# Virtualizing Business-Critical Applications on vSphere

WHITE PAPER





vmware

## Table of Contents

# Audience

This white paper provides solution and product information for educational purposes and assumes a basic knowledge and understanding of vSphere™.

- Architects can use this document to overcome perceived hurdles and challenges to virtualization.
- Engineers and administrators can use this document as a catalog of benefits.
- DBAs can use this document to gain an understanding of how database virtualization can benefit them.
- App owners can use this document to gain an understanding of how app virtualization can benefit them.
- Business staff and process owners can use this document to help consolidate Return on Investment (ROI) and time-per-activity operational efficiencies achieved with virtualization.

# Why Virtualize Critical Apps?

Most VMware customers have virtualized a significant portion of their datacenter. However, virtualizing business-critical applications—databases, ERP systems, email servers, and industry-specific solutions—feels like a completely different ballgame, and you may wonder whether the risk vs. return ratio is still worth it. In addition, these applications often have app owners that may not be familiar with virtualization.

VMware vSphere 5 is the best platform to virtualize all your applications, including business-critical applications. Starting with vSphere 4, and more recently using vSphere 5, customers are virtualizing business-critical applications at an accelerated pace. Application infrastructure administrators and CIOs see that the value of virtualization extends far beyond basic consolidation, and that applications run better virtualized, with faster time to market and improved Quality of Service (QoS). Later in this whitepaper we will detail specific features beneficial to business-critical applications like vMotion™, Dynamic Resource Schedule, Storage vMotion, Hot-add CPU, and Site Recovery Manager.

Legacy concerns relating to performance, support, and licensing have been addressed. Since 2009, VMware has continued to focus on critical apps and their performance. With each major release of vSphere, we make enormous improvements to the handling of business-critical applications. vSphere 5 provides sufficient scalability for the largest databases and applications in the world, many of which have already been virtualized.

Ask yourself, “What applications can benefit the most in my datacenter from high availability and disaster recovery?” The correct answer is business-critical applications. See the Benefits section for a full discussion of reasons to virtualize each business-critical application.

# Is Anyone Doing This?

Thousands of VMware customers have virtualized their Exchange, Oracle Databases, Oracle eBusiness Suite, SQL, SAP, and Java applications. These applications are often considered the six business-critical applications (BCAs). There are also business-critical apps that are industry specific (such as for retail, telecom, and healthcare industries) as well as newly emerging business-critical apps (such as Hadoop). According to a recent VMware survey[1], 75 percent of VMware customers report they virtualize at least one business-critical application in their production environment.

The figure below identifies many large companies that are currently virtualizing their business-critical applications with VMware. You will find additional virtualization success stories at www.vmware.com/customers.

| Microsoft Exchange | ORACLE | Microsoft SQL Server | SAP |
|---|---|---|---|
| American Tire | Alstom | Boise | ABB |
| Bowdoin College | American Tire | Canada Interior Health | AstraZeneca |
| Campbell School District | E.ON | Cleveland Indians | Callaway Golf |
| Canada Interior Health | Green Mountain Power | Erdgas Sudbayern | Columbia |
| Cleveland Indians | Indiana University | Kronos | Eli Lilly |
| Intermedia Hosting | Revlon | Subaru | Mazda |
| Navy Marine Intranet | Reisebank | Tucson Electric Power | SAP |
| Raymond James | University of British Columbia | U.S. Department of Education | T-Mobile |

**Figure 1:** Companies Virtualizing Business-Critical Applications with VMware

1. Source: VMware customer survey, June 2011.

# Performance

vSphere delivers the performance required to run business-critical applications in large-scale environments. vSphere 5 provides 16 times[2] the performance of VMware Infrastructure 3 while keeping virtualization overhead at a very limited 2 to 5 percent. The fact is that the virtualization overhead or "tax" is often greatly exaggerated and many application owners are managing applications that have already been virtualized by the server and virtualization teams, and the applications owners don't even know it.

## The Virtualization Tax Is Often Greatly Exaggerated

Performance is a major factor in business-critical applications. Virtual machines perform the same as their physical equivalents, as witnessed in production by the app owners. The following set of graphs illustrates this performance across several applications.

Virtualized Oracle databases perform the same as native databases from the application owner's perspective.[3]

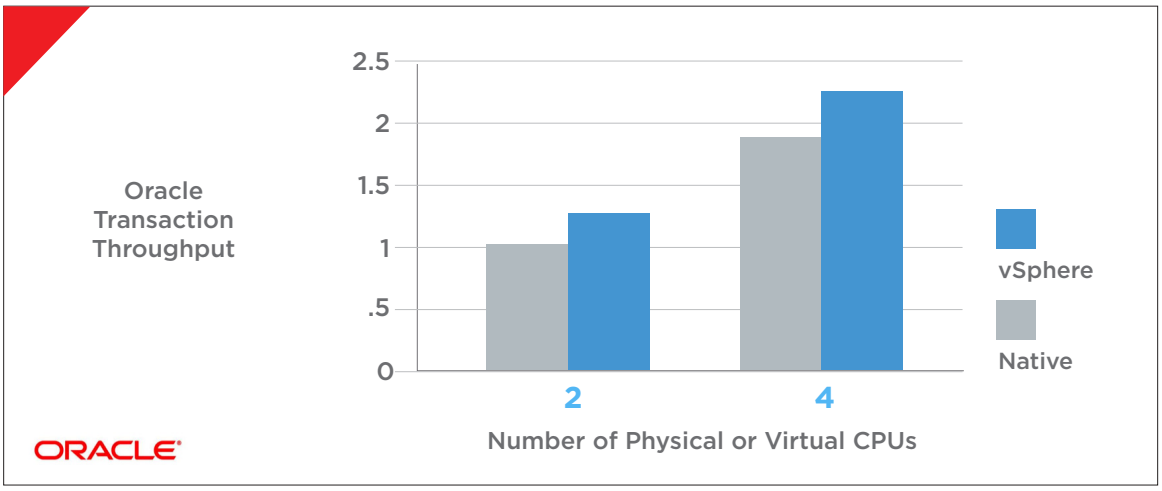



**Figure 2:** Oracle Database Performace Comparison in vSphere 4

Confio, a third-party company unaffiliated with VMware, compared virtual and physical servers in a side-by-side test, finding the performance would be the same to the DBA.[4]

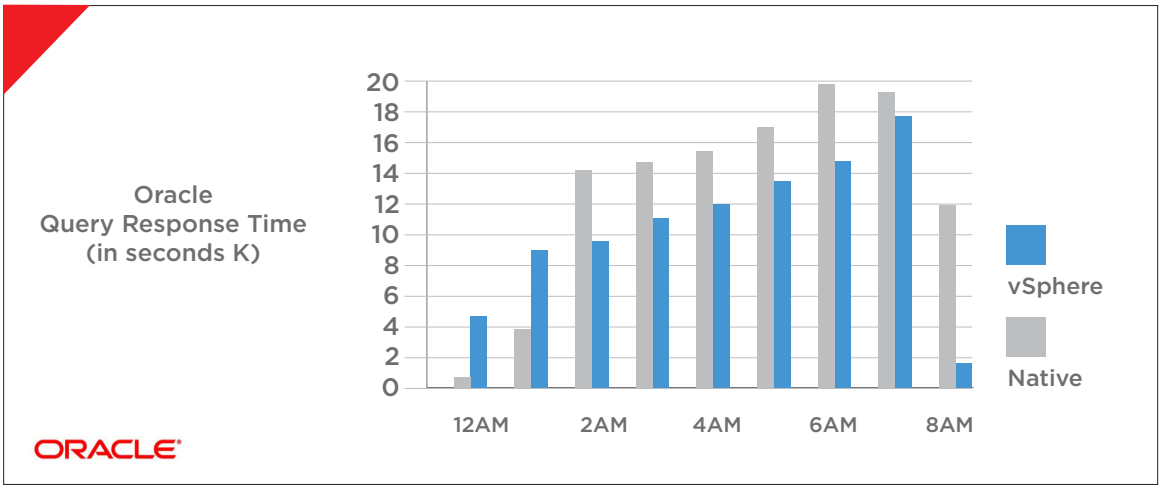



**Figure 3:** Physical vs. Virtual Performance Is the Same to the DBA

2. Source: See Figure 13 in this paper.
3. Source: Virtualizing Performance-Critical Database Applications in VMware vSphere.
4. Source: A Comparison of Oracle Performance on Physical and VMware Servers, 2012. Written by Confio, www.confio.com.

Virtualized SQL databases perform the same as native databases from the application owner's perspective. [5]

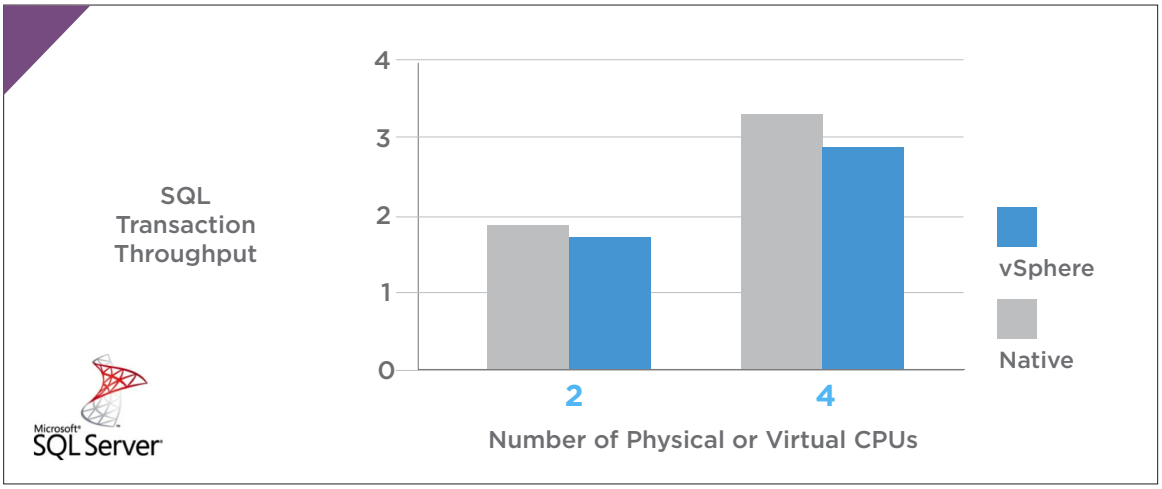



**Figure 4:** Scale-up Performance in vSphere 4 Compared with Native

Virtualized SAP performs the same as native equivalents from the application owner's perspective.[6]

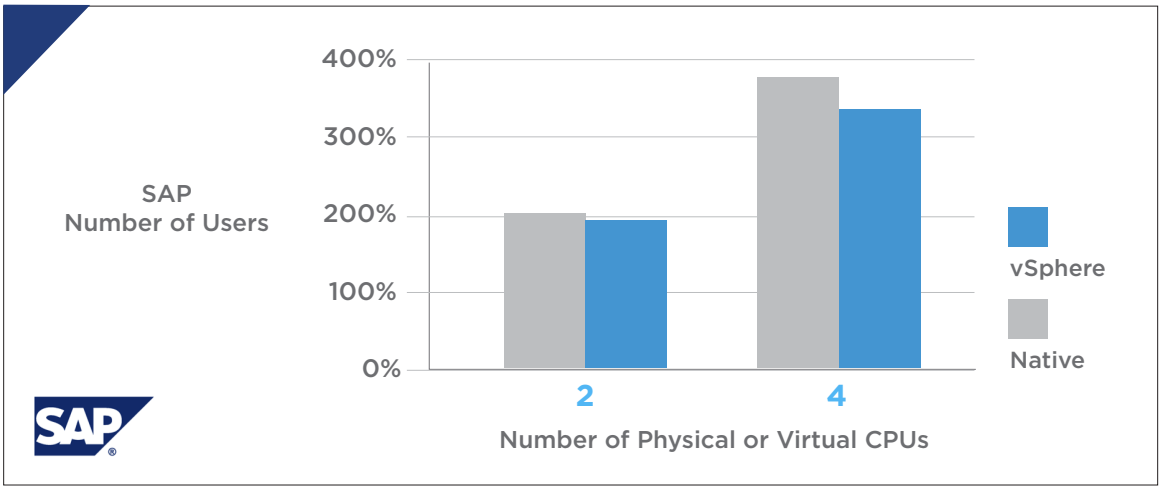



**Figure 5:** SAP Scale-up in vSphere 4 in Physical and Virtual Environments

5. Source: Performance and Scalability of Microsoft SQL on vSphere.
6. Source: Virtualized SAP Performance with VMware vSphere 4.

Virtualized Java performs the same as native equivalents from the application owner's perspective.[7]

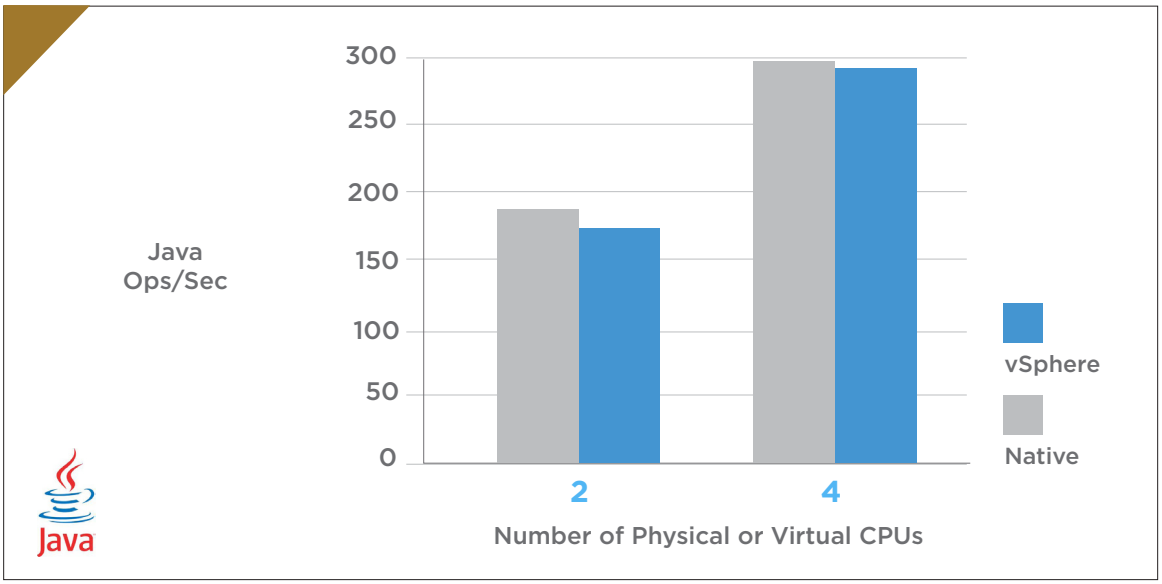



**Figure 6:** Single Instance Peak-Throughput for Olio in vSphere 4

Virtualized Hadoop performs the same as native equivalents from the application owner's perspective.[8]

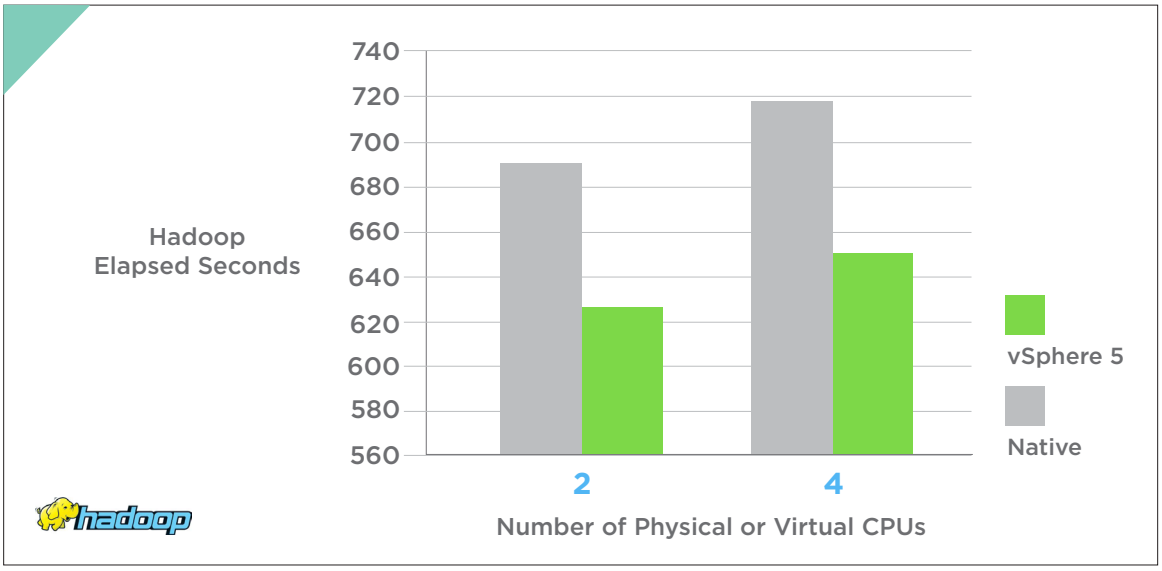



**Figure 7:** Hadoop Performance in vSphere 5 (Number of VMs Shown is per Host)

7. Source: Performance of Enterprise Java Applications on VMware vSphere 4.1 and SpringSource tc Server.
8. Source: "A Benchmarking Case Study of Virtualized Hadoop Performance on VMware vSphere® 5", 2012.

# Benefits

Figure 8 lists some of the top business and technical reasons to virtualize business-critical applications.

| APPLICATION | TOP REASONS TO VIRTUALIZE |
|---|---|
| Microsoft® Exchange | • Provide availability without the complexity and synching issues of Exchange DAG<br>• Provision Exchange servers in minutes<br>• Enable availability and implement reliable disaster recovery<br>• 4–10x consolidation of all Exchange roles |
| ORACLE® | • Cloning allows creation of an optimized golden image for rapid provisioning<br>• Provide availability without the cost and complexity of Oracle RAC and Data Guard<br>• Increase utilization of Oracle licensing<br>• Reduce hardware by 50% with 4–20x consolidation |
| Microsoft® SQL Server® | • Accelerate database delivery with on-demand provisioning and automated release cycles<br>• Provide availability without the complexity of Microsoft clustering<br>• Cut hardware and software license costs by more than 50%<br>• 4-20x consolidation |
| SAP® | • Cloning allows faster time to service with upgrades and implementations<br>• Improved SAP service levels and risk management<br>• Optimized business continuity and disaster recovery<br>• Lower TCO and better ROI with a dynamic SAP IT model<br>• 4–20x consolidation |
| Microsoft® SharePoint® 2010 | • More flexibility in design, deployment, and growth<br>• Simple, inexpensive, high-availability options for SQL nodes<br>• Dynamic scalability and rapid provisioning<br>• 4–20x consolidation |
| Java® (WebLogic, WebSphere, JBoss) | • Enhanced dynamic scalability<br>• Optimal availability (guard against host failure)<br>• Business continuity (automatic disaster recovery)<br>• Enhanced management (all tiers virtualized in one platform)<br>• 4–10x consolidation |

**Figure 8:** Top Reasons to Virtualize Business-Critical Applications

**Note:** Consolidation rates are averages based on "VMware Customer Readiness Reviews." Licensing savings are cited in the Licensing section of this paper.

## Benefit 1: Accelerate Upgrades with Cloning

According to feedback from the DBAs we've worked with, the primary reason DBAs and IT architects virtualize Oracle or SAP is for cloning.

Application provisioning can be a cause of major inefficiencies. IT administrators must support the overhead of configuring each application tier, including the hardware, OS, and application. At the same time, configuration errors and configuration drift are very common, often leading to application downtime. To make matters worse, provisioning isn't limited to production environments, but often includes test, development, and training systems. Over time, these systems often fall out of sync with production systems, resulting in inaccurate testing and QA cycles.

With vSphere, once an application is ready to be rolled out into production, application teams are able to package the application as a vApp, a golden image of the application that can be provisioned on demand onto the production infrastructure. A vApp is essentially a template of a multi-tier application. It includes multiple pre-configured virtual machines containing the different application tiers (e.g., Web, app, and database). The virtual machines are pre-integrated through network fencing, and the virtual machine boot sequence can be customized.

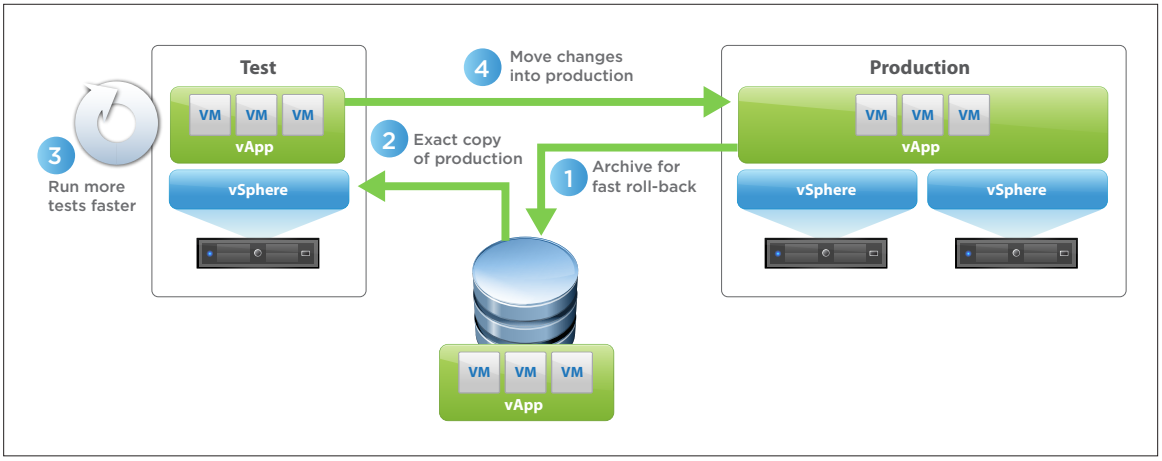



**Figure 9:** vSphere Cloning of Production Databases and Applications

*Case in Point*

*"In a physical server model, cloning our production Oracle Database for test and development was time consuming, complex, and expensive. Virtualizing our Oracle databases with vSphere allows us to quickly create many test and dev environments in minutes. Our ability to virtualize Oracle has saved the bank hundreds of thousands of euro."*

– Andrei Maier, System Architect of Swedbank

## Benefit 2: Guarantee Resource Reservations

Key datacenter resources are compute, memory, network, and storage.

Application owners are sometimes reluctant to virtualize because they feel they no longer get 100 percent of server resources. As it turns out, features within VMware allow for business-critical applications to hold reservations and minimums to enable them to get the highest QoS in the datacenter, even if they are sharing physical resources with other less critical applications.

IT administrators are expected to achieve the business' required service levels—for every single application and application tier. Features like Distributed Resource Scheduler (DRS), Network I/O Control, and Storage I/O Control help you maintain service levels through intelligent allocation and performance.

- **DRS** continuously monitors resource utilization and intelligently allocates across virtual machines. That means the applications that you've ranked as the highest priority get the resources they need, when they need them. vSphere DRS delivers the performance, scalability, and availability that may be impossible to achieve in a physical infrastructure. Beyond higher hardware utilization and reduced energy consumption, business units also gain dedicated IT resources, empowering them to build and manage virtual machines—all under centralized IT control.
- **Network I/O Control** enables performance. Once you configure rules and policies to specify priorities of each VM, Network I/O Control automatically adjusts resources so you can improve service levels and virtualize more types of workloads.
- **Storage I/O Control** enables a pre-programmed response when a storage resource becomes contentious. When congestion is detected, Storage I/O Control dynamically allocates available resources based on your policies. Further, Storage I/O Control enables performance for your most important VMs, and provides an additional level of isolation in a private or public cloud.
- **CPU Reservations** and **Memory Reservations** provide resource levels for critical apps.

## Benefit 3: Juice up Apps with Hot-Add

When the application running on VMs is business critical, the stakes are even higher to keep resources available while adding more capacity on the fly. It is this moment when Hot-Add CPU and RAM become necessary. Hot-Add features help you manage fluctuating workloads with less risk. The Hot-Add features allow you to add RAM and CPU dynamically, without shutting down the virtual machine or application. When running business-critical applications, downtime is not an option.

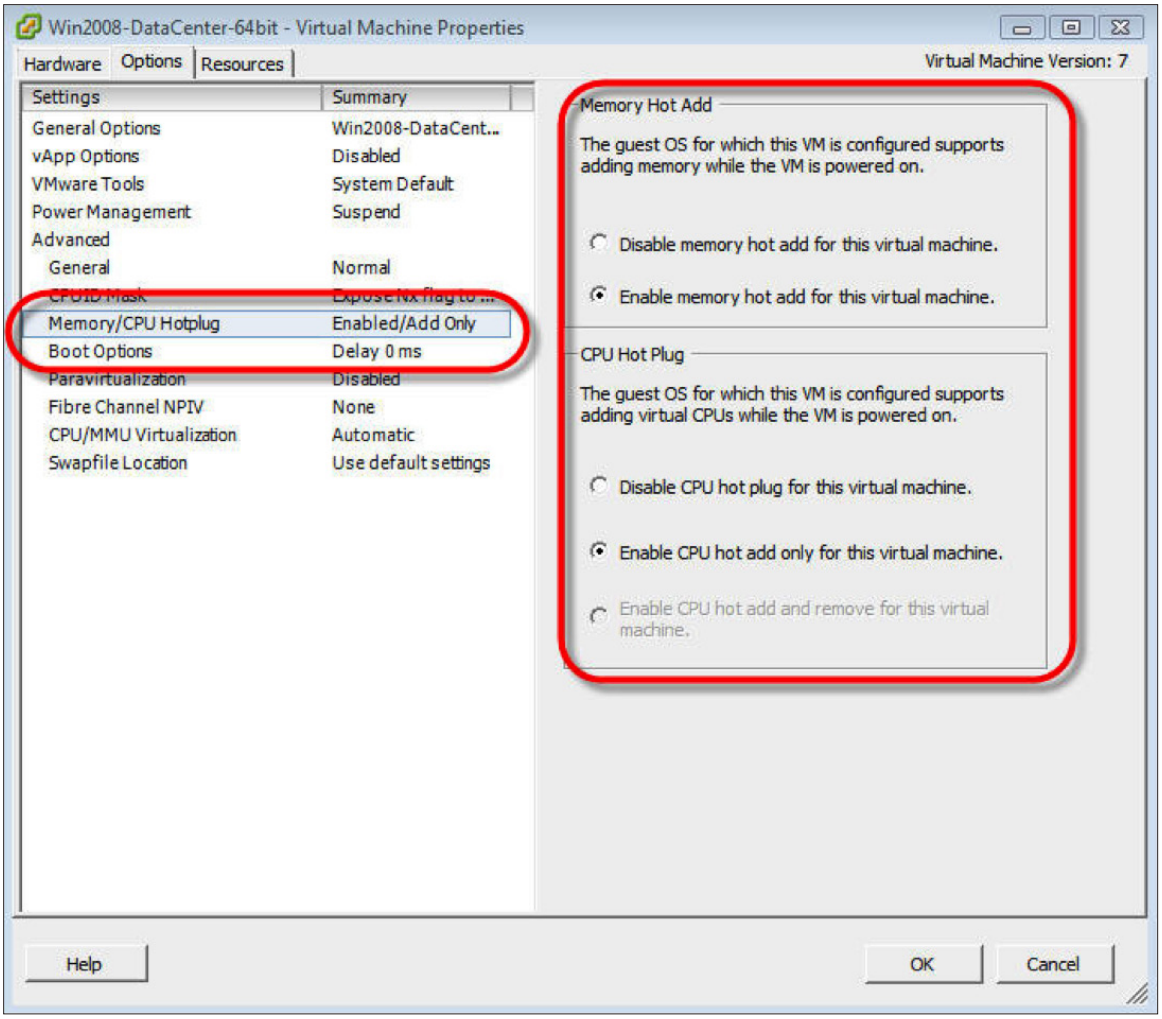



**Figure 10:** Hot-Add CPU and RAM Adds Computer Power to a Running VM Without Taking down the Application

When increasing demand starts to impact performance, it is often necessary to scale an application to restore service levels. Unfortunately, when running on dedicated physical servers, re-sizing applications requires re-provisioning on larger physical hosts, which is a time-consuming and highly disruptive undertaking. Databases are a good example. Administrators have to forecast capacity requirements years in advance and translate that estimate into system specs, including CPU and memory. If conditions change, the app must be re-provisioned, causing downtime, disruption, and serious unhappiness in the corner offices.

## Benefit 4: Protect Apps from Failure with HA

Ensuring availability of your applications is difficult. Each application component must be made highly available, and operations teams often struggle with a proliferation of different clustering and availability options. The Web tier is fairly simple to protect using network load balancing, and the application tier can be clustered, but databases are typically the most difficult tier to protect. Databases can be protected using Microsoft Clustering, database mirroring, or high-end options such as Oracle RAC.

VMware provides a range of capabilities that can extend availability to 100 percent of applications including databases, without the complexity or cost of clustering. These capabilities are:

- **vMotion** – Move running virtual machines from one physical server to another with no impact to end users. vMotion keeps your IT environment up and running, giving you unprecedented flexibility and availability to meet the increasing demands of your business and end users.
- **High Availability** – Provides automated application restart in the event of host failure or OS failure within the virtual machine. It is automatically available for any application running on vSphere. VMware HA is simple and does not require OS- or app-level clustering. It is also very cost effective because it doesn't rely on dedicated standby servers, and in many cases allows the use of lower-cost OS and application licenses.
- **App-Aware High Availability** – Monitors the application and if it goes down, it can be restarted. App-Aware HA will run the failover only when the application doesn't come back up again. The underlying technology depends on the VMware HA to automatically initiate the failover. App-Aware HA is an API that allows users to plug in one of two currently available third-party App-Aware products from Symantec or Neverfail.
- **Fault Tolerance** – Protects any application against host failure with continuous availability, without data loss or downtime. VMware FT creates virtual machine "pairs" that run in lock step—essentially mirroring the execution state of a virtual machine. To the external world they appear as one instance (one IP address, one application)—but they are fully redundant instances.

The siloed example of availability methods shown in Figure 11 requires expensive licenses, dedicated standby infrastructure, and highly skilled staff to configure and manage. The alternative to this expensive approach is a standardized approach using vSphere technology, though some companies choose to implement both app-specific and VMware solutions running in tandem.

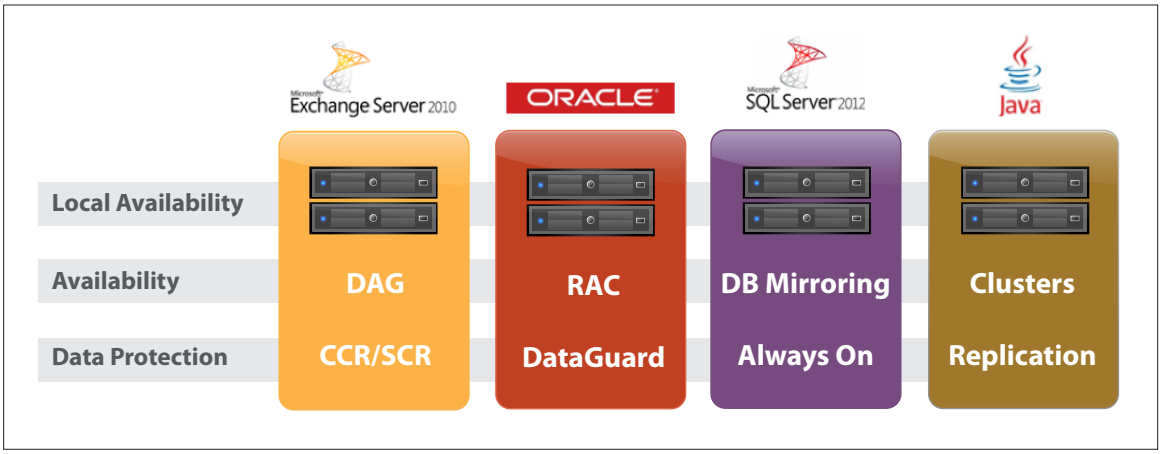



**Figure 11:** The Confusion That Is Caused When Each Application Has Its Own Silo of Availability and Data Protection—The Alternative Is a Consistent Approach Using vSphere

To prepare for availability issues affecting an entire datacenter, VMware vCenter™ Site Recovery Manager (SRM) enables datacenter teams to build, manage, and execute reliable disaster recovery plans for all applications, including business-critical apps. By taking full advantage of the encapsulation and isolation of virtual machines, SRM enables simplified automation of disaster recovery. SRM helps meet recovery time objectives, reduces costs traditionally associated with business continuance plans, and achieves low-risk and predictable results for recovery of a virtual environment.

## Benefit 5: Unify App Monitoring with vCOps

Performance, capacity, and configuration management are becoming inseparable due to the dynamic nature of converged infrastructure. Traditional tools and processes designed for siloed, static, physical infrastructures don't provide the automation and control you need to effectively manage highly virtualized and private cloud environments.

vCenter Operations Management Suite (vCOps) sets the industry standard in operational efficiency and allows you to: proactively enable virtual/cloud infrastructure performance for your business-critical applications; provide continuous compliance with operational and regulatory requirements; and, optimize resource utilization and cost.

Through the use of adapters, VMware vCenter Operations Manager can collect performance, topology, and events data from Oracle Enterprise Manager (OEM), Microsoft System Center Operations Manager (SCOM), and many other third-party monitoring tools to provide a comprehensive and coordinated view across all of the data you collect in your environment.

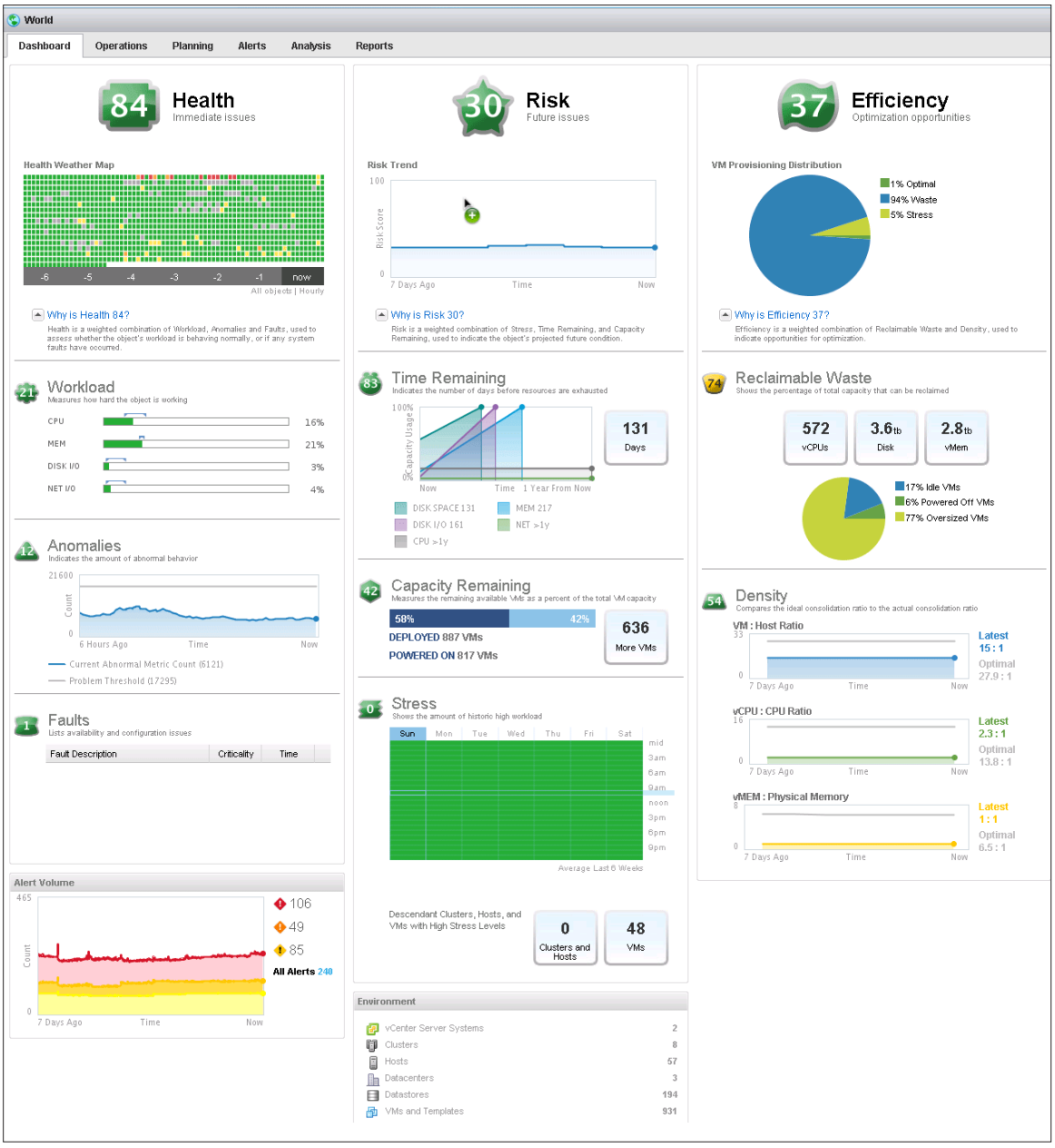



**Figure 12:** vCOps Reduces Application Problem-Solving Efforts

## Benefit 6: Monster App Scalability with vSphere 5

VMware supports running Monster VMs. Application performance is based on four infrastructure measures. Today, virtual machines on vSphere 5 can scale to 32 vCPUs, 1TB of memory, 36GB/s network, and 1 million storage IOPS.

These advances in performance are charted in Figure 13. And what they mean for you is that resource-intensive applications perform very well on vSphere. In fact, we have measured the resource requirements of more than 700,000 production applications running on x86 servers. vSphere is able to support more than 99 percent of those applications. [9]

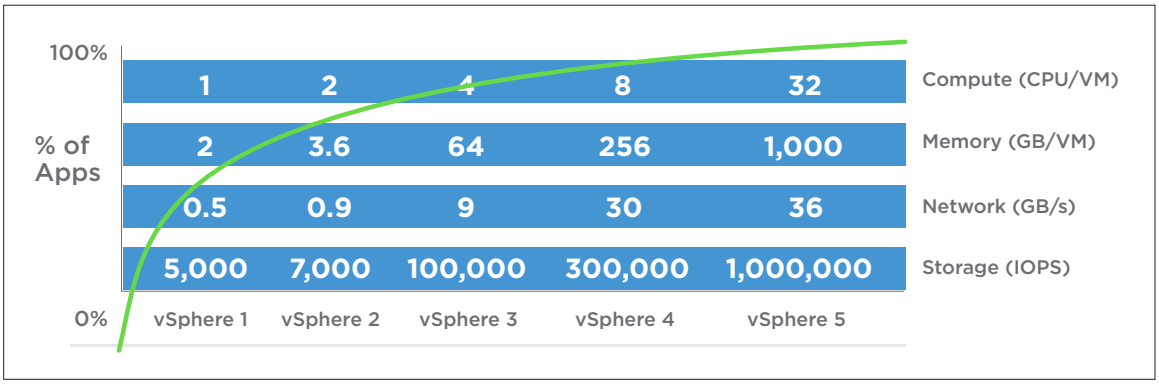



**Figure 13:** vSphere 5 Is Ready for the Most Demanding Applications

vSphere is also improving its performance per operation in core areas, such as vMotion. For example, vSphere 5 decreased vMotion duration by 44 percent from vSphere 4.1. This benefits application owners by providing vMotion without downtime or delay.

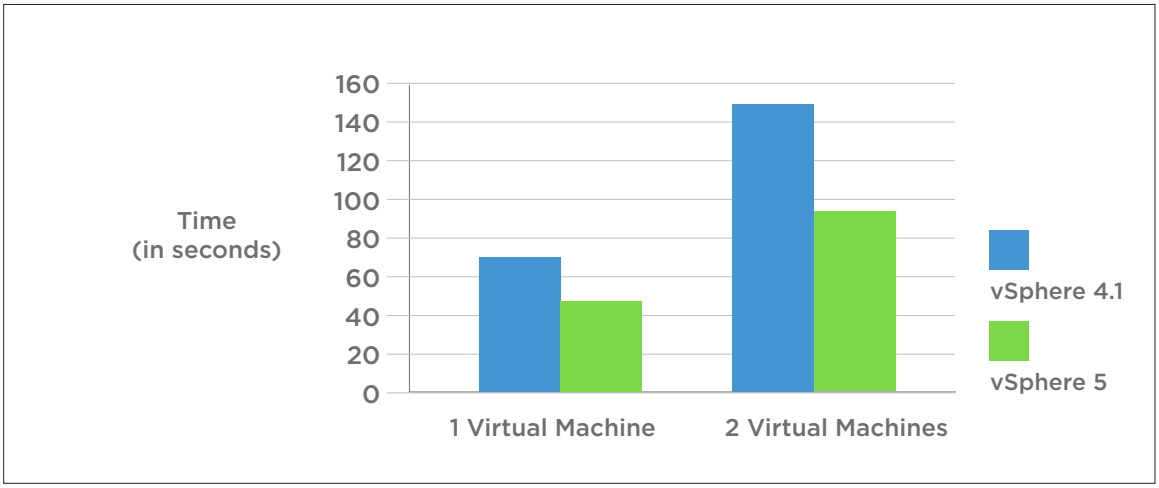



**Figure 14:** Duration of vMotion on vSphere 4.1 and vSphere 5, for Single and Multiple Exhange Server Deployments [10]

9. Source: VMware Capacity Planner™ assessments.

10. Source: VMware vSphere vMotion Architecture, Performance and Best Practices in VMware vSphere 5.

## Benefit 7: Lowest App Cost of Ownership with vSphere 5

Much like owning a car, there is more to the cost of ownership than the sticker price. The car's fuel efficiency, maintenance costs, and overall reliability can have a large impact on the owner's wallet. A better way to assess the economic value of various virtualization platforms is to look at the total cost of ownership (TCO).

Referencing a third-party study by Principled Technologies,[11] Figure 15 compares the time to perform common datacenter jobs using vSphere vs. Hyper-V. To test this scenario, Principled Technologies placed six VMs, each with 10GB of RAM, in a three-server cluster, and then ran a medium database workload on each of the 18 VMs. The study measured the time it took one server in the cluster to enter maintenance mode, evacuate all its VMs to the two remaining servers, and then migrate the VMs back to the original server. The study found the solution running vSphere 5 reduced the time to complete the shifting of VM workloads by 79 percent over the Microsoft solution.

| | VSPHERE | MICROSOFT HYPER-V R2 |
|---|---|---|
| **1.** Migrate all VMs off node and enter maintenance mode | 1:06 | 7.56 |
| **2.** Provision new host | 2:53 | 7:21 |
| **3.** Test non-disruptive DR recovery | 1:00:10 | 10:32:50 |
| **4.** Migrate VM Storage | 4:23 | 1:43:06 |
| **5.** Isolate storage-intensive VM | 2:05 | 1:34:32 |

**Figure 15:** vSphere Compared to Microsoft Hyper-V in Terms of Time to Shift VM Workloads

IT architects can run similar comparisons with their own numbers using the VMware Cost-Per-Application Calculator.

11. Source: Principled Technologies, Total Cost Comparison, VMware vSphere vs. Microsoft Hyper-V, 2012.

# Each Application in Detail

This section provides more specific information and detail about the advantages of virtualizing the six business-critical applications.

## What about Exchange?

| | SUPPORT STATEMENT | VIRTUAL PERFORMS EQUIVALENT TO PHYSICAL | KNOWN LICENSING ISSUES | PERCENT VIRTUALIZED BY VMWARE CUSTOMERS |
|---|---|---|---|---|
| Microsoft Exchange | YES | YES | NONE | 42% |

Email has become one of the most critical applications in an organization's IT infrastructure. Organizations increasingly rely on messaging tools for individual and organizational effectiveness. As a result, messaging administrators face a constant challenge as they continually seek to manage the conflicting demands of availability, agility, and cost.

Microsoft Exchange is the most widely used email system in the world. It's operational and performance characteristics are well understood, and best practices for design, deployment, and operations are readily accessible. Exchange continues to evolve through enhanced features and functionality, and previous limitations have been addressed with each successive new version.

With its release of Exchange Server 2010, Microsoft has added many features that improve messaging performance, reliability, and scalability. These provide a major step forward. However, Exchange Server 2010 is still subject to many of the shortcomings inherent in most applications running directly on physical hardware, such as hardware platform dependence, under-utilization of server computing resources, lack of flexibility to respond to changing workloads, and heavy costs associated with maintaining disaster recovery, test, and development environments. The architectural improvements in Exchange Server 2010 do not fully address these limitations.

The ideal platform for Exchange would adapt easily to changing workloads, provide flexibility to accommodate changing demands on an organization's IT infrastructure, remain reliable and resilient despite system outages, and improve both staff and infrastructure hardware effectiveness. A new operational platform based on vSphere can accomplish these goals.

---

*Case in Point*

*Like many companies that choose VMware virtualization technology, Raymond James Financial began with a server consolidation project that achieved impressive results. By the completion of the initiative, the Florida-based diversified holding company had reduced its web server capital costs by 90 percent. Raymond James started by virtualizing Microsoft Exchange, one of the company's most critical and high-profile applications.*

*Through virtualization, Raymond James has been able to better meet its business needs. "Right now, around 60 percent of our servers are virtualized," says Sue Werner, Systems Engineer at Raymond James. "But our goal is to achieve 87 to 90 percent virtualization." This will include not only the company's Microsoft Exchange environment, but also other business-critical systems such as its SQL databases. "Implementing our new Microsoft Exchange environment has further validated the benefits of VMware," Werner concludes. "It has enabled us to make significant progress toward our virtualization goal."*

---

## What about Oracle?

| | SUPPORT STATEMENT | VIRTUAL PERFORMS EQUIVALENT TO PHYSICAL | KNOWN LICENSING ISSUES | PERCENT VIRTUALIZED BY VMWARE CUSTOMERS |
|---|---|---|---|---|
| ORACLE DATABASE | YES | YES | NONE* | 28% |
| ORACLE MIDDLEWARE | YES | YES | NONE* | 34% |

*__Note:__ *No known issues, however customers are sometimes given information by Oracle that appears to contradict Oracle's licensing agreements. For processor-based licenses, Oracle expects to be paid for any hardware that runs Oracle software. Customers that run Oracle software on more servers than they originally planned to (whether those servers are physical or virtual) can expect Oracle to request payment for the additional use. On the other hand, licenses on older, slower machines, or on machines that are used at less than 15% of their capability, need licenses that cost the same as a heavily used server. Customers typically benefit by consolidating Oracle workloads to a smaller number of high-performance servers and paying for fewer core licenses.*

Oracle Database is one of the most widely deployed database platforms in the world, with some of the largest databases in the world, many of which also run on vSphere. VMware is also an Oracle customer; our E-Business Suite and Siebel instances are virtualized; and VMware routinely submits and receives assistance with issues for Oracle running on VMware virtual infrastructure.

Oracle and VMware have a long history of working well together. Unfortunately, VMware has been made aware of Oracle sales people occasionally trying to use misinformation to dissuade customers from virtualizing using vSphere. Based upon reliable reports from the field, the figure below addresses some examples of this misinformation and VMware's responses:

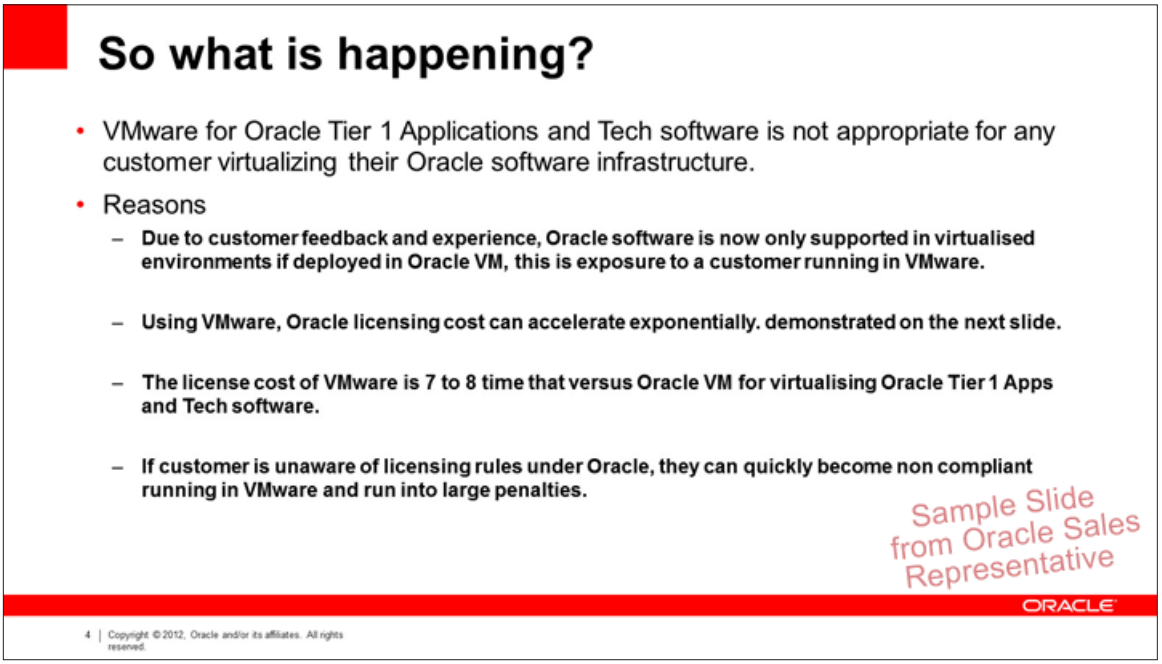



**Figure 16:** Sample Slide

The following table addresses VMware responses to the confusing accusations made in the sample Oracle slide.

| ORACLE MISINFORMATION | VMWARE RESPONSE |
|---|---|
| Due to customer feedback and experience, Oracle software is now only supported in virtualized environments if deployed in Oracle VM, this is exposure to a customer running in VMware. | **False.** Oracle has **not** withdrawn support for its applications running on VMware, let alone in response to "customer feedback and experience." To the contrary, Oracle's official, published policy has and continues to be to provide support for issues that either are known to occur on the native OS or can be demonstrated not to result from running the application on VMware. In fact, Oracle's highly sophisticated RAC clustering is fully supported on VMware, too. |
| Using VMware, Oracle licensing cost can accelerate exponentially. | **False.** In most cases customers will save money by consolidating their Oracle licenses and using advanced vSphere technologies such as "host affinity" to support compliance with Oracle's complex and punitive licensing rules. For more guidance on how to reduce costs when running Oracle applications on vSphere, see the Licensing section. |
| The license cost of VMware is 7 to 8 times that versus Oracle VM for virtualizing Oracle Tier 1 Apps and Tech software. | **False.** As noted above, most customers can save money running Oracle applications on vSphere despite Oracle's punitive approach that favors OVM. And of course, Oracle gives OVM away. Lacking a competitive product, what choice does Oracle have? VMware's ability to run more workloads more efficiently can reduce the number of cores needed, creating large savings in Oracle licensing and support costs. |
| If customer is unaware of licensing rules under Oracle, they can quickly become non-compliant running in VMware and run into large penalties. | **False.** As noted above, VMware provides sophisticated tools to enable license compliance with Oracle's complex rules. |

**Figure 17:** VMware Responses to Oracle Field Representative Claims

Some companies, notably iQuate, have developed software to help customers manage their Oracle licenses, in a virtualized or non-virtualized context. VMware introduces iQuate to customers that need help managing their Oracle licenses. Learn more about iQuate here: http://www.iquate.com/what-we-do.

The capabilities provided by vSphere are well beyond the needs of almost all databases, including Oracle. Figure 18 illustrates the standard CPU, memory, disk and network I/O needed for Oracle databases compared with the capacity of each VM.[12] As evidenced below, each VM can handle well over the resource requirements of Oracle databases.

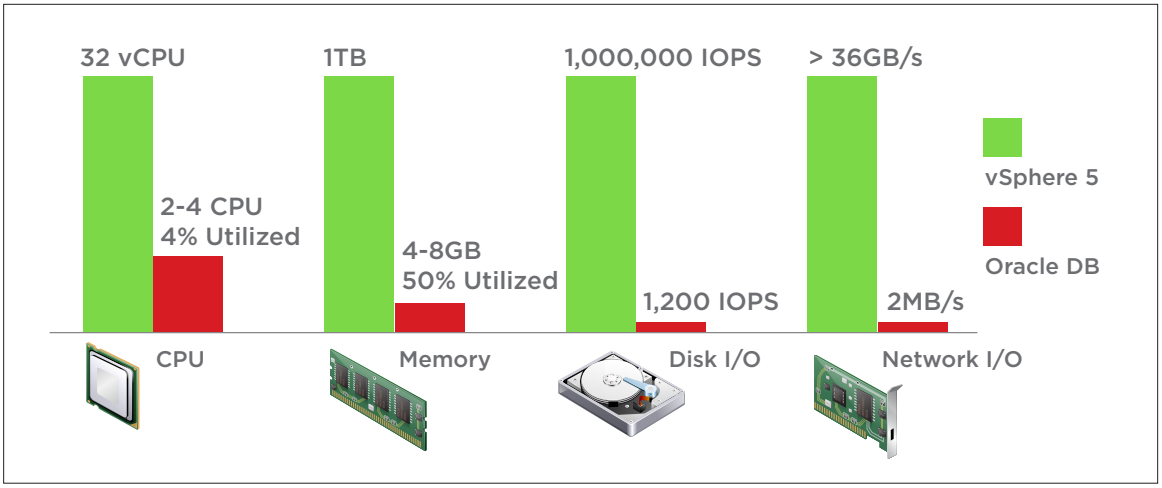



**Figure 18:** Average Oracle Database Fits Easily in a Virtual Machine

*Case in Point*

*"With the help of House of Brick and VMware Professional Services, we have been able to virtualize our most demanding Oracle databases on x86 servers. Where initially we believed that these databases would be too demanding for a virtual machine, we now have the confidence that vSphere can handle our largest transaction-processing databases with ease."*

– Rob Lowden, Director of IT at Indiana University

12. Source: VMware Capacity Planner analysis of >700,000 servers in customer production environments.

## What about SQL?

| | SUPPORT STATEMENT | VIRTUAL PERFORMS EQUIVALENT TO PHYSICAL | KNOWN LICENSING ISSUES | PERCENT VIRTUALIZED BY VMWARE CUSTOMERS |
|---|---|---|---|---|
| Microsoft SQL Server | YES | YES | NONE WITH SOFTWARE ASSURANCE | 47% |

SQL 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.

In SQL Server 2012, vMotion of SQL workloads is unlimited with Software Assurance (SA) and prohibited without SA (i.e. customer must license the origin and target host to accommodate the vMotion). In SQL 2008, vMotion of SQL workloads is unlimited with SA and limited to once every 90 days without SA. This limitation is a Microsoft licensing limitation, not a technical limitation.

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. The proliferation of large, multi-socket, multi-core servers has led many organizations to attempt traditional database consolidation, moving small databases into large shared database environments. Migrating to such a model can be an extremely complex endeavor requiring in-depth application remediation at the forefront and rigorous attention to operational processes once implemented for version control and continued application compatibility.

Virtualizing SQL can allow the best of both worlds, simultaneously optimizing compute resources through server consolidation and maintaining application flexibility through role isolation. SQL Servers can be migrated in their current state without expensive and error-prone application remediation and without changing the operating system, 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.

Another challenge is utilization. Most databases are performing at 0 to 5 percent utilization all but a few days of the year (e.g., Christmas shopping, quarter end). Figure 19 shows utilization of a physical SQL Database and a virtualized and consolidated SQL Database. [13]

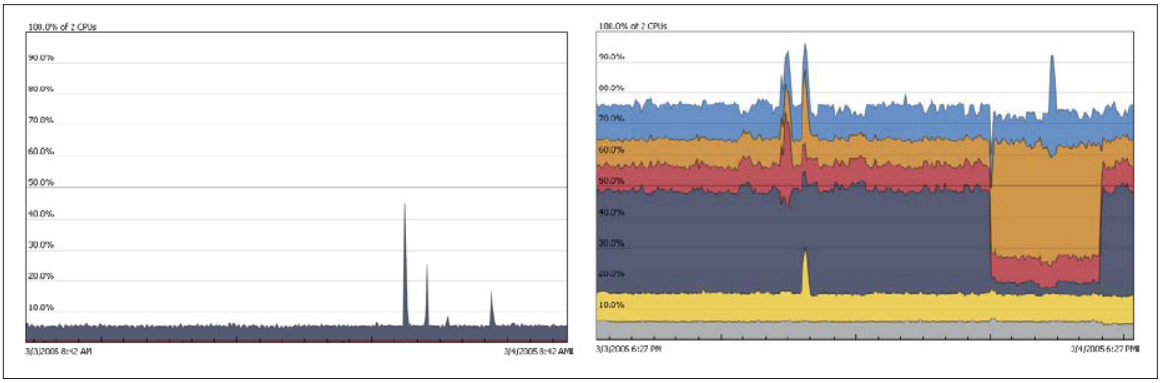


**Figure 19:** CPU Utilization on a vSphere Host Before and After Consolidation

Higher utilization rates of SQL deployments mean that IT teams are able to do more with less.

13. Source: Microsoft Exchange 2010 on VMware Use Cases.

## What about SAP?

| | SUPPORT STATEMENT | VIRTUAL PERFORMS EQUIVALENT TO PHYSICAL | KNOWN LICENSING ISSUES | PERCENT VIRTUALIZED BY VMWARE CUSTOMERS |
|---|---|---|---|---|
| SAP | YES | YES | NONE | 28% |

SAP and VMware are collaborating to provide customers with modern scalable, flexible infrastructure solutions with automated management tools, services, and support to accelerate the Journey to Cloud Computing. For example, vSphere is the only integrated hypervisor in the new release of Landscape Virtualization Management, SAP's tool for virtualization and infrastructure as a service. Customers with SAP NetWeaver benefit from an "on-demand" IT environment with a number of benefits:

- The pressure to ensure high availability is intense for SAP managers. VMware virtualization takes advantage of SAP's high-availability features to enable the software to stay running.
- Upgrades are a fact of life for every SAP landscape and they can be complex and time-consuming and often they take hours or days in a non-virtualized platform. In a virtual environment, new virtual machines can be provisioned in minutes, and then deprovisioned rapidly, recovering the resources.
- As IT budgets continue to shrink, the imperative to lower operating costs gets more urgent—and virtualization can make a real difference. Server consolidation translates directly into lower costs for power, cooling, and space—and boosts the organizations "green" profile in the bargain.
- The IT investment priority in 2012 is virtualization. 71% of surveyed companied plan to invest in SAP virtualization in Germany.[14]
- 38% of x86 SAP customers in Germany have 100% virtualized their SAP landscape.[15]

SAP software also performs well on vSphere. For an apples-to-apples comparison take a look at two-tier benchmark certifications 2011028 (physical) and 2011027 (vSphere5). The virtual result is within six percent of physical, which is completely imperceptible to the SAP Basis admin, but with all the cloning, provisioning, and reliability benefits. Read the details of the SAP benchmark certifications here: http://www.sap.com/solutions/benchmark/sd2tier.epx.

*Case in Point*

*The IT department at Columbia Sportswear Company, the outdoor apparel manufacturer, was looking to get out of the constant churn of physical hardware and into bringing more value to the rest of the business. Exponential growth, combined with the limitations of physical servers, led Columbia to consider virtualizing SAP with VMware and EMC. Through this partnership, Columbia has gained efficiency, reliability, scalability, capacity planning and management, performance tuning and is gaining greater insight into its virtualization layer.*

*The company started by virtualizing IT-based applications, but the new environment proved so beneficial to its business that Columbia decided to move tier-1 workloads, including SAP. Michael Leeper, Senior IT Manager, explained that the decision to virtualize SAP wasn't a hard one to make. The results Leeper and his team have seen are proof: "SAP running on VMware, running on our architecture, looks and feels exactly like everything else we run."*

*Because Columbia was running the rest of the company on a very similar virtual architecture, Leeper explained, "We had no significant concerns that putting SAP on that architecture would cause any issues. As a matter of fact, it probably helped us with a lot of things." At this point, Columbia's operations are 90 percent virtualized, and IT has been able to deliver business intelligence using new technology, not the technology of the past 10 years.*

14. Source: DSAG investment survey, 2012.
15. Source: RAAD.

## What about SharePoint?

| | SUPPORT STATEMENT | VIRTUAL PERFORMS EQUIVALENT TO PHYSICAL | KNOWN LICENSING ISSUES | PERCENT VIRTUALIZED BY VMWARE CUSTOMERS |
|---|---|---|---|---|
| Microsoft SharePoint 2010 | YES | YES | NONE | 67% |

Because SharePoint encourages rapid growth and "viral" proliferation, user goals may conflict with the ability of the IT staff to deliver the desired services when needed within budgetary and manpower constraints. Flexibility is extremely valuable during this early period. If rapid growth and evolution can be supported at realistic costs, SharePoint can become an important tool to rapidly increase everyday productivity. vSphere facilitates this capability, allowing organizations to leverage the benefits of SharePoint on a pay-as-you-go basis. Because high availability features are inherent to the vSphere platform, these can be leveraged on demand. By virtualizing SharePoint, the common problems of deploying a complex, high-growth IT service are alleviated, allowing resources to be spent on maximizing the value of the tool in routine business practice.

Unlike some applications that have consistent workload patterns on a per user basis (for example, Exchange or SAP), SharePoint workloads can vary greatly depending on how the application is used within the organization. SharePoint services can be deployed in a wide variety of combinations to accommodate very specific application use cases. Even within a specific application use case, usage patterns can vary greatly depending on frequency of user access, time of day, document reads/writes, and document sizes.

Out of the box, vSphere offers several capabilities that enable you to quickly respond to changing usage patterns. Allocation of processor and memory resources to virtual machines can be easily changed to suit the most current business requirements and, in the case of Hot-Add, without any interruption to the operating system or application. You can use vMotion to migrate heavily used SharePoint virtual machines to another host to alleviate physical resource bottlenecks. Finally, template-based provisioning allows the rapid deployment of new SharePoint virtual machines to satisfy increased load.

## What about Java?

| | SUPPORT STATEMENT | VIRTUAL PERFORMS EQUIVALENT TO PHYSICAL | KNOWN LICENSING ISSUES |
|---|---|---|---|
| Java | YES | YES | NONE |

Whether a custom Java application or third-party vendor application, all virtualize relatively easily. Often our customers notice improvements in performance and scalability when moving to a virtualized platform. Java application clusters are known to contain many instances that require increased managment when on a physical infrastructure. Many of our customers look for consolidation opportunities while improving performance and scalability. The prime reason for virtualizing Java applications these days is the ability to reduce the JVM instance sprawl that many administrators dread—and have to consolidate through virtualization in order to keep the scale manageable and feasible. Many of our customers have virtualized IBM WebSphere, Oracle WebLogic, JBoss, and Tomcat. In the last three years, virtualization of Java applications has become mainstream, as seen with many of our customer accounts.

The results of the tests discussed in this paper show that enterprise-level Java applications can provide excellent performance when deployed on VMware vSphere 4.1. The application used in these tests was Olio, a multi-tier enterprise application that implements a complete social networking Web site. Olio was deployed on SpringSource tc Server, running both natively and virtualized on vSphere 4.1. Figure 5 shows the peak throughput for a single instance of Olio running on tc Server, both natively and in a VM, with two and four CPUs.

---

*Case in Point*

*"With our OrderExpress project we upgraded our WebSphere Commerce, Portal, WCM, Service Layer, DB2 Database; migrated from AIX to Linux; virtualized on VMware; moved the application into a three-tier DMZ; increased our transactions by over 150 percent; and added significant new capabilities that greatly improved the customer experience. Changing such a wide range of technology components at once was a huge challenge. However using VMware vSphere and additional architectural changes we were successful in improving performance by over 300 percent; lowered costs in the millions; improved security, availability, and scalability; and how we plan to continue evolving this application to maintain greater than 30 percent yearly growth."*

– Jeff Battisti, Senior Enterprise Architect at Cardinal Health

---

## What about Hadoop?

| | SUPPORT STATEMENT | VIRTUAL PERFORMS EQUIVALENT TO PHYSICAL | KNOWN LICENSING ISSUES |
|---|---|---|---|
|  | YES | YES | NONE |

Hadoop is a modern application with features such as consolidation of jobs and HA that overlap with capabilities enabled by virtualization. This leads some to believe there is no motivation for virtualizing Hadoop; however, there are a variety of reasons for doing so. Some of these are:

- **Scheduling** – Taking advantage of unused capacity in existing virtual infrastructures during periods of low usage (for example, overnight) to run batch jobs.
- **Resource Utilization** – Co-locating Hadoop VMs and other kinds of VMs on the same hosts. This often allows better overall utilization by consolidating applications that use different kinds of resources.
- **Storage Models** – Although Hadoop was developed with local storage in mind, it can just as easily use shared storage for all data or a hybrid model in which temporary data is kept on local disk and HDFS is hosted on a SAN. With either of these configurations, the unused shared storage capacity and bandwidth within the virtual infrastructure can be given to Hadoop jobs.
- **Datacenter Efficiency** – Virtualizing Hadoop can increase datacenter efficiency by increasing the types of workloads that can be run on a virtualized infrastructure.
- **Deployment** – Virtualization tools ranging from simple cloning to sophisticated products like VMware vCloud™ Director can speed up the deployment of Hadoop nodes.
- **Performance** – Virtualization enables the flexible configuration of hardware resources.

# Licensing

Cost reduction through consolidation remains a strong driver for virtualization. vSphere can deliver huge savings not only in hardware, but also in power and administrative costs. In January 2008, CIO Magazine published the results of its "Virtualization in the Enterprise" survey of nearly 300 CIOs. When asked why they have virtualized their servers, 81 percent of the companies responded: "to cut costs via server consolidation."

These high consolidation ratios are also common with large, business-critical applications. The 8:1 consolidation ratio achieved for SAP is typical. Some customers have gone beyond that, comfortably achieving 10:1 consolidation ratios with SAP. For example, AstraZeneca, one of the world's leading pharmaceutical companies, consolidated its entire SAP environment to 50 to 60 virtual machines hosted on six HP servers, and as a result expects cost savings of more than $1 million over three years.[16]

For Exchange, consolidation ratios are usually in the range of 5:1 to 10:1. Without vSphere, each Exchange server role—mailbox server, edge, hub, and client—is deployed on a dedicated server. In addition, there are often dedicated standby servers for availability, as well as multiple Exchange hubs, creating ample opportunity for high consolidation ratios. Organizations such as the University of Plymouth, medical device manufacturer NuVasive, and packaging manufacturer Boise have taken advantage of this opportunity to cut down on hardware costs and ramp up on efficiency, flexibility, and agility.

In many cases, customers are also able to consolidate software licenses, sometimes by as much as 10:1. Best practice recommendations say to start at 1:1 and work up to 10:1 as the business-critical application workload requirements are understood..

- Some applicationss can be licensed by "virtual CPU," such as in the case of IBM with the sub-capacity licensing model. In this instance, organizations have the opportunity to license only the capacity they are effectively using (virtual CPU), as opposed to the full physical capacity of the server. License consolidation ratios of 2:1 to 4:1 are common with this model.
- Other applications can also be licensed by "physical CPU" or "physical core," for example Oracle databases and SQL. Organizations that have multiple instances of such an application can create a dedicated vSphere cluster for the application. By licensing all the physical processors in the cluster, they create an "all you can eat" environment in which an unlimited number of instances and virtual machines can be deployed. Consolidation ratios of 5:1 to 10:1 are common with this approach.

Here's an example of Oracle license savings associated with virtualizing, along with an improvement in performance and reliability.[17]

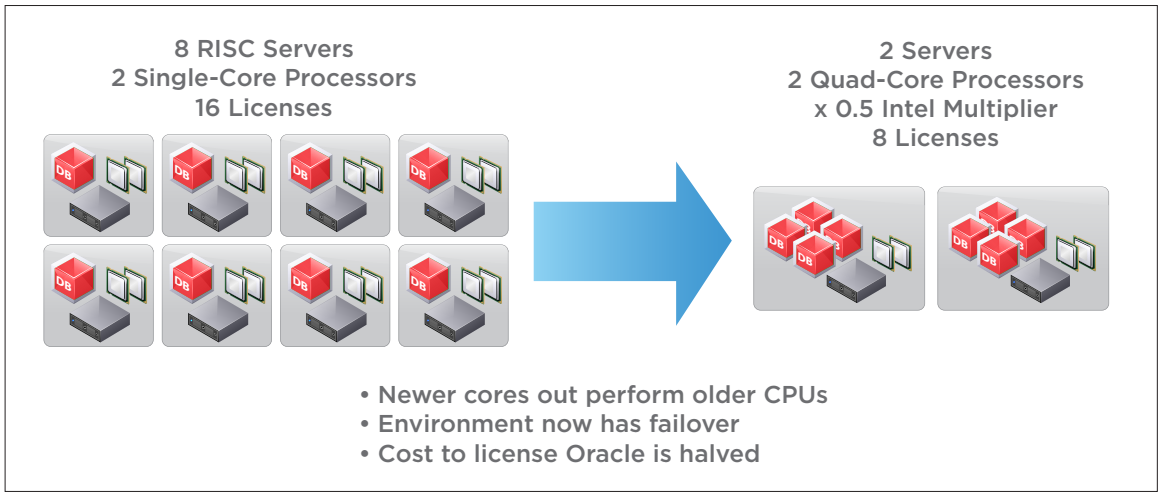



**Figure 20:** Oracle Licensing Consolidation

16 Source: VMware AstraZeneca Customer Snapshot.

17. Source: iQuate, www.iquate.com.

Here's an example of SQL license savings associated with virtualizing.[18]

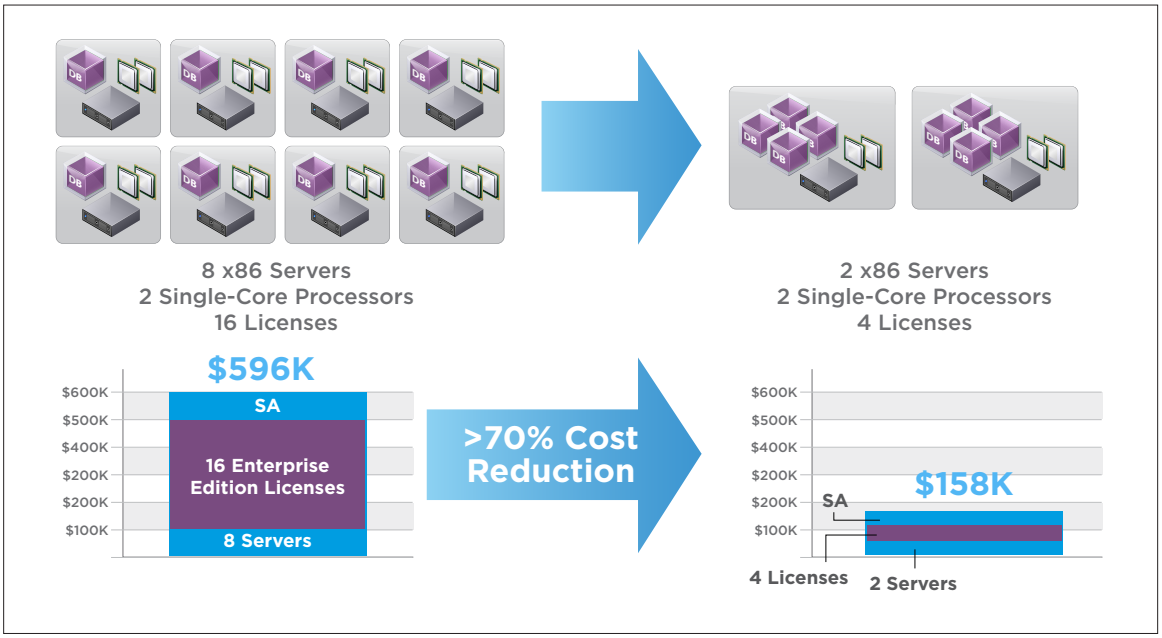



**Figure 21:** SQL/Oracle Database Consolidation Reduces Software Costs by >70%

For more information on licensing read this whitepaper: Understanding Oracle Certification, Support and Licensing for VMware Environments, 2011.

## Database Consolidation

Database consolidation is an increasingly popular use case for vSphere. Nearly all applications require their own database, and many organizations are faced with spiraling database sprawl and costs.

Databases also tend to be the most over-provisioned applications in the datacenter, and are very expensive due to high license costs and top-tier infrastructure requirements.

| METHODS TO COMBAT DATABASE SPRAWL | STRUCTURE |
|---|---|
| Traditional multi-instancing | Multiple SQL or Oracle instances on a shared OS image |
| Traditional shared-instancing | Multiple databases within a shared SQL |
| vSphere virtualization | Multiple SQL or Oracle instances in virtualized platform |

**Figure 22:** Database Consolidation Methods

Traditional approaches have challenges:

- No high availability solution—a single OS failure could result in dozens of databases and applications being down simultaneously
- No isolation of OS configuration, security, fault, and resource isolation between databases
- Load balancing between physical hosts requires re-provisioning databases

18. Source: VMware Infrastructure Solution for Microsoft SQL Server white paper.

Database virtualization has benefits over traditional approaches:

1. **Fast consolidation with P2V** – With vSphere, consolidating existing legacy databases is simple. Databases can be migrated with a simple physical-to-virtual (P2V) migration, or re-provisioned in a virtual machine with their existing OS and database configurations. This eliminates the need to re-test and update databases to run on standardized OS and database configurations.
2. **Isolation** – Databases consolidated on vSphere preserve isolation between instances (configuration, fault, security, and resource isolation). Databases can run on their own OS and SQL version, and a single OS failure will only impact a single database. This is an obvious benefit of virtualization, but not possible with conventional database consolidation approaches.
3. **Resource Controls** – Control resources with great precision to enable each database to deliver its required service levels, without the risk of misbehaving databases taking over critical resources from other databases.
4. **Load Balancing** – With vSphere, when a host is running out of capacity, databases can be migrated in real time and with no downtime to other hosts. This eliminates the need to over-provision, and increases consolidation ratios while maximizing database service levels.

# Support

As the industry standard for virtualization, vSphere has received strong ISV support from 18,000 ISVs, including support statements from the four largest ISVs: Microsoft, IBM, SAP, and Oracle.[19]

| SUPPORT STATEMENT FOR VMWARE | | | | | |
|---|---|---|---|---|---|
| Microsoft Exchange Server 2010 | ORACLE DATABASE | ORACLE MIDDLEWARE | Microsoft SQL Server | SAP | Microsoft SharePoint 2010 |
| YES | YES | YES | YES | YES | YES |

**Figure 23:** Support Statements for Business-Critical Applications for VMware

## Microsoft Support

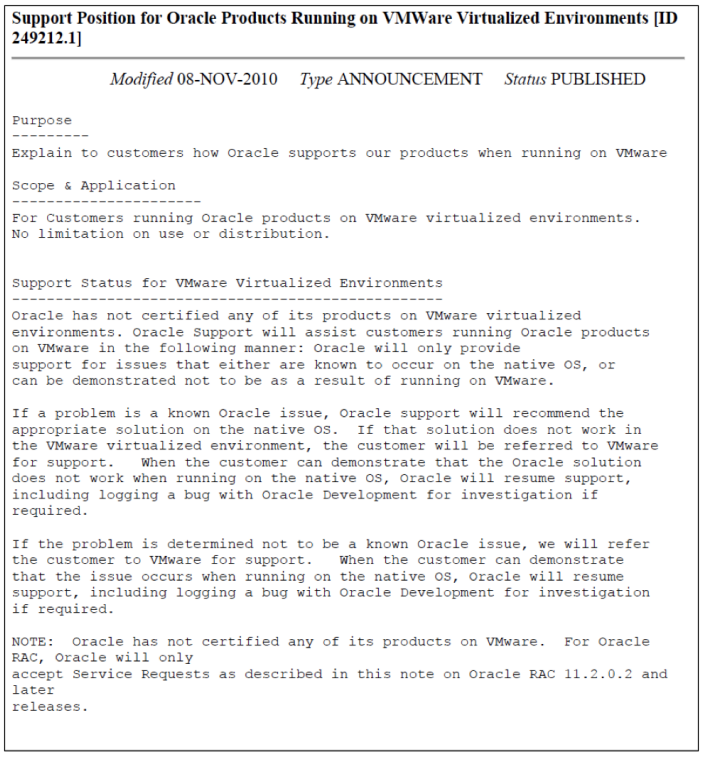
Support statements for Microsoft products can be found at these links:

- Windows Microsoft software
- Microsoft server
- Exchange
- SQL
- SharePoint

19. Source: VMware customer surveys, Jan 2010 and June 2011.

## Oracle Support

Although some Oracle marketing documents may imply that Oracle does not support VMware, and Oracle sales might tell you that VMware is not supported, we are pleased to clarify that Oracle does have a support statement in place for VMware. Oracle's Metalink note 249212.1, published on MyOracleSupport, defines Oracle's policy for supporting applications on VMware. Here is the support statement:



**Support Position for Oracle Products Running on VMWare Virtualized Environments [ID 249212.1]**

*Modified* 08-NOV-2010 *Type* ANNOUNCEMENT *Status* PUBLISHED

Purpose
---
Explain to customers how Oracle supports our products when running on VMware

Scope & Application
---
For Customers running Oracle products on VMware virtualized environments.
No limitation on use or distribution.

Support Status for VMware Virtualized Environments
---
Oracle has not certified any of its products on VMware virtualized environments. Oracle Support will assist customers running Oracle products on VMware in the following manner: Oracle will only provide support for issues that either are known to occur on the native OS, or can be demonstrated not to be as a result of running on VMware.

If a problem is a known Oracle issue, Oracle support will recommend the appropriate solution on the native OS. If that solution does not work in the VMware virtualized environment, the customer will be referred to VMware for support. When the customer can demonstrate that the Oracle solution does not work when running on the native OS, Oracle will resume support, including logging a bug with Oracle Development for investigation if required.

If the problem is determined not to be a known Oracle issue, we will refer the customer to VMware for support. When the customer can demonstrate that the issue occurs when running on the native OS, Oracle will resume support, including logging a bug with Oracle Development for investigation if required.

NOTE: Oracle has not certified any of its products on VMware. For Oracle RAC, Oracle will only accept Service Requests as described in this note on Oracle RAC 11.2.0.2 and later releases.

**Figure 24:** Oracle Support Position for Products Running on VMware Virtualized Environments

The second to last paragraph states that Oracle may ask a customer to replicate the issue on non-virtual hardware if an issue hasn't been previously seen by Oracle. This occurs only once for each issue (the first time), and when it occurs VMware has a Total Ownership Policy to take accountability of that issue and resolve it for the customer. Here is the VMware support statement to that effect: "VMware will accept accountability for any Oracle-related issue reported by a customer. By being accountable, VMware Support will drive the issue to resolution regardless of which vendor (VMware, Oracle, or others) is responsible for the resolution. In most cases, reported issues can be resolved via configuration changes, bug fixes, or feature enhancements by one of the involved vendors." This statement is available at http://www.vmware.com/support/policies/oracle-support.html.

---

*Case in Point*

*House of Brick is a large solution provider with expertise in virtualizing the world's largest databases.*

*"In our experience virtualizing the world's largest and most complex tier-1 databases, we have never seen an instance of re-platforming a database off virtualized hardware onto non-virtualized hardware. Once customers virtualize they do not want to go back, and I've never seen a case when Oracle made a customer re-platform onto non-virtualized hardware. Virtualizing Oracle databases has become commonplace."*

– David Welch, CTO, House of Brick

---

## SAP Support

VMware and SAP have been working closely for over five years. In 2007, SAP granted full support to run SAP on VMware. In 2012, SAP went even further and gave support for SAP Sybase ASE. In 2012, VMware engineers are working with SAP to gain support of HANA, SAP's new in-memory database.

Support statements for SAP can be found at the SAP Community Network.

## Support from Other Vendors

vSphere does not introduce functional changes for applications running on it. Hence, customers can run applications on vSphere without official support statements from the software vendor. Nevertheless, the largest software vendors have still written support statements for running on VMware, as seen in the following figure:

| TOP 11 HEALTHCARE VENDORS | TOP 10 FINANCIAL VENDORS | TOP 6 TELECOM VENDORS | TOP 5 BUSINESS INTELLIGENCE VENDORS | TOP 4 OUT OF 5 RETAIL VENDORS |
|---|---|---|---|---|
| Agfa | Advent Software | Aastra | Actuate | Epicor |
| Allscripts | CTI | Alcatel-Lucent | Business Objects/ SAP | Exact Software |
| Amicas | Fiserv | Avaya | IBM | Microsoft Dynamics |
| Cardinal Health | Infor Global | Cisco | Information Builders | Sage |
| Cerner | Jack Henry | Mitel | MicroStrategy | |
| Epic | Kronos | Sterling Commerce/ IBM | | |
| FujiFilm Medical | Lawson | | | |
| GE Healthcare | Metavante | | | |
| McKesson | Sage | | | |
| Sage | Verint | | | |
| SAIC | | | | |

**Figure 25:** VMware Has Official Support Statements from the Largest Software Vendors

# Best Practices

The following best practices for virtualizing business-critical applications can provide useful guidance for virtual CPU, virtual memory, networking and storage setup.

| | | |
|---|---|---|
| EXCHANGE | Virtual CPU   | • Size based on physical processor capabilities<br>• Determine the CPU requirements based on physical CPU throughput and mailbox profile<br>• Use the Exchange Processor Query Tool and the Exchange Mailbox Role Calculator<br>• Initial physical to virtual processor sizing should be 1:1 until a steady state workload is achieved<br>• CPU virtualization adds only a small amount of overhead<br>• Exchange is not NUMA-aware—vSphere is—keeping the VM size to within the NUMA node |
| | Virtual Memory   | • Use memory reservations to avoid over-commitment<br>• Provide available physical memory to satisfy an SLA, or to reclaim VM swap file space<br>• Memory will be wasted if the Exchange VMs are not utilizing the configured memory efficiently<br>• Do not set memory limits for memory-intensive applications |
| | Networking  | • Separate management traffic (vMotion, FT logging, VMKernel) and virtual machine traffic—either using separate physical NICs or using VLAN tagging<br>• Use the VMXNET3 para-virtualized NIC. VMXNET3 is optimized for virtual environments and designed to provide high performance<br>• Follow the networking design guidelines in VMworld 2010 session TA8595 - Virtual Networking Concepts and Best Practices |
| | Storage  | • PVSCSI driver can provide better throughput with less host CPU utilization—test first for your environment; in low IO environment LSI SAS vSCSI driver may be adequate<br>• Dedicate VMFS volumes for Exchange data unless properly sized to accommodate more<br>• Use multiple vSCSI adapters and evenly distribute target devices<br>• When using VMFS for Exchange data create VMDK files eagerzeroedthick or uncheck Windows “Quick Format” option |

| ORACLE DATABASE | | |
|---|---|---|
| | Virtual CPU   | • Total number of vCPUs assigned to all the VMs equal to or less than the total number of physical cores<br>• CPU virtualization adds only a small amount of overhead; enable hyper threading<br>• Keep VM size to within the NUMA node |
| | Virtual Memory   | • Set memory reservations to avoid over-commitment, provide available physical memory<br>• Size the memory suggested by Oracle DBA<br>• Use HugePages for Oracle |
| | Networking  | • Separate management traffic (vMotion, FT logging, VMKernel)<br>• Allocate at least 2 NICs per vSwitch to leverage NIC teaming capabilities<br>• Use the VMXNET3 para-virtualized NIC<br>• Use network I/O control to converge network and storage traffic onto 10GbE |
| | Storage  | • Use Paravirtualized SCSI adapters for Oracle data files with demanding workloads<br>• Create dedicated datastores to service database workloads<br>• Use multiple vSCSI adapters and evenly distribute target devices<br>• Use Oracle Automatic Storage Management(ASM) where ever applicable<br>• Use vSphere VMFS for Oracle single instance and RAC database deployments<br>• Align VMFS properly<br>• Enable jumbo frames for IP-based storage using iSCSI and NFS |

| | | |
|---|---|---|
| SQL | Virtual CPU   | • Understand existing workload, avg., and peak<br>• Properly manage pCPU allocation<br>- For Tier 1 workload, avoid pCPU over-commitment<br>- For lower-tiered databases workload, reasonable over-commitment can increase aggregate throughput, and maximize license savings; leverage vMotion, DRS for resource load balancing<br>• Monitor to optimize<br>- Host level: %RDY, %MLMTD, and %CSTP<br>- VM Level: Processor Queue Length<br>• Keep NUMA node size in mind<br>- For smaller VM, allocate vCPUs to <= cores in a physical node<br>- For wide VM (ESX 5), align vCPUs to physical NUMA boundaries, enable vNUMA on ESX to allow SQL Server NUMA optimization |
| | Virtual Memory   | • Do not over-commit memory until VC reports that steady state usage is below the amount of physical memory on the server<br>• For critical SQL Server workloads, consider setting memory reservation = allocated memory to avoid ballooning or swapping<br>• If over-committing memory, monitor SWAP /MB: r/s, w/s and MCTLSZ<br>• Use Active memory counter with caution; always confirm usage by checking memory counter in perfmon<br>• Do not set memory limits for memory-intensive applications |
| | Networking  | • Separate management traffic (vMotion, FT logging, VMKernel) and virtual machine traffic<br>• Separate NICs assigned to separate vSwitches<br>• Use VLAN Tagging (802.1q)<br>• Allocate at least two NICs per vSwitch to leverage NIC teaming capabilities<br>• Use the VMXNET3 para-virtualized NIC. VMXNET3 is optimized for virtual environments and designed to provide high performance<br>• Consider installing MS KB2344941 if using Windows 2008 R2-based templates<br>• Follow the networking design guidelines in VMworld 2010 session TA8595 - Virtual Networking Concepts and Best Practices – this includes designs to efficiently manage multiple networks and redundancy of network adaptors on vSphere hosts |
| | Storage  | • Use PVSCSI driver for IO intensive SQL Server volumes; use patch versions in http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=2004578<br>• Dedicate VMFS volumes for Tier-1 SQL Server files unless properly sized to accommodate more<br>• Ensure disk partition alignment at VMFS and guest OS level<br>• Use multiple vSCSI adapters and evenly distribute target devices<br>• Provision VMDK files as eagerzeroedthick to avoid lazy zeroing for Tier-1 SQL Server volumes<br>• Separate VMDKs for SQL binary, data, log, and tempdb files<br>• Understand the path to the drives, i.e. storage protocol, multi-pathing<br>• Use multiple smaller LUNs for better manageability and performance |

| | | |
|---|---|---|
| SAP | Virtual CPU   | • For an initial sizing estimate of production SAP systems try to ensure the total number of vCPUs assigned to all the virtual machines is equal to or less than the total number of physical cores<br>• CPU virtualization adds only a small amount of overhead; typically this is mitigated by newer generation processors<br>• Know how NUMA affects your VMs—keeping the VM size to within the NUMA node will provide the best performance. If a wide database VM is required set virtual NUMA to align with the NUMA architecture of the ESX host<br>• To balance and limit available CPU resources across virtual machines use resource pools. Avoid setting limits separately for each VM |
| | Virtual Memory   | • For production SAP use memory reservations to avoid over-commitment<br>• "Right-size" the configured memory of a VM to avoid memory wastage<br>• Do not set memory limits for memory-intensive SAP applications<br>• Use the latest processor generations (from Intel: Nehalem microarchitecture-based XEON and successors; from AMD: 10h microarchitecture-based Opteron and successors), due to their enhanced support for virtualization—there is no performance impact from the SAP memory model |
| | Networking  | • Separate management traffic (vMotion, FT logging, VMKernel) and virtual machine traffic<br>• Use separate NICs assigned to separate vSwitches and leverage VMware NIC teaming capabilities<br>• Use VLAN Tagging (802.1q)<br>• Use the VMXNET3 para-virtualized NIC. VMXNET3 is optimized for virtual environments and designed to provide high performance |
| | Storage  | • PVSCSI driver can provide better throughput with less host CPU utilization—test first for your environment<br>• Spread database over multiple LUNs/datastores—follow similar design practices as physical for I/O performance<br>• Use multiple vSCSI adapters and evenly distribute target devices<br>• Create VMDK files storing database log and data files in eagerzeroedthick format |

| | | |
|---|---|---|
| JAVA | Virtual CPU   | • It is best to follow the best practices outlined here: http://www.vmware.com/resources/techresources/1087<br>• Establish a workload profile and conduct a load test to measure how many JVMs you can stack on a particularly sized virtual machine. In this test, establish a best-case scenario of how many concurrent transactions you can push through a configuration before it can be safely deemed a good candidate for scaling horizontally in an application cluster<br>• For performance-critical enterprise Java applications virtual machines in production, make sure that the total number of vCPUs assigned to all of the virtual machines does not cause greater than 80 percent CPU utilization on the host<br>- For example, if your performance load test determines that two vCPU is adequate up to 70 percent CPU utilization, but instead you allocate four vCPU to your virtual machine, then potentially there can be two vCPUs idle, which is not optimal<br>• If the exact workload is not known, size the virtual machine with a smaller number of vCPUs initially and increase the number later if necessary<br>• Always leave HT on<br>• Turn off any power-saving modes at the BIOS level |
| | Virtual Memory   | • Set memory reservation for the most critical java applications<br>• A sizing example is shown here http://blogs.vmware.com/apps/2011/12/sizing-virtual-machines-for-jvm-workloads-part-2.html |
| | Networking  | • There are no special considerations for Java workloads |
| | Storage  | • VMware recommends a minimum of four paths from a host to a storage array, which means the host requires at least two HBA ports |

**Figure 26:** Virtualization Best Practices for BCAs

## When to Virtualize That App

You cannot afford for many applications in your datacenter to go down. With that in mind, let's look at which events might provide a good opportunity to virtualize applications in your datacenter. Below are some questions to ask when considering virtualization. If you answer "yes" to any of the questions, it might be time to virtualize that app.

| APPLICATION | QUESTIONS |
|---|---|
| GENERAL | • Are you in need of a hardware or software refresh?<br>• Are you having uptime or compliance issues?<br>• Is your business undergoing mergers or rapid business transformations? |
| Microsoft Exchange Server 2010 | • Are you looking to upgrade to Exchange 2010 from either 2003 or 2007?<br>• Are you having issues with DAG or clustering? |
| ORACLE | • Are you migrating from traditional Unix (HP-UX, AIX, Solaris Sparc) to x86 Linux?<br>• Are you looking to create cost-effective development and testing environments quickly?<br>• Do you have underutilized Oracle Database servers that need consolidation? |
| Microsoft SQL Server | • Is it time for a SQL version upgrade (from 2005, 2008 or 2012)?<br>• Are you changing Microsoft licensing from Enterprise to Datacenter? |
| SAP | • Are you undergoing a new SAP install or upgrade or adding new SAP products (e.g. CRM, BW, SCM)?<br>• Are you planning a platform change, hardware refresh, or Unicode conversion? |
| Microsoft SharePoint 2010 | • Is it time for a version upgrade (from 2007 or 2010)?<br>• Are you looking to migrate from other collaboration platforms or applications? |
| Java | • Are you experiencing scalability issues (e.g. parallelism or data latency)?<br>• Are you experiencing application downtime due to frequent software and system upgrades? |
| UNIX MIGRATION | • Are you looking for ways to cut costs or are you at the end of a lease?<br>• Are you changing database platforms (e.g. DB2 to Oracle)? |

**Figure 27:** Application Virtualization Questions to Consider

## Organizational Best Practices for BCA

When embarking on your virtualization journey, keep these key organizational best practices in mind.

| PRACTICE | DETAILS |
|---|---|
| **Gain a Solid Understanding of How Virtualization Works**  | • Virtualization requires alignment across your servers, network, storage, and applications. Unite the teams behind each layer for the best chance of success.<br>• Specifically when virtualizing business-critical applications, it is important to remember that outages and downtime you might have seen in development and testing will carry a significant impact. |
| **Maintain Proper Insight at All Layers**  | • The management tools in place must give the servers, network, storage, and application teams mentioned above the proper view into their layer. In this way, they can plan and troubleshoot accordingly.<br>• Every team must be proactive with capacity, deliver proper reports and metrics, and define processes throughout. |
| **Segment a Team to Focus on Business-Critical Applications Support while Virtualizing**  | • An internal VMware BCA support team on the central infrastructure side can focus on unique aspects of managing virtual environments that might not be seen until the migration begins. |
| **Business-Critical Applications Can Lose Millions of Dollars per Minute if They Go Down**  | • Manage the process proactively to avoid significant losses in transition. Avoid using help tickets after a problem occurs.<br>• Make manual vMotion moves if needed.<br>• Change if issues arise. |

**Figure 28:** Key Organizational Best Practices for Business-Critical Applications

## Where to Start with BCA Design

Base the sizing of your virtual environment on physical servers. It's critical to understand your application requirements and have a good sense of the capacity and storage you'll need.

- **VMware Capacity Planner** – Helps you to gain insight into IT resource utilization and develop a virtualization roadmap for server containment and consolidation.
- **VMware vCenter Application Discovery Manager** – Allows you to quickly and accurately map your application dependencies so you can accelerate datacenter moves.
- **Microsoft has Exchange and SQL tools for performing the migration.**

When you begin the migration, use VMware's vStorage APIs for Array Integration to save time while moving, starting or creating VMs by eliminating redundant data flow. With Storage APIs, vSphere can perform faster while consuming less CPU, memory, and storage bandwidth.

For reference architectures, please see:

- vBlock
- Flexpod

# Experts

VMware Partners have the option to complete extra coursework to become VBCA Competent. There are many partners with this designation globally to help you virtualize your business-critical applications. The following is a partial list of the VBCA Competent partners. Please go to http://partnerlocator.vmware.com for a complete list of partners in your area.

| | Microsoft | ORACLE | SAP |
|---|---|---|---|
| **North America** | AdvizeX<br>Ahead<br>EMC<br>GreenPages<br>Groupware<br>House of Brick<br>Ideal Integrations<br>IT Partners<br>Nexus Information Systems<br>Varrow<br>VirtuIT<br>VMware Consulting Services | Cognizant<br>House of Brick<br>IT Partners<br>Ntirety<br>Viscosity Technology<br>VMware Consulting Services | TExperts<br>VMware Consulting Services |
| **Europe** | Assyrus<br>comdivision Consulting<br>Computacenter<br>EDV Compas<br>KN3<br>NIL<br>PQR<br>SIEVERS-SNC<br>SVA System Vertrieb Alexander<br>Tecnidata<br>VMware Consulting Services | PQR B.V.<br>VMware Consulting Services | AddOn Systemhaus<br>VMware Consulting Services |
| **Asia** | CcloudFX PTE<br>Data# 3<br>Datacom Systems<br>HP<br>IT Solutions 2000<br>VMware Consulting Services | HP<br>IT Solutions 2000<br>VMware Consulting Services | HP<br>IT Solutions 2000<br>VMware Consulting Services |

**Figure 29:** Global VMware VBCA Competent Partners

Partners in the above table are certified to meet learning and experience requirements virtualizing business-critical apps. Working with these partners enables customers to get the best service possible from an expert in virtualization.

Click here to more about VMware Consulting Services.

# Learn More

- Deployment Guides, Best Practices, Whitepapers
- VMware Blog
- Email (Exchange, Lotus, BlackBerry)
- Oracle
- What's New in Performance in vSphere 5.0
- Application Solution Guides

### Blogs

- All Apps
- Exchange
- Oracle
- SQL
- SAP
- SharePoint
- Java

# Conclusion

Join many other VMware customers on the next step of your journey to transform your infrastructure. Run your business-critical applications, including Exchange, Oracle, SQL, SAP, and Java on vSphere with breakthrough performance and outstanding reliability. Build a flexible cloud computing infrastructure that can deliver business-critical applications as dynamic, cost-efficient, and reliable IT services.

**VMware, Inc.** 3401 Hillview Avenue Palo Alto CA 94304 USA Tel 877-486-9273 Fax 650-427-5001 www.vmware.com