



SQL Server on VMware Use Cases

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1. Background

"I found out that if you are going to win games, you had better be ready to adapt."
Scotty Bowman

Microsoft SQL Server is one of the most widely deployed database platforms in the world, with many organizations having dozens or even hundreds of instances deployed in their environments. The flexibility of SQL Server with its rich application capabilities translates directly into application flexibility, giving end-users more useful application features and ultimately improving productivity.

But application flexibility comes at a cost to operations. As the number of applications in the enterprise continues to grow, an increasing number of SQL Server platforms are brought under lifecycle management. Each application has its own set of requirements for the database layer, resulting in multiple versions, patch levels, and maintenance processes. As application workloads vary widely, many of these SQL Server platforms are given more hardware than they need, while others are starved for compute resources.

The challenge for the administrator is to provide database services to application owners with the flexibility and autonomy they expect while keeping the infrastructure as simple and economical as possible. Traditional database consolidation can be a complex endeavor requiring in-depth application remediation at the forefront and rigorous attention to operational processes implemented for version control and continued application compatibility.

Virtualizing Microsoft SQL Server with VMware vSphere® can allow the best of both worlds, simultaneously optimizing compute resources through server consolidation and maintaining application flexibility through role isolation. SQL Server platforms can be migrated in their current state without expensive and error-prone application remediation and without changing operating system or application version or patch level. For high performance databases, VMware and partners have demonstrated the capabilities of vSphere to run the most challenging SQL Server workloads. For smaller, specialized databases, vSphere offers high consolidation ratios and advanced resource scheduling features, giving application owners the flexibility and performance they need while simplifying and lowering costs for the enterprise.

2. Microsoft Support Considerations

Customers looking to take advantage of VMware virtualization technology in their Microsoft environment can now benefit from recent improvements in Microsoft licensing and support policies. The following are important changes:

- Support for SQL Server running on VMware Infrastructure™ or vSphere – VMware ESX® 3.5 Update 2 was the first hypervisor to be listed under the Microsoft Server Virtualization Validation Program (SVVP). This certification provides VMware customers who run ESX 3.5 Update 2 or later (including vSphere), Windows Server 2008, and SQL Server 2005 or later versions access to cooperative technical support from Microsoft and VMware. If escalation is required, VMware can now escalate mutual issues rapidly and work directly with Microsoft engineers to expedite resolution. With this support program in place, customers can now take advantage of the many benefits that come with virtualization of SQL Server on vSphere. For more information on the Microsoft Server Virtualization Validation Program, see <http://windowsservercatalog.com/svvp.aspx?svvppage=svvp.htm>.
- Relaxed policies for application license mobility – SQL Server 2012 further relaxed its licensing policy for customers under Software Assurance (SA) coverage. With SA, you can re-assign SQL Server licenses to different servers within a server farm as often as needed. You can also reassign licenses to another server in another server farm, or to a non-private cloud, once every 90 days. For additional information, see <http://www.microsoft.com/en-us/download/details.aspx?id=21793>.

3. SQL Server Performance Considerations

VMware vSphere v5.1 brings performance and scalability to a new level. In vSphere 5.1, a single virtual machine can scale up to 64 vCPU and 1TB of memory. Even the largest SQL Server can fit in a virtual machine. The improved resource management capabilities in vSphere 5.1 enable higher consolidation ratios with unequaled performance. The greater consolidation can significantly reduce the cost of physical infrastructure and of licensing SQL Server, even in smaller-scale environments.

In 2009, VMware conducted a detailed performance analysis of Microsoft SQL Server 2008 running on vSphere v4. The performance test placed a significant load on the CPU, memory, storage, and network subsystems. The results demonstrated efficient and highly scalable performance for an enterprise database workload running on a virtual platform.

The test demonstrated the performance and scalability of the vSphere platform as follows:

- Measured performance of SQL Server 2008 in an 8 virtual CPU (vCPU), 58GB virtual machine using a high end OLTP workload derived from TPC-E1.
- Scaled the workload, database, and virtual machine resources from 1 vCPU to 8 vCPUs (scale up tests).
- Consolidated multiple 2 vCPU virtual machines from 1 to 8 virtual machines, effectively over-committing the physical CPUs (scale out tests).
- Quantified the performance gains from some of the key new features in vSphere.

The following metrics were used to quantify performance:

- Single virtual machine OLTP throughput relative to native (physical machine) performance in the same configuration.
- Aggregate throughput in a consolidation environment.

For further details, see *Performance and Scalability of Microsoft SQL Server on VMware vSphere 4* (http://www.vmware.com/files/pdf/perf_vsphere_sql_scalability.pdf).

4. Benefits of Virtualizing SQL Server

In this section, we examine some of the primary technical benefits that can be achieved by deploying SQL Server on VMware vSphere. These benefits are presented along with examples based on real VMware customer experiences. The examples are described using a composite, fictitious organization named XYZCorp.com. The examples follow XYZCorp.com, a rapidly growing online retailer with 2,000 employees.

4.1 Server Consolidation

Server consolidation provides significant benefits for virtualized SQL Server platforms:

- Utilize all server processor cores.
- Consolidate SQL Server platforms with minimal impact to applications.
- Consolidate SQL Server licenses.

4.1.1 Utilize All Server Processor Cores

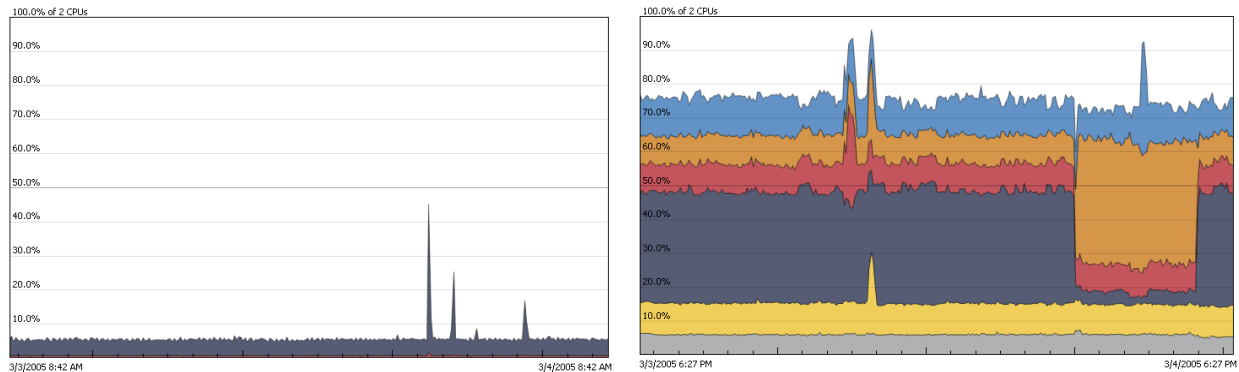
Large multicore servers are becoming the norm and most applications cannot take advantage of all the processor cores in a physical server. Although vSphere virtual machines can scale to 32 vCPU if needed for the workload, smaller virtual machines offer flexibility in placement and can help increase consolidation ratios and improve performance.

Today's 64-bit servers come with increasing numbers of multi-core CPUs, increased memory limits, and physical RAM. For many organizations, particularly those not using virtualization, it is unlikely that a single SQL Server will use the full computing power of these systems. However, in many cases, the cost of filling all available processor slots when purchasing a new 64-bit server might not result in a substantial cost increase. With vSphere, this extra CPU power is put to good use.

For example, smaller SQL Server deployments might be able to benefit from server consolidation while still preserving database server isolation. Larger environments can run large SQL Server virtual machines with up to 1TB of RAM and benefit from the increased flexibility that vSphere provides. Running multiple virtual machines on these 64-bit systems is an excellent way to maximize the value derived from this powerful hardware.

Example: XYZCorp has been fortunate to experience substantial growth. The IT department plans to purchase two new 64-bit servers for a new application that requires a SQL Server database. The servers each have two hex-core CPUs and 128GB of physical RAM. As a small company, even with recent growth, the application environment does not use the full physical resources of these powerful servers. To fully utilize the hardware, the IT department runs the application and SQL Server virtual machines on the new 64-bit servers, and also migrates other SQL Server databases to the new environment. The IT department is now able to maintain CPU and RAM utilization at 65%, maximizing value to the organization and providing a rapid ROI on this hardware investment. As an added benefit, IT staff can retire several older servers that were previously running SQL Server.

Figure 1. CPU Utilization on a vSphere Host Before and After Consolidation



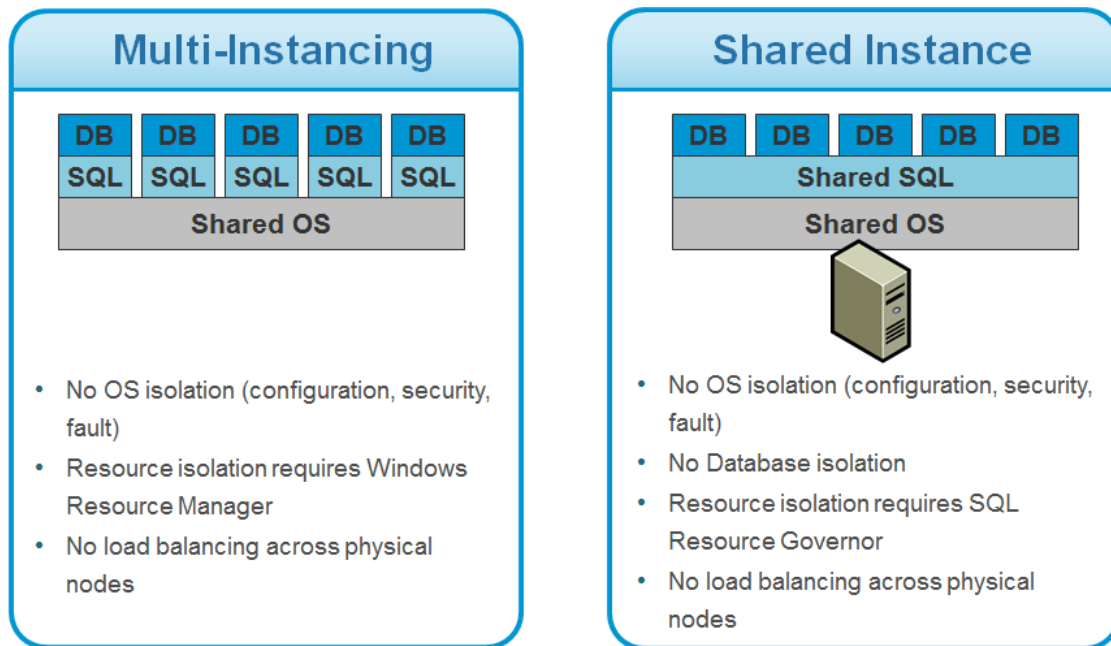
4.1.2 Consolidate SQL Server Platforms with Minimal Impact to Applications

Traditional database consolidation can be difficult to achieve, as it requires in-depth application remediation and changes to existing business processes. Each application has its own requirements for the database layer (operating system and SQL Server versions, patch levels, and so on) and many applications either have technical issues preventing a migration or concerns about violating ISV support agreements. When you consolidate SQL Server using vSphere, you can preserve your existing SQL Server configurations. Simply migrate physical servers “as-is” using P2V or by swinging LUNs to RDM disks attached to new virtual machines. No changes are required to the operating system or SQL Server versions, and no application remediation is required. Even the IP address and computer name remain unchanged.

If you have ever been involved with database consolidation projects, you know first-hand how difficult they can be. SQL Server instances support a variety of application workloads, and each application has varying requirements for performance, scalability, configuration, and support. Commercial applications may have strong recommendations for configuration and a strict support policy that must be followed. Custom applications that are written in-house are subject to their own set of issues, such as use of antiquated database functions that prevent version upgrade or poor coding practices such as hard-coding server names or IP addresses.

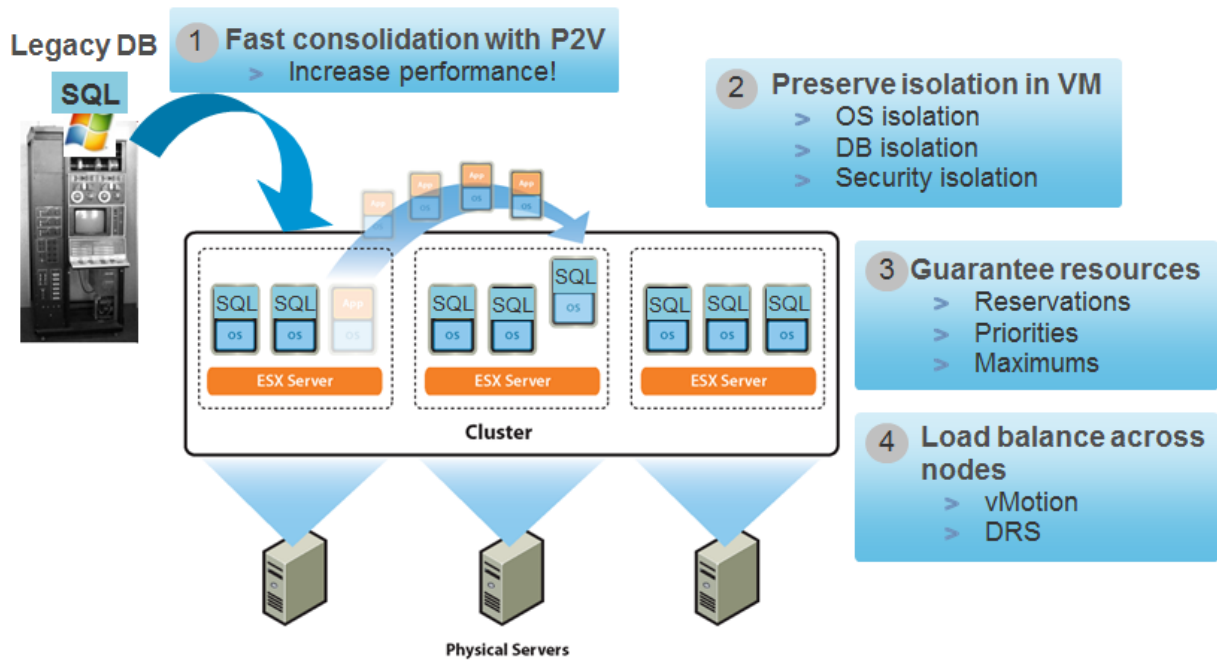
Database consolidation on physical servers usually takes one of two forms: *multi-instance* or *shared-instance* (see the following figure). With the multi-instance approach, multiple instances of SQL Server are installed on a single operating system with each instance running one or more databases. This provides granularity at the database application level, so you can lose a particular instance without affecting the other databases, and you have a certain amount of flexibility with SQL Server versions. Unfortunately, in this configuration, the operating system is the single point of failure for all instances and it’s hard to control the resource consumption of each instance. With the shared-instance approach, one SQL Server instance is used to run multiple databases. This configuration not only requires standardization on a particular SQL Server version, but also exposes the SQL Server engine as a single point of failure (in addition to the operating system). Resource consumption in the shared-instance method requires the use of SQL Resource Governor.

Figure 2. Traditional Database Consolidation with Physical Servers



Database consolidation within a virtual infrastructure provides the benefits of physical database consolidation while also significantly reducing the described implementation challenges. Many customers approach virtual database consolidation by doing a physical to virtual (P2V) conversion of each of their physical servers. The new virtual machine contains the entire isolated software stack that was on the physical server, so there is no reduction in resource isolation from a Windows or SQL Server perspective. There is no need to re-architect the security model within the new Windows guest operating system. vSphere provides the ability to present resources (CPU, memory, and storage) to your virtual machine as needed and to guarantee them for applications as needed. These capabilities reduce the need to overprovision the virtual machine to handle peak workloads. The virtual machines also get increased service levels associated with VMware vSphere High Availability, Fault Tolerance, and VMware vSphere vMotion®.

Figure 3. Database Consolidation with vSphere



Example: While monitoring SQL Server platforms at XYZCorp.com, the administrator discovers that many of the servers are underutilized and are not taking advantage of all the hardware resources provided. Some of these servers also have maintenance contracts that need to be renewed in the near future. The administrator reads up on database consolidation and decides to migrate SQL Server instances to fewer physical servers using traditional database consolidation techniques. The administrator quickly discovers that each SQL Server is configured differently, with varying operating system, SQL Server, and patch versions. He also discovers that each SQL Server instance is tightly coupled with the requirements of the application, both from a technical and a support perspective. Only about 30% of the servers that were originally tagged for consolidation can be migrated to the new consolidated infrastructure. Unless he is willing to remediate and correct all the other applications, the impact of the consolidation project will have minimal success.

In investigating possible solutions, the administrator begins to consider virtualization as an option. Consolidating SQL Server with vSphere simultaneously optimizes compute resources through server consolidation and maintains application flexibility through role isolation. Servers can be migrated in their current state without expensive and error-prone application remediation and without changing operating system or application version or patch level. Consolidating in this manner helps the administrator achieve operational goals without adversely affecting the application owners and development staff.

4.1.3 Consolidate SQL Server Licenses

Software licenses tend to dominate in the cost structure for SQL Server deployments. By consolidating SQL Server instances on vSphere, you can realize significant cost savings not just on the infrastructure side, but also on the licensing side. Licensing physical processor sockets can help to increase virtual machine density and reduce licensing costs in certain situations.

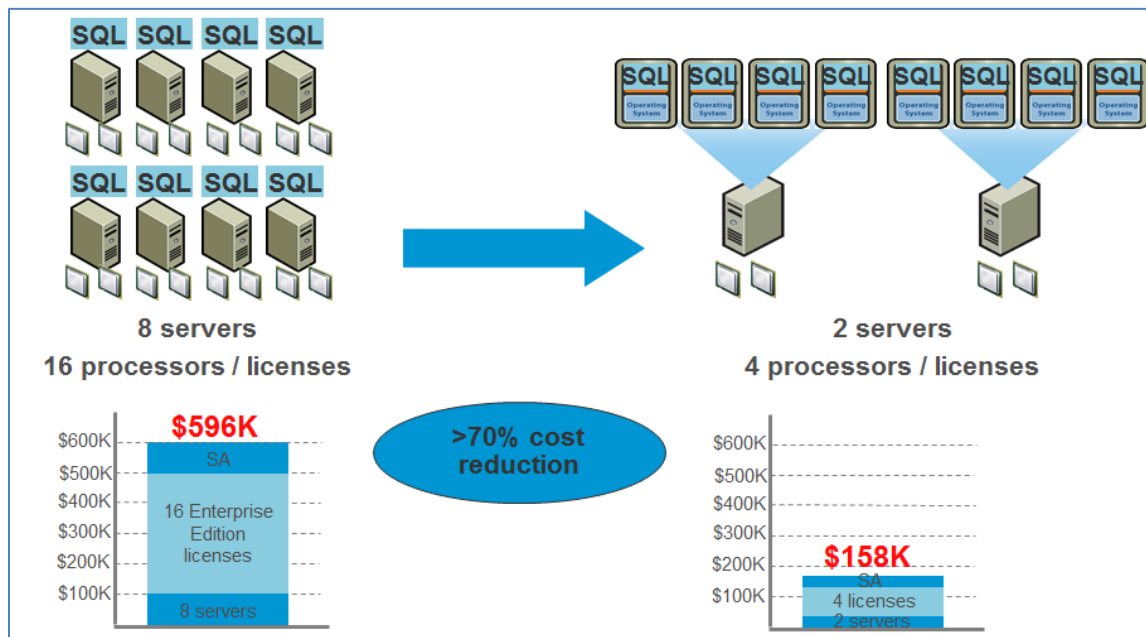
Consolidating your SQL Server instances on vSphere can save on license costs. All SQL Server versions provide licensing options to allow running an unlimited number of virtual machines per vSphere host. For example, with the SQL Server 2012 Enterprise Edition, customers that have licensed all physical cores on the server and purchased Software Assurance (SA) coverage can run any number of instances of the software to run in any number of virtual machines. You can deploy any number of virtual machines to handle dynamic workloads and fully use hardware computing capacity.

SQL Server licensing can be a complex topic. Review published Microsoft guidelines or speak with your Microsoft representative before making any licensing decisions.

References:

- Microsoft SQL Server 2008 Licensing Guide
http://download.microsoft.com/download/6/F/8/6F84A9FE-1E5C-44CC-87BB-C236BFCBA4DF/SQLServer2008_LicensingGuide.pdf
- SQL Server 2008 R2 Licensing Quick Reference Guide
http://download.microsoft.com/download/2/7/0/270B6380-8B38-4268-8AD0-F480A139AB19/SQL2008R2_LicensingQuickReference-updated.pdf
- SQL Server 2012 Licensing Guide
http://download.microsoft.com/download/7/3/C/73CAD4E0-D0B5-4BE5-AB49-D5B886A5AE00/SQL_Server_2012_Licensing_Reference_Guide.pdf

Figure 4. SQL Server License Consolidation with vSphere



Example: XYZCorp.com is in the process of consolidating eight physical SQL Server instances onto vSphere. Each physical server has two physical processors that must be licensed with SQL Server 2008 Enterprise Edition, for a total of 16 licenses. After reading licensing material from Microsoft, the company decides to apply two of the existing SQL Server 2008 Enterprise Edition licenses to two physical servers that will run the vSphere hypervisor. Each vSphere host will have two processor sockets with 4 cores per socket (total of 8 vCPU worth of processing power). By migrating SQL Server systems to vSphere, XYZCorp.com is able to achieve a 70% reduction in licensing costs while maintaining the same amount of processing power for SQL Server workloads.

4.2 Operational Advantages

4.2.1 Rapidly Respond to Changing Workloads

Running SQL on vSphere provides significant operational advantages, allowing rapid response to changing workloads:

- Rapidly provision SQL Server platforms with virtual machine templates.
- Hot-add CPU and memory.
- Enhance testing and troubleshooting using cloned production virtual machines.

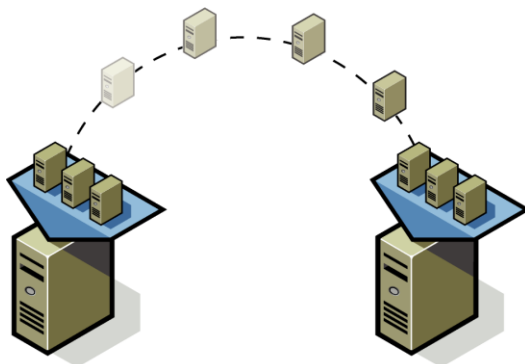
4.2.1.1. Rapidly Provision SQL Server Platforms with Virtual Machine Templates

Virtual machine templates can speed deployment times by eliminating repetitive operating system installation and patching tasks. New virtual machines can have their core configuration deployed in a matter of minutes, allowing rapid provisioning of applications into production and reduction of manual work required during their deployment. In addition, products like VMware Data Director and VMware PowerCLI can help accelerate and further automate the process of moving tested SQL Server virtual machines into production.

Deploying a new SQL Server can take many hours by the time you configure the hardware and storage, install the operating system and patches, and install the associated applications and updates. This process must be repeated for every server instance and can result in long deployment times, especially for large, complex architectures.

Alternatively, a virtual machine template can be configured and stored once for each type of server in the environment, allowing administrators to keep a virtual library of all server images. This can save countless hours when deploying new systems, particularly for larger SQL Server deployments that might involve hundreds of new servers to support an organization's application requirements.

Figure 5. Virtual Machine Templates



To save time and reduce outages in software troubleshooting scenarios, it can be faster in some cases to deploy a new virtual machine from a template, configure SQL Server, and then connect existing databases to the new virtual machine. After the databases are connected to the new virtual machine, user application service is restored and the old virtual machine is freed up for other tasks, such as performing advanced troubleshooting and diagnostics. Alternatively, the old virtual machine can simply be decommissioned.

VMware vSphere PowerCLI™ is a powerful command-line tool that lets you automate all aspects of vSphere management, including network, storage, virtual machine, guest operating system and more. vSphere PowerCLI is distributed as a Windows PowerShell snap-in and includes more than 150 PowerShell cmdlets along with documentation and samples. For more information about vSphere PowerCLI, see <http://communities.vmware.com/community/vmtn/vsphere/automationtools/powercli>.

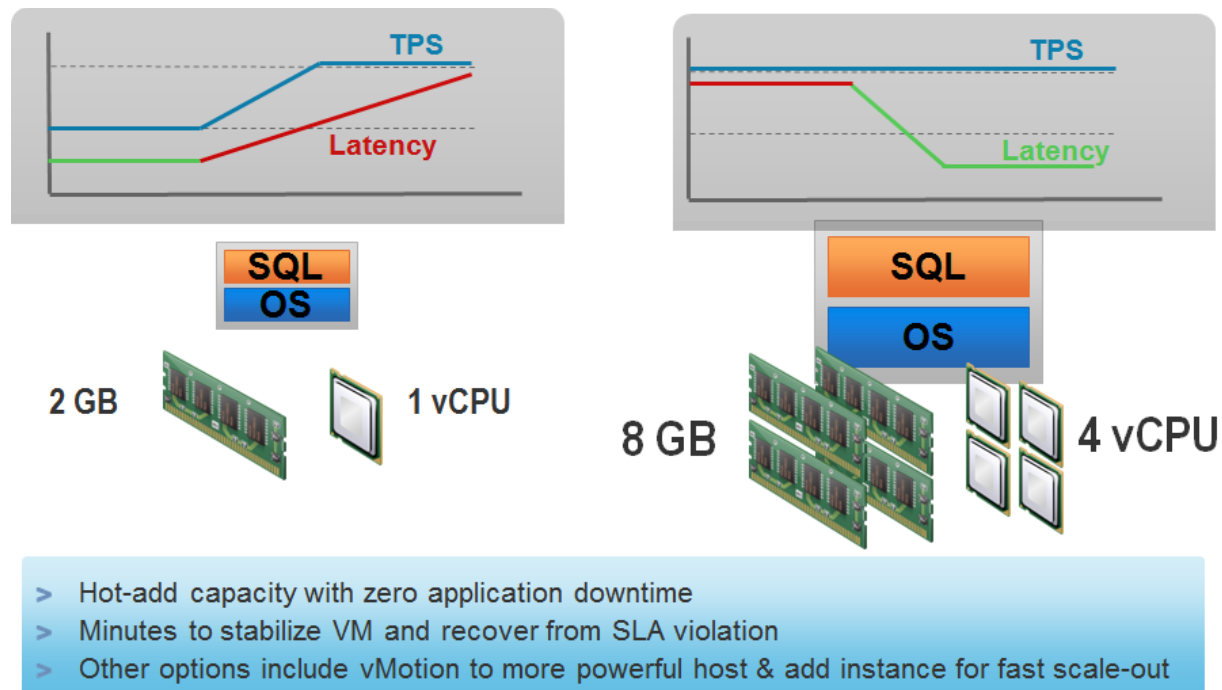
4.2.1.2. Hot-Add CPU and Memory

Many applications are difficult to size—databases are a good example. Administrators are often forced to forecast capacity requirements for 3-5 years in the future and then translate that estimate into system specifications (CPU, memory, and storage). If they guess wrongly, then the application must be re-provisioned, causing downtime and major disruption to the application.

With the vSphere Hot Add feature, applications can be provisioned in a “future proof” manner. As applications grow over time and require more compute, memory, network, or storage resources, administrators can now scale up virtual machines dynamically and on the fly, without disrupting the application or requiring complex re-provisioning.

The following figure shows that the transaction rate (TPS) is increasing and, as a result, latency increases beyond the SLA limits. The administrator can respond to this problem by hot-adding capacity to the virtual machine, and SQL Server automatically detects this new capacity. In a matter of minutes and without downtime, SQL Server stabilizes with new capacity, and the latency reduces to within SLA requirements.

Figure 6. Hot Add of CPU and Memory



Example: XYZCorp recently acquired four smaller companies to solidify market position, increasing the size of the company by 25%. Fortunately, the acquired divisions will use existing XYZCorp applications, allowing IT to avoid a complex migration and remediation. However, the new users will need to access the existing applications, which were designed for a smaller organization.

To avoid performance issues associated with the new growth, the administrator decides to migrate existing SQL Server systems to vSphere. The administrator uses virtual machine templates to scale out the SQL Server environment to support the new user activity. In a matter of minutes, the environment is ready to receive new users.

After two weeks, monitoring and user complaints indicate a performance problem with the system. The administrator discovers that some servers are at 100% CPU utilization, which is affecting application performance. With VMware hot-add, the administrator adds virtual CPU to the running SQL Server virtual machines and performance improves without interruption to the application or its users.

4.2.2 Enhance Testing Using Cloned Production Virtual Machines

Snapshots and clones provide powerful tools for testing and troubleshooting any virtual machine. In complex application environments supported by SQL Server, this capability becomes especially valuable. VMware-enabled troubleshooting can help to substantially shorten time to resolution of critical issues and reduce their overall impact on the production environment.

Snapshots and cloning of a virtual machine allows administrators to make an exact, independent copy of any virtual machine in their environment. The copy can then be installed in a test environment for offline testing and troubleshooting. Sharing the virtual machine with third-parties, such as consultants, other partners, and vendors, eliminates the sometimes challenging step of creating a duplicate environment to reproduce problems.

Example: One of the XYZCorp SQL Server virtual machines is experiencing an intermittent problem. It is difficult to troubleshoot this issue on the production system during normal business hours when users are on the system. XYZCorp staff makes a clone of the problem virtual machine and imports the cloned virtual machine into their test and development environment, which has remained synchronized with the production environment since the consolidation project began. Using a cloned virtual machine in an isolated test environment allows XYZCorp staff to immediately begin troubleshooting with an exact copy of the production machine, with no impact to end users.

4.3 Higher Availability with Less Complexity

The vSphere platform can be leveraged to provide a wide-range of availability options. vSphere HA provides protection from server hardware failure that is independent of the operating system or applications and works for every virtual machine running on vSphere. To aid in dynamic load balancing of SQL Server virtual machines, VMware vSphere Distributed Resource Scheduler™ (DRS) can be used to balance workloads automatically. Base solutions built on vSphere HA and vSphere DRS can be deployed with minimal configuration changes and provide a robust availability solution. These solutions can also be enhanced to provide higher levels of availability by combining them with more traditional clustering and replication options, as described later in this section.

By leveraging the inherent benefits of a virtualization-based platform, a SQL Server deployment using vSphere offers a variety of availability options. Each of these options provides different levels of protection and cost and is capable of meeting the unique high availability requirements of any SQL Server environment. Tools available from VMware, Microsoft, and third-party software and hardware vendors can be used to facilitate both in-site and remote site availability and recovery. The vSphere platform leverages two powerful features, vSphere HA and vSphere DRS, as the basis for building high availability solutions. Using the availability options available with vSphere you can:

- Reduce planned downtime due to hardware or BIOS updates with vMotion.
- Reduce unplanned downtime due to hardware failure or resource constraints.
- Implement simple and reliable SQL Server disaster recovery.

4.3.1 Reduce Planned Downtime Due to Hardware or BIOS Updates with vMotion

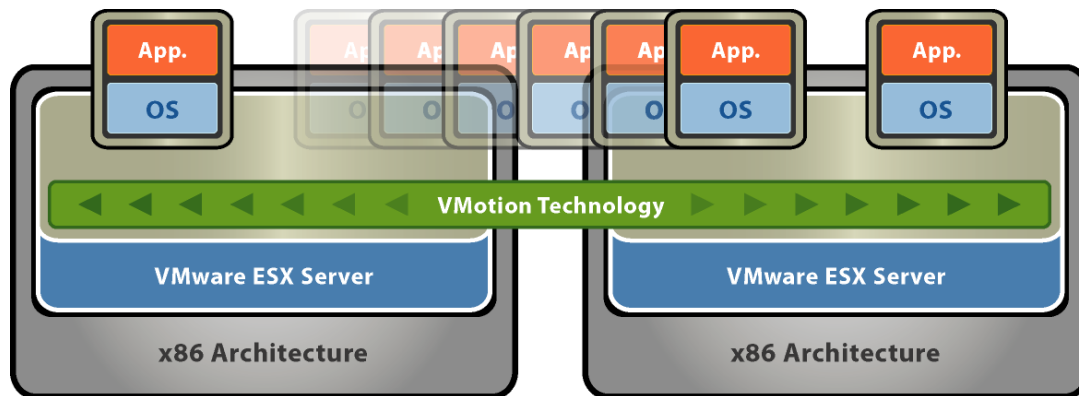
Virtual machines decouple the operating system and applications from the underlying hardware, allowing supporting infrastructure to grow and change rapidly. vMotion allows any virtual machine to be migrated across physical servers, even servers from different vendors with different hardware configurations. Planned downtime can be minimized and a more flexible infrastructure makes the SQL Server environment more resilient. In an environment without virtualization, this level of flexibility does not exist.

After an application is deployed into production, the deployment tends to become relatively static, meaning that the workload is more intimately tied to the hardware platform on which it runs. As a result, hardware upgrades to the application infrastructure tend to directly correspond to the release and upgrade cycle of the application itself.

With the frequent changes that are sometimes required in the business world, the static nature of the application infrastructure can limit the ability to meet changing demands in the organization environment. For example, a massive influx of new application users can require additional hardware and a great deal of system re-engineering to support.

In contrast to a static, physical server deployment, VMware decouples the OS and associated applications from underlying server hardware. With vMotion, any virtual machine can be migrated “on the fly” between vSphere servers with no interruption to service (see the following figure). vMotion allows administrators to move SQL Server workloads to more powerful hardware without outages or costly system re-engineering. This added agility allows the application environment to change as the business environment changes. Planned downtime can also be minimized as SQL Server virtual machines can be migrated to alternate hosts during scheduled hardware maintenance windows.

Figure 7. Migrating Virtual Machines Across vSphere Hosts with vSphere vMotion



Example: The XYZCorp ongoing maintenance processes include regular updates of the BIOS and other firmware on host servers. To accomplish this without disruption, XYZCorp uses vMotion to move all virtual machines off of an affected vSphere host. Heavily loaded SQL Server platforms can be moved online to a different vSphere host with no loss of service. Virtual machines can even be moved onto hosts from different vendors with different hardware configurations. After all virtual machines are migrated from a host, XYZCorp updates the BIOS and all firmware, reboots, and then uses vMotion to move virtual machines back to the host. This process is repeated for their entire server infrastructure. This is just one example of how vMotion can be used to provide new levels of flexibility and reduce downtime on critical servers.

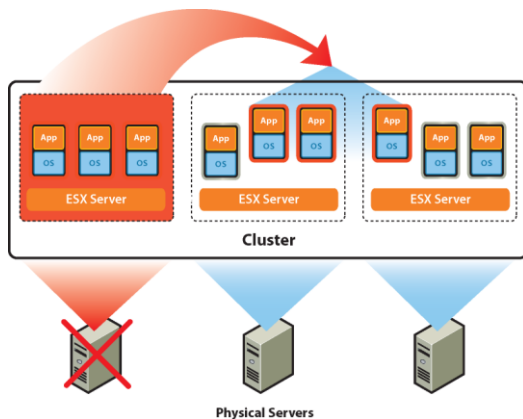
4.3.2 Reduce Unplanned Downtime Due to Hardware Failure or Resource Constraints

The vSphere platform can be leveraged to provide a wide-range of availability options. vSphere HA provides protection from server hardware failure that is independent of the operating system or applications and works for every virtual machine running on vSphere. To aid in dynamic load balancing of SQL Server virtual machines, vSphere DRS can be used to balance workloads automatically. Base solutions built on vSphere HA and vSphere DRS can be deployed with minimal configuration changes and provide a robust availability solution.

The following solutions can also be enhanced to provide higher levels of availability by combining them with more traditional clustering and replication options:

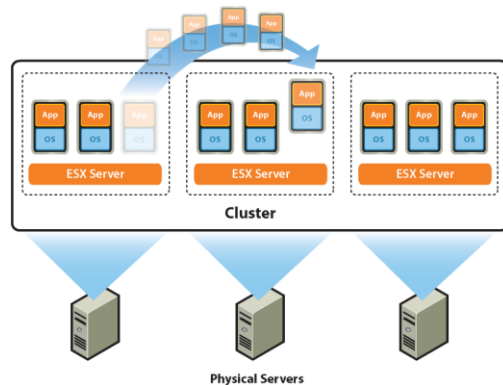
- vSphere High-Availability (HA) – Provides simple, low-cost protection for every virtual machine by guarding them against physical host failure. In the event of server hardware outage, vSphere HA automatically restarts all virtual machines on another vSphere host (see the following figure), minimizing disruption to the SQL Server environment. vSphere HA is simple to set up and protects every virtual machine without requiring complex clustering software.

Figure 8. vSphere HA Managing a vSphere Host Hardware Failure



- vSphere DRS – With vSphere DRS, virtual machines are dynamically load balanced across an entire pool of server resources. DRS collects resource usage information for all hosts and virtual machines and generates recommendations for virtual machine placement. These recommendations can be applied manually or automatically. DRS can dynamically load balance all virtual machines in the environment by shifting workloads across the entire pool of vSphere hosts (see the following figure). Critical SQL Server virtual machines in the environment always have the CPU and RAM resources they need to maintain optimal performance.

Figure 9. vSphere DRS Dynamic Load Balancing



Solutions built using vSphere HA and vSphere DRS provide out-of-the-box high availability for the entire SQL Server environment without requiring any Microsoft or other third-party clustering software. For SQL Server platforms deployed with vSphere, the vSphere HA and vSphere DRS solution provides a new alternative that leverages the simplicity of standalone virtual machines while providing complete server hardware redundancy for every virtual machine, not just the clustered ones.

vSphere HA is focused on hardware failure, not on operating system or software failure. If you need greater levels of protection and guarantees of availability for SQL Server to handle those situations, vSphere HA can be combined with traditional cluster solutions like SQL Server 2012 AlwaysOn Availability Groups (AAG).

The following examples show how to extend the vSphere HA/DRS solution:

- AlwaysOn Availability Groups – AAG protects databases and allows multiple databases to fail over as a single unit. AAG is built on non-shared disk architecture. Each AAG replica has its own copy of the database. Log streams are replicated from the primary to the secondary replicas synchronously or

asynchronously. Although AAG uses Window Server Failover Cluster (WSFC) for failover policy or quorum management, no disk quorum is required. AAG can be safely used in combination with all vSphere features and technologies, including vMotion, DRS, and HA.

- Database Mirroring – SQL Server database mirrors utilize a non-shared storage availability solution, using built-in SQL Server replication technology to create and maintain one or more copies of each database on other SQL Server platforms in the environment. SQL Server database mirrors provide application-aware availability, and the lack of a quorum disk makes this a VMware-friendly solution, allowing the full use of vMotion, vSphere DRS, and vSphere HA.
- Log Shipping – Geared towards disaster recovery scenarios, log shipping delays the commitment of log files into the database copy based on an administrator-defined lag time. Replay lag provides protection against logical database corruption by providing the ability to recover up to the last copied and inspected log file, or to a specific point-in-time (PIT) within the lag window by manipulating the log files.
- Microsoft Failover Clustering (MSCS) – Microsoft failover clusters utilize a shared storage availability solution using the Microsoft Clustering Service to handle failover of application services in the event of active node failure. Microsoft failover clusters provide application-aware availability, but require solutions at the storage level for providing data redundancy. There are certain restrictions when running Microsoft failover clusters with VMware features like vMotion, vSphere DRS, and vSphere HA. For guidelines, see http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1037959.

Example: XYZCorp is seeking 99.99% total uptime (less than one hour of downtime annually) for the new application environment and supporting SQL Server platforms. They have been evaluating several different high availability options that involve sophisticated cluster software that requires additional 64-bit server hardware to function as the passive/secondary cluster node. The additional cost and complexity of these cluster solutions is more than XYZCorp wants for the initial deployment.

XYZCorp decides to avoid cluster solutions entirely in the initial deployment and instead leverage a solution built on vSphere HA and DRS. This solution provides complete protection from server hardware failure that extends beyond SQL Server and protects every virtual machine. In the future, XYZCorp plans to enhance this solution by adding SQL Server database mirroring, which will work in conjunction with vSphere HA to provide enhanced availability.

In XYZCorp testing, a physical server running the SQL Server and application virtual machines is powered down in a simulated failure. In response, vSphere HA automatically restarts the affected virtual machines on surviving servers. After the failed host is brought back online, vSphere DRS automatically re-balances the workload across all three servers. This approach meets the need for availability at a low cost and is approved for use in the production system.

4.3.3 Implement Simple and Reliable SQL Server Disaster Recovery

vSphere simplifies SQL Server disaster recovery (DR) by reducing hardware compatibility constraints and by reducing through consolidation the number of servers required at the DR site. Combined with SQL server mirroring or log shipping, recovery from hardware and software failure can be greatly improved, reducing the time to restore essential mail services to end users. Hardware independence allows the SQL Server virtual machines to be restarted on any supported vSphere host, and SQL Server replication is simplified using virtual machine encapsulation.

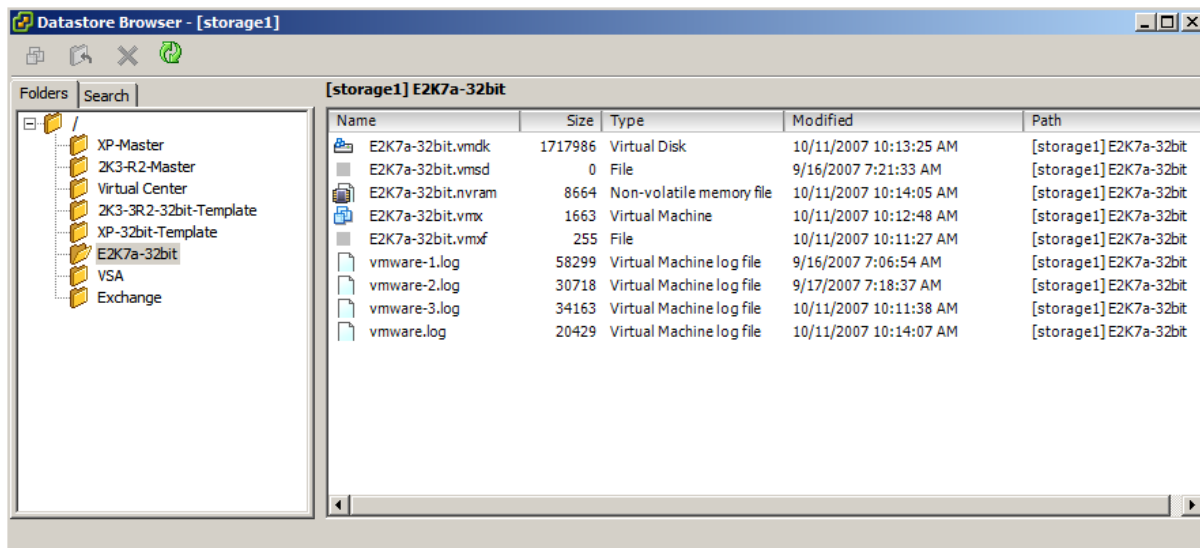
An important benefit of virtualization is abstraction of the operating system and application from the underlying physical server hardware. This is useful in disaster recovery scenarios because it eliminates the traditional requirement of physical server-based disaster recovery to provide identical hardware at the DR site. Any virtual machine can be brought online on any supported vSphere host without worrying about hardware or software compatibility. The ability to run multiple virtual machines on a single server also reduces the costs of a DR solution through consolidation of SQL Server components and services on fewer physical servers than would otherwise be required. Having all the necessary SQL Server, application, and infrastructure components running in virtual machines at a DR site can be achieved with minimal hardware and can help speed recovery in a disaster situation.

Regardless of the make and model of the physical server hosting the virtual machines in production, virtual machines can be brought online on any VMware-supported vSphere host at the DR site. Older servers freed up from other VMware vSphere consolidation projects are commonly repurposed to host a DR site, minimizing the overall lifecycle costs of hardware.

When used in conjunction with vSphere, the portability of SQL Server databases creates additional options for disaster recovery. Standby virtual machines can be installed and made available at both the production and DR sites. These virtual machines can be easily configured to connect to existing SQL Server databases during a recovery.

Finally, virtual machine encapsulation means that an entire SQL Server can be contained in a small set of files (see the following figure), which simplifies replication to DR sites. Moving an entire virtual machine can be accomplished with a simple file copy.

Figure 10. Virtual Machine Encapsulated into a Small Set of Files



Example: XYZCorp.com adopts more stringent disaster recovery requirements as part of a recent business continuity project. The new objectives state that the company will restore application systems to full functionality in less than 24 hours following a total loss to the primary datacenter. Designing the application and SQL Server environment to meet this requirement is critical to the success of this project.

XYZCorp contracted with a third-party disaster recovery site approximately 300 miles from the company's home office. Two vSphere hosts have been provisioned at the DR site as part of their recovery plan. To enable the fastest possible recovery, XYZCorp wants to make sure that all the required components are online and available at the DR site at all times. To accomplish this, all Active Directory servers have been deployed in virtual machines on the vSphere hosts at the DR site and are online. The SQL Server and application servers have been provisioned as standby virtual machines and storage replication is being used to synchronize DR data with the production site. In the event of a failure, these virtual machines connect to the replicated SQL Server databases and are brought online. Additional virtual machines required to bring up the application environment are deployed in a similar fashion. Thus, a complete standby application environment is online and ready whenever it is needed. A proof-of-concept test showed that the entire application environment could be restored to live operation in a few hours.

Finally, because the vSphere hosts at the DR site will be heavily used only by the application in the event of a disaster, XYZCorp also uses them to host a number of test virtual machines used by their software developers. With the resource pools feature provided by vSphere, the test virtual machines can use only a specified amount of the CPU and RAM resources available on the vSphere hosts, and will shut these virtual machines down in a disaster scenario. This design allows XYZCorp to take advantage of the computing resources of these servers when they are not being used for disaster recovery purposes.

XYZCorp continues to test application and SQL Server recovery ability on a quarterly basis and plans to test VMware vCenter™ Site Recovery Manager™ (SRM) to further automate their ability to quickly and reliably restore application service.

5. Deployment Alternatives

This document described several benefits of virtualizing SQL Server on vSphere. There are multiple ways that virtualization can be used to take advantage of these benefits today to assist in SQL Server deployment. A few common deployment scenarios include the following:

- Virtualizing SQL Server in test and development environments – Virtualization provides a simple and cost-effective method for running SQL Server in a staging or test lab environment using minimal server hardware. Testing on virtual machines is a good way to simulate application or migration scenarios in a controlled environment before rolling out new releases into production.
- Virtualizing passive SQL Server Mirrors or Cluster nodes – Virtual machines can be used as passive nodes whether using Microsoft failover clustering or SQL database mirroring. Using virtual machines as passive nodes can reduce the amount of hardware required for availability while still providing application-level protection.
- Virtualizing SQL Server disaster recovery servers – In the physical world, disaster recovery essentially doubles production hardware costs. Every production physical server requires an identical match of equipment provisioned at the disaster recovery site. Moreover, physical server-based recovery procedures can be complex and error-prone. Virtualizing your disaster recovery site can greatly decrease cost and complexity. First, you are not bound to the 1:1 ratio of hardware required at both production and DR sites, and you can run as many virtual machines on a physical host as performance allows. Second, you can use any hardware you want. Your DR servers do not need to be identical. And finally, SQL Server disaster recovery design and testing can be completely automated using SRM.
- Full virtualization of all SQL Server platforms – With SQL Server, performance in a virtual machine is comparable to native performance, making SQL Server systems ideal candidates to realize the benefits of virtualization.

The decision about which components to virtualize in a production environment depends on many factors, including your level of proficiency with SQL Server and vSphere, and support agreements with Microsoft, VMware, and your hardware vendors. Regardless of the method that most suits your needs, you can begin to maximize value from IT assets with virtualization today.

6. Conclusions

Any new platform chosen for hosting application and database workloads should be as reliable and proven as the traditional physical server alternative. More than 100,000 customers worldwide use VMware products. More than 50% of VMware customers running SQL Server have virtualized it for production use. The vSphere platform has the maturity, stability, performance, and functionality required to host critical SQL Server infrastructures.

To meet the needs of a continually shifting business landscape, today's application and database environments must also be highly available, flexible, and cost efficient. Using vSphere as the preferred platform for SQL Server can help you to better align your application environment to your business goals.

Features such as vSphere HA and vSphere DRS can decrease downtime associated with server hardware failure and allow for more rapid recovery of messaging services. Virtual machine snapshots and clones help with troubleshooting and resolving other deployment issues and can greatly enhance efficiency in the development cycle.

By decoupling the operating system and associated applications from the underlying hardware, vMotion greatly enhances the resilience and agility of your application, allowing for on-the-fly hardware replacements and upgrades and the ability to quickly scale to changing workloads.

Finally, vSphere helps to maintain a cost-effective SQL Server environment by maximizing utilization of computing power through conservative resource requirement sizing and taking advantage of other physical server consolidation opportunities. The robust feature set of vSphere can help to reduce management costs as well, eliminating many mundane and repetitive tasks and freeing up IT administrators for other challenges that are strategically important to the business.

For more information visit <http://www.vmware.com> for more information or contact your local VMware sales representative.