID type, physical drive size, and speed of the production SQL 2008 databases	RAID 10, 300 GB SAS drives (15k rpm)
FAST Cache configuration	4 x 100 GB EFDs, RAID 1 configuration

### Key results summary

Following are some of the important results that were obtained after validating this solution:

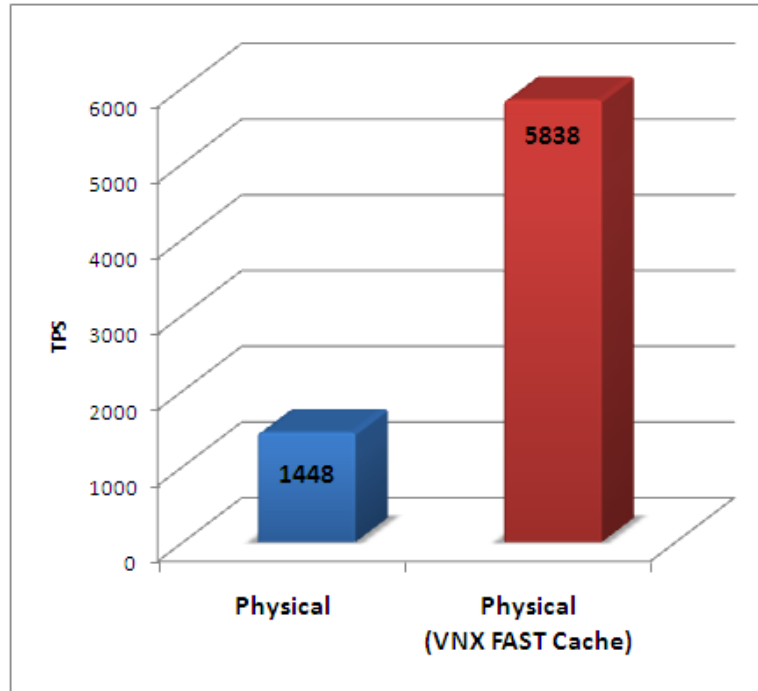
- EMC VNX series storage performed well in a SQL 2008 OLTP environment. The tested profile achieved 1,448 transactions per second (TPS) in the physical environment and achieved more than 1,300 TPS in the Hyper-V environment.
- Virtualizing SQL Server on Hyper-V can be achieved with less than 10 percent impact on the maximum transaction load of the system.

Scenarios	Physical	Hyper-V (Pass-through)	Hyper-V (VHD)
Maximum TPS achieved	1,448	1,368	1,105
TPS degradation (in percentage)	Baseline	5.52	23.69



- Adding FAST Cache to the existing configuration improved performance by over 300 percent.

Scenarios	Physical	Physical (FAST Cache)
Maximum TPS achieved	1,448	5,838
TPS comparison	Baseline	300 percent



## Hardware and software resources

---

### Hardware

The following table lists the hardware used to validate the solution.

Equipment	Quantity	Configuration	Notes
Storage	1	<ul style="list-style-type: none"><li>• EMC VNX5700™</li><li>• 300 GB SAS drives (15k rpm)</li><li>• 4 x 100 GB EFDs</li></ul>	Primary database storage
Enterprise-class FC switch	1	4 GB FC switch	Production systems may require additional hardware for high-availability purposes
Enterprise network switch	1	Gigabit Ethernet (GbE) switch	Production systems may require additional hardware for high-availability purposes
Dell PowerEdge R710	1	<ul style="list-style-type: none"><li>• Two quad-core Intel Xeon X5550 with 2.67 GHz 64-bit processors</li><li>• 64 GB RAM</li></ul>	Primary database server
Dell PowerEdge 2950	4	Two quad-core Intel Xeon E5440 with 2.83 GHz 64-bit processors	Load generation for test workload

---

### Software

The following table lists the software used to validate the solution.

Software	Version
Microsoft Windows Server	<ul style="list-style-type: none"><li>• Windows 2008 x64 Enterprise Edition R2</li><li>• Windows 2003 x32 Enterprise Edition R2 SP2</li></ul>
Microsoft SQL Server	Enterprise Edition 2008 SP1
VNX OE for block	05.31.000.3.071
EMC PowerPath	5.3 SP1

---

## Conclusion

---

### Summary

This reference architecture depicts a validated solution using the EMC VNX platform and demonstrates the performance benefits of using EMC VNX series and Microsoft Windows Server 2008 R2 Hyper-V for Microsoft SQL Server in an OLTP environment. The solution demonstrates how to achieve improved performance with VNX FAST Cache, and how to successfully virtualize SQL Server with Hyper-V.

---

### Next steps

EMC can help accelerate assessment, design, implementation, and management while lowering the implementation risks and costs of a unified storage solution for a Microsoft SQL Server environment.

To learn more about this and other solutions, contact an EMC representative.

---