UNDERSTANDING ORACLE CERTIFICATION, SUPPORT AND LICENSING FOR VMWARE ENVIRONMENTS

vmware®

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Oracle databases, middleware and applications are increasingly running on the VMware vSphere® platform. Recent studies in both 2014 and 2016 conducted by Database Trends and Analysis of the Independent Oracle Users Group (IOUG) show that over seventy percent of the membership of that user group is using vSphere as a platform for Oracle implementations. In addition, VMware studies show that over 40 percent of the VMware customer base is using vSphere as the platform of choice for Oracle databases. Driving this rapid adoption is the fact that VMware delivers an industry-leading intelligent virtual infrastructure that maximizes performance, scalability and availability while enabling fully automated disaster recovery, better-than-physical security, and proactive management of service levels. Here is a summary of the benefits of virtualizing mission-critical Oracle applications on VMware. (To learn more about the VMware advantage, see Appendix 1.)

Improve quality of service:
• Better application performance with dynamic scalability and resource allocation
• Outstanding virtual machine scalability providing up to 128vCPUs and 4TB of RAM per virtual machine
• Enhanced availability and automated disaster recovery (DR) for all applications

Increase efficiency:
• Lower hardware and software costs with 3-10x consolidation ratios being common
• Reduced operating expenditures (OpEx) with intelligent policy management Accelerate time to market:
• Provisioning times reduced from weeks to minutes
• Streamlined testing/development cycles

Despite the widespread, tenured virtualization of Oracle applications, some Oracle licensees still have questions regarding the impact of virtualization on Oracle support and licensing. The purpose of this guide is to provide customers with information regarding certification, support and licensing of Oracle on VMware vSphere.

This information is based on the experience and knowledge that VMware and proponents of its technology have acquired from over a decade during which VMware has successfully virtualized the majority of Oracle workloads on vSphere.

This guide does not provide legal advice concerning a customer's license or support agreement with Oracle or any other third party. Rather, this guide is intended to help customers understand the issues and be better prepared for optimal licensing interaction with Oracle and third party vendors.

1. Oracle Certification and Support for VMware Environments

Oracle has an official support policy for virtualization on VMware vSphere, articulated in MyOracleSupport Document ID #249212.1, which customers can access with a valid MyOracleSupport login. A copy of the document also appears in Appendix 2 of this guide. In November 2010, Oracle expanded this support policy to include Oracle Real Application Clusters (RAC) on vSphere. We see this as a tacit acknowledgment by Oracle that customers are increasingly running even their most mission-critical systems on vSphere, and that the vSphere platform is technically sound for running these applications.

1.1 Certification

Oracle does not certify any third party infrastructure elements below the operating system. For example, Oracle does not certify any traditional HP, Dell or IBM hardware platform. But customers don't allow this to limit their choice to deploying only on Oracle (formerly Sun) hardware, and instead most customers exercise their options by deploying on noncertified hardware.

Similarly, in a virtualized environment, Oracle officially certifies only its own Oracle VM platform. Rigorous testing spanning years has occurred across the different layers of VMware stacks involving Oracle-certified operating systems. We believe that customers should choose the system stack components that best meets their needs at both the hypervisor and physical layers.

1.2 Support

Oracle has an official support statement for VMware.

The Oracle support policy states that "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." This statement may create a perception that customers are somehow at risk, but the preponderance of customers that have virtualized Oracle on VMware have done so after carefully weighing the benefits against this implied risk. We believe that three considerations are especially relevant to this assessment:

• You can evaluate the risk by considering the following facts:
  – VMware does not modify the native OS, so the solution Oracle provides for the native OS is fully expected to work for that same OS running on VMware.
  – VMware has received no reports of incidents in which vSphere was determined to have induced a functional bug in the Oracle application or database.
  – At worst, Oracle might ask a customer to reproduce the issue on a physical server, particularly if Oracle's solution does not work. This request is rarely made. Even in the physical world, Oracle reserves the right to request reproduction on different physical hardware.

• You can negotiate the terms in your support agreement with Oracle and insist that Oracle provide you with the support commitment that meets your needs, including unqualified support for Oracle products running on vSphere.

• VMware has its own policy to support customers running Oracle applications on VMware, available at https://www.vmware.com/support/policies/oracle-support. html. If required, VMware will take ownership of the support request and pursue rapid resolution, in collaboration with the Oracle support organization through TSANet as needed. VMware will re-platform the workload to physical in its labs if necessary. Because VMware customers virtualize all types of Tier 1 applications, we have significant expertise in making this a seamless support experience.
https://www.vmware.com/files/pdf/solutions/oracle/VMware-Oracle-Support-Affirmation.pdf
https://www.vmware.com/support/policies/oracle-support

2. Oracle Licensing in VMware Environments

Many Oracle products, including the database, have license metrics that involve physical processor counts. VMware vSphere enables you to consolidate multiple workloads in the form of virtual machines on a single physical host. Additionally, VMware enables you to move these virtual machines across hosts with VMware vSphere vMotion®, VMware Distributed Resource Scheduler™ (DRS) and High Availability (HA). When running products with license metrics that involve physical processor counts on vSphere, customers should ensure the following:

• Virtual machines are running on processor cores fully licensed for Oracle.

• Virtual machine movement is restricted to hosts that are fully licensed for Oracle.

• Virtual machine execution and inter-host movements are tracked so that customers are able to demonstrate compliance with Oracle's requirements.

2.1 Hosts: License All CPUs in a Host for Oracle

In the case of a fully licensed host, customers are allowed to run an unlimited number of virtual machines and application instances on that host without additional licenses, up to that host's capacity, of course.

The following table outlines the main CPU-licensing strategies, and explains when customers need to license all the CPUs in the host.

LICENSING ALL CPUS IN A HOST	LICENSING A SUBSET OF CPUS IN THE HOST
For multicore hosts, customers typically license all the CPUs for Oracle and load many virtual machines running Oracle applications onto this fully licensed host. This approach enables customers to consolidate Oracle licenses by better utilizing the licensed physical capacity. Customers who do not have enough Oracle applications to fully utilize entire multicore systems typically choose to use systems with fewer cores. Some customers disable sockets via BIOS since CPUs can sometimes be less expensive than Oracle licenses.	As Oracle's rules are processor-based, customers are free to use vSphere CPU Affinity to restrict virtual machines to licensed cores.

Table 1. CPU Licensing Strategies

2.2 Clusters: Fully Licensed Versus Partially Licensed Clusters

In a vSphere environment, multiple hosts are typically clustered together, enabling virtual machines to move freely between the hosts by means of vMotion, Distributed Resource Scheduler, VMware HA, and VMware Fault Tolerance. In a vSphere cluster, there are two distinct Oracle licensing scenarios to consider. In the first scenario, all the hosts in the cluster are fully licensed to run the Oracle product (fully licensed clusters). In the second scenario, only a subset of the hosts in the cluster are licensed for Oracle (partially licensed clusters).

Scenario A: Fully Licensed Clusters

When a customer has enough Oracle application instances to justify creating a dedicated cluster for those applications, all the hosts in the cluster can be fully licensed for the application. This approach has multiple advantages:

• Customers can deploy an unlimited number of virtual machines running the Oracle application on the cluster. In essence, the cluster becomes an "all you can eat" cluster from an Oracle licensing standpoint. Typically, this enables a significant reduction in licensing requirements by consolidating physical processors and licenses by as much as 3-10X.

• Customers can take advantage of VMware software's many advanced features, such as Distributed Resource Scheduler and VMware HA, to get the highest possible infrastructure utilization and further reduce licensing costs.
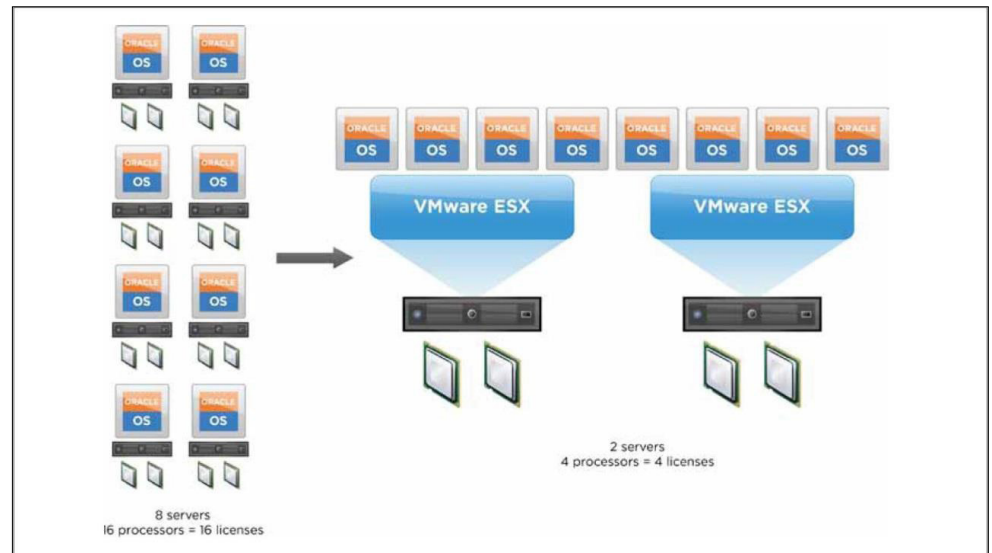

Figure 1. Licensing Example

Scenario B: Partially Licensed Clusters

When a customer does not have enough Oracle program instances to justify creating a dedicated cluster for those applications, only a subset of the hosts in the cluster are licensed for the Oracle program. In this situation, the customer must restrict the movement of Oracle application instances and virtual machines to only those hosts that are licensed to run the product.

In this case, DRS Host Affinity rules can be used to appropriately restrict the movement of virtual machines within the cluster. DRS Host Affinity is a vSphere feature that enables you to ensure that your Oracle applications are restricted to move only between a subset of the hosts—that is, not all hardware in the cluster is "available" to the Oracle software. DRS Host Affinity is a clustering technology, not a mechanism for soft or hard partitioning of individual servers. It enables you to design your environment such that the Oracle workloads are free to run on fully licensed hosts inside the cluster. Customers can easily maintain records for compliance purposes as explained in section 2.3.

The advantages of this approach are similar to the advantages achieved with a fully licensed cluster. Because customers are typically able to increase the utilization of licensed processors, they reduce license requirements.

2.3 Tracking Virtual Machine Movements for Compliance

With VMware vMotion and DRS technologies you can migrate a live virtual machine running Oracle software from Host A to Host B for server maintenance or load-balancing purposes.
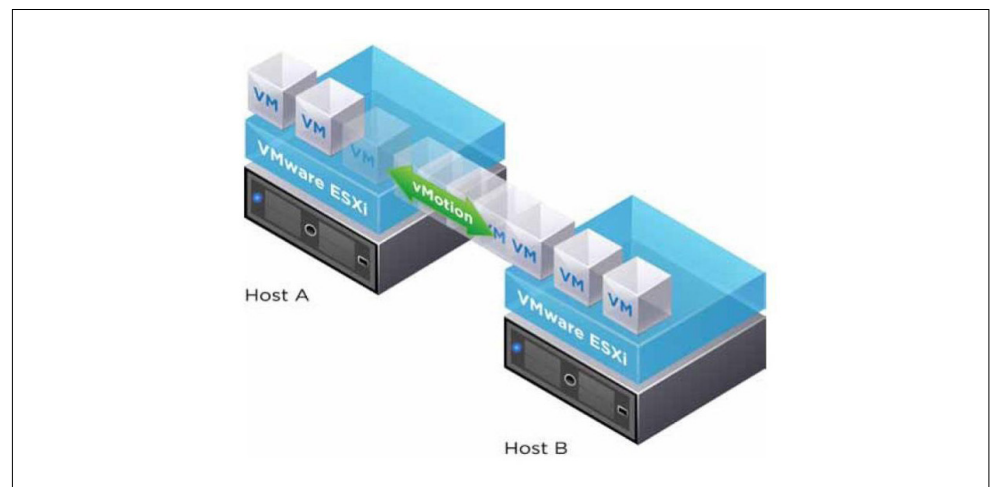

Figure 2. Virtual Machine Migration

Take the example of a single Oracle program virtual machine with Oracle software contained in a VMDK specific to the virtual machine. vMotion of the virtual machine transfers the Oracle license to the target host. This is because a virtual machine is never executing on more than one vSphere host in any given moment.

However, simultaneous vMotion of multiple virtual machines running the same Oracle program will involve the virtual machines being spread across both hosts for some moments. In such instances you should ensure that the migration occurs between fully licensed hosts by using vSphere capabilities such as DRS Host Affinity—that is, both Host A and Host B must be fully licensed hosts from an Oracle licensing perspective (as described in section 2.1). Alternatively, transfer the license by shutting down all the Oracle program virtual machines on the source host and cold move them to the target host.

VMware vCenter Server® generates several migration log files maintained at /var/log/vmware/hostd.log and /vmfs/volumes/datastore/vm/vmware.log that can be leveraged to track and record such virtual machine movements across hosts for compliance purposes. Additionally, VMware provides an extensive open API that allows compliance tools to generate user-friendly reports using this data. In particular, VMware vRealize® Configuration Manager™ provides host-level change-tracking mechanisms that enable you to record virtual machine movements across hosts. Since this host-level change tracking leverages an open API, third-party configuration-management solutions may also provide some of this functionality for VMware environments.

2.4 Oracle's Asserted Definition of "Installed"

The Oracle License and Services Agreement, Oracle's self-described standard agreement for licensing its products and services, states:

> "Processor: shall be defined as all processors where the Oracle programs are installed and/or running." (OLSA_V121510_US_OPN, http://web.archive.org/web/20140930121522/http://www.nu-solutions.com/downloads/us-olsa-037355.pdf)

Whatever the logical imprecision of the phrase "installed and/or running," this definition of "Processor" clearly addresses conditions at a single, present moment in time and not on prospective conditions.

Yet, in recent litigation Oracle took the very different position that the definition of "Processor" encompasses what could happen in the future: The Mars v. Oracle action filed October 23, 2015 documents Oracle's assertion of the definition of "installed." The Declaration of Elouise Backer quotes Chad Russell, Corporate Counsel--Oracle's September 25, 2015 memo to Mars, Inc.'s Khaled Rabbani--General Counsel (p. 44) :

> "Oracle programs are installed on any processors where the programs are available for use. Third party VMware technology specifically is designed for the purpose of allowing live migration of programs to all processors across the entire environment. Thus, Oracle Database Enterprise Edition is installed and available for use on every processor in a vCenter."

Given the apparent outcome of the dispute – plaintiff's motion for dismissal with prejudice was accepted - Oracle's overreach does not appear to have been effective.

We view the situation as follows: where there is no virtual machine with Oracle programs in an installed state on a given VMware host, it is not possible to run Oracle programs on that host without a configuration change. Oracle core technology software is not keyed. An enterprise has no licensing obligation on every workstation in its enterprise that it could install with products downloaded from the Oracle Partner Network prior to actually having done so. Similarly, there is no licensing obligation for any vSphere server in a vSphere Cluster, vCenter, or VMware enterprise that Oracle software virtual machines could run on at some future point but as of yet have not been migrated to or installed on. That holds true regardless of vSphere's progressively-enhanced ability to vMotion within a vCenter or the entire VMware enterprise.

That both vSphere and the Oracle Technology Network are designed to facilitate the availability of Oracle programs does not induce a licensing event in and of itself. What mechanisms may or may not be in place to prohibit the installation and/or running of Oracle programs is irrelevant to the actual occurrence of a licensing event.

Oracle's prospective vSphere licensing claim is a consistent component of its audits. The claim often first manifests itself in Oracle's request for vSphere server specifications beyond those the licensee actually has installed. The Oracle audit report's inflation of the licensee's alleged compliance gap can range between substantial and astronomical. Preparation should reduce fear of an audit. Licensees that are uncertain about how to meet their compliance obligations to Oracle may consider engaging the services of a qualified Oracle licensing consultancy and/or law firm. Licensees that have leveraged vSphere as a key strategic consolidation component may view an audit notice as an indication of their licensing efficiency.

2.5 Soft Partitioning Server Cores Using VMware CPU Affinity

The vSphere Resource Management Guides for ESXi 5.5 and ESXi 6.0 contain a detailed description of core affinity configuration under the heading 'Using CPU Affinity.' In addition, the 2016 Knowledge Base article https://kb.vmware.com/kb/2145719 describes the technology behind CPU Affinity to exquisite detail.

ESXi CPU-affinity restricts the Virtual machine processing and therefore any and all software running within that VM to the respective cores assigned to the VM. The VM is isolated to running on those assigned cores and therefore the Oracle software only needs to be licensed for that subset. CPU Affinity exactly respects assigned core boundaries and has done so in previous versions.

By using CPU Affinity, you can license only those cores in a server that are actually required for a particular workload, instead of licensing all of the cores. There are tradeoffs in doing this, so we encourage a careful study of the CPU Affinity considerations described in the vSphere Resource Management Guide as well as section 4.1.4 of the House of Brick paper Licensing Databases on EMC and VMware Technology referenced herein and as published in the vSphere Resource Management Guide.

2.6 Oracle Licensing Example

Figures 3 and 4 depict a real customer scenario. In this case, the customer had to decide between deploying Oracle on dedicated physical servers or on a vSphere cluster. By deploying on a vSphere cluster, Oracle licensing costs were reduced by half, from a total of $1,520,000 to $760,000.
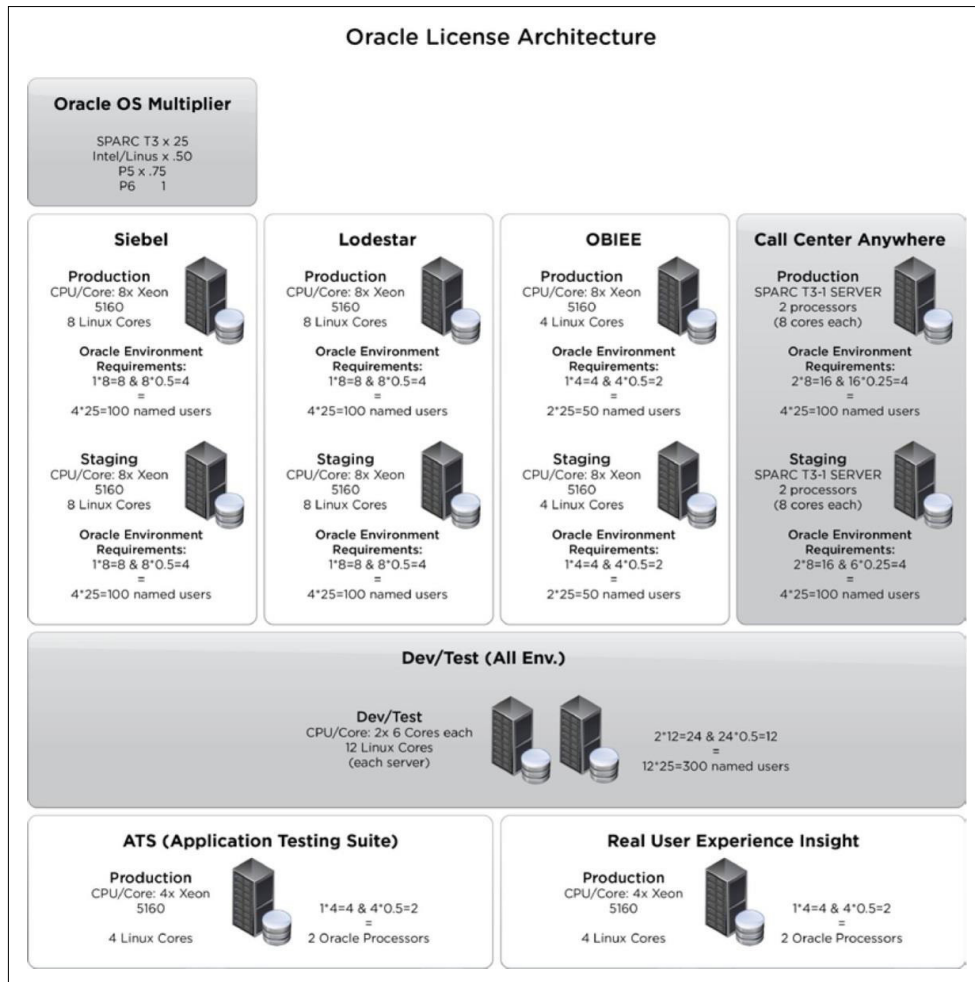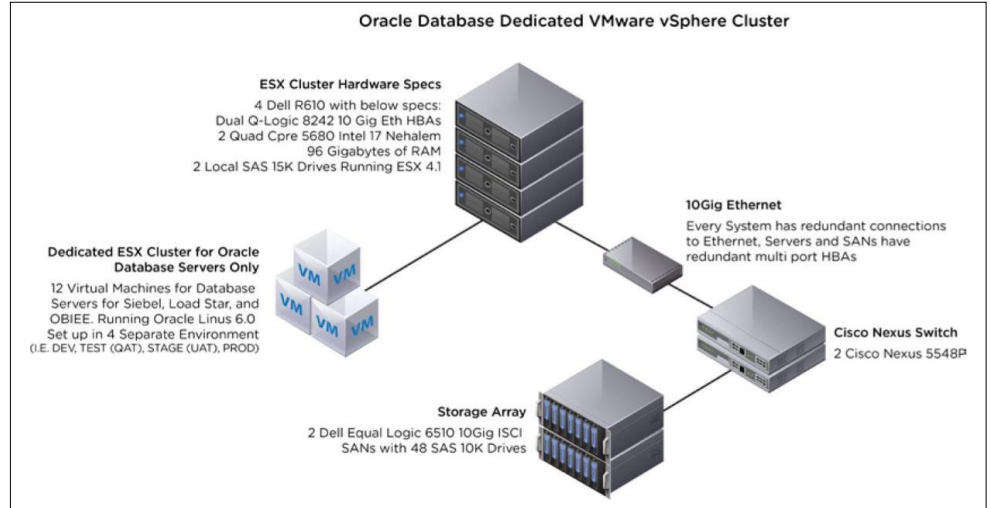

Figure 3. Physical Configuration

Figure 4. Virtual Configuration with VMware
Source: Anthony Rivieccio, Virtualization Architect, ProSys

The following table compares costs associated with the physical and virtual configurations shown in Figures 3 and 4.

ORACLE DATABASE LICENSINGIN PHYSICAL CONFIGURATION	ORACLE DATABASE LICENSING IN VIRTUAL CONFIGURATION WITH VMWARE
Total cores = 64 Total cores x .50 (Intel multiplier) = M M x $47,500 = total licensing cost M = 32 x $47,500 Total licensing cost = $ 1,520,000	Total cores = 32 Total cores x .50 (Intel multiplier) = M x $47,500 = total licensing cost M = 16 x $47,500 Total licensing cost = $ 760,000

Table 2. Comparison of Oracle Licensing in Physical and Virtual Configurations

2.7 Licensing Oracle on vSphere in Public Clouds

Most public cloud environments will need to provide Oracle on vSphere customers dedicated servers so as to make the running Oracle program virtual machines manageable and viable from an Oracle licensing perspective. Examples of such public cloud environments:

• The VMware Cloud™ on Amazon AWS consists of dedicated servers per customer—outside of the Oracle licensing-privileged Amazon EC2 cloud.
• VMware vCloud® Air™ (with OVH as of April 2017)
• IBM SoftLayer

In such dedicated server, public cloud offerings, Oracle licensing privileges are the same as on-premises vSphere environments.

It should be noted, however, that Oracle's Licensing Oracle Software in the Cloud
Computing Environment policy document describes privileged licensing granted to
Amazon AWS Elastic Compute Cloud (EC2), Amazon Relational Database Service
(RDS), and Microsoft Azure. The policy purports to license virtual cores in these
privileged public cloud environments rather than all cores on underlying hosts.
Although the policy document is not referenced by Oracle contract templates,
Oracle appears to have interacted consistently with respect to the extra-contractual
privileges the policy grants.

2.8 Third Party Expertise on Oracle on vSphere Licensing

The white paper "Database licensing on VMware and EMC technology" discusses
licensing of popular brands of relational databases. VMware mentions it here for the
purpose of providing substantial supplemental information with respect to licensing
Oracle on VMware. The paper was authored by House of Brick Technologies and
partially funding by Dell/EMC Corporation and VMware Corporation.

Summary

• Oracle chooses not to certify any third-party virtualization product or hardware that
sits below the operating system. As in the physical world, the lack of certification
should not limit customers' choice of virtualization platform. As long as the OS is
certified by Oracle and supported by VMware, customers can run Oracle on VMware
with the same level of confidence as on physical systems.

• Oracle has an official support statement for VMware. Many VMware customers are
successfully running Oracle on VMware vSphere while receiving the level of support
they require from Oracle.

• As long as Oracle software runs on fully licensed processor cores, customers should
be able to comply with Oracle's requirements. In particular, DRS Host Affinity rules
can be used to run Oracle on a subset of the hosts within a cluster. In many cases,
customers can use vSphere to achieve substantial licensing savings.

Appendix 1: VMware Advantage

Over the past decade, VMware has emerged as the industry's leading virtualization platform. Today, more than 500,000 customers have chosen to build their virtual and cloud infrastructures on vSphere, trusting their mission-critical applications and production environments to the advanced capabilities and reliability that only vSphere provides.

VMware vSphere 6 delivers enhanced scalability with 128-way VMware Virtual Symmetric Multiprocessing, increased I/O performance, and additions of brand-new, industry-first capabilities such as Profile-Driven Storage, Storage DRS and vSphere Auto Deploy that Oracle VM just cannot match. Independent industry experts agree that vSphere 4 had "at least a 5-year pure technology lead" over competing virtualization platforms. With the release of vSphere 6, that gap widened even further.

As you make infrastructure decisions, consider how virtualization and cloud computing is transforming your datacenter into a seamless pool of dynamic resources. Creating sub-optimized silos of technology fails to deliver the true benefits of virtual infrastructure, such as dynamic resource allocation, built-in availability, automated disaster recovery and intelligent policy management.
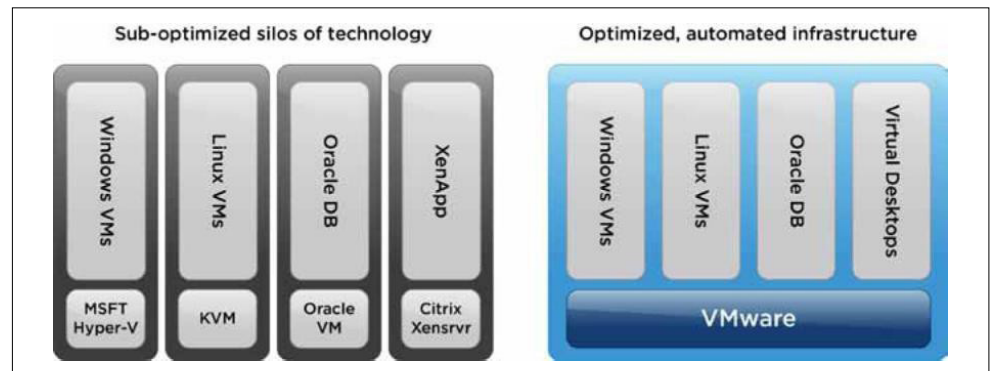

Figure 5. Evolution of the Datacenter

Hypervisor Architectures Do Matter

The VMware purpose-built, thin hypervisor is designed for virtualization. Oracle VM is based on the Xen hypervisor, which relies on a general-purpose operating system in the "parent partition." This mixed architecture introduces reliability concerns, because the parent OS has a much larger attack surface and becomes a single point of failure. The far thinner VMware vSphere hypervisor architecture removes dependence on a general-purpose OS in the virtualization layer and requires no patching or maintenance to secure the generic operating system code that has nothing to do with virtualization.
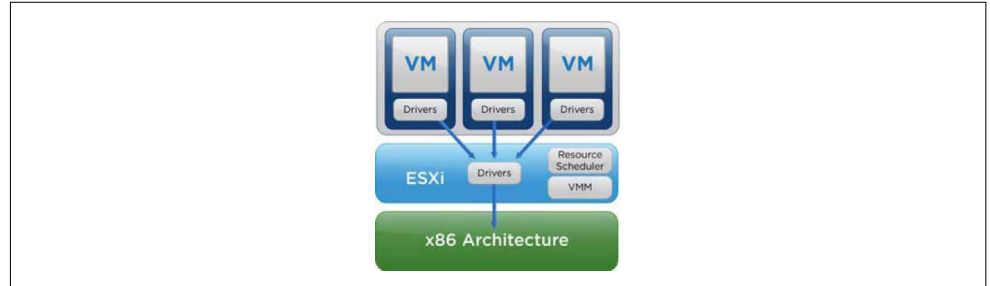
Figure 6. Hypervisor Architectures Matter

Oracle VM also uses an indirect I/O design that routes all virtual machine network and storage traffic through the parent OS. Rather than relying on I/O drivers known to be the least reliable component of a general-purpose OS, vSphere uses a direct I/O design that avoids bottlenecks by connecting virtual machines to host hardware with drivers embedded in the hypervisor. The drivers are specifically hardened and optimized for virtualization.
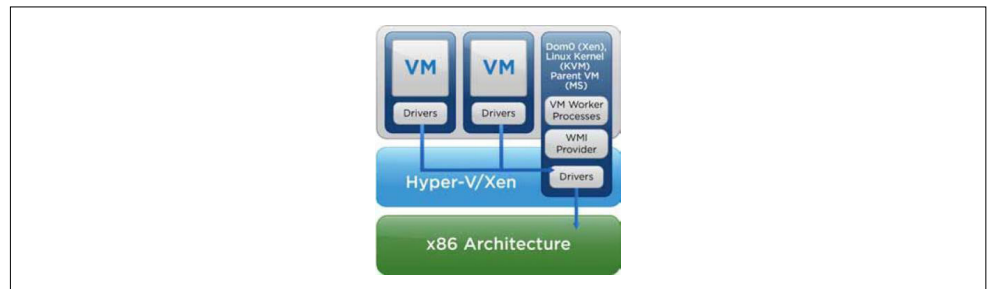
DIFFERENTIATORS	VMWARE ARCHITECTURE	ORACLE VM ARCHITECTURE
Hypervisor disk footprint	True, thin hypervisor with no general- purpose OS Impact: far smaller code size means extremely high reliability, fewer vulnerabilities, less patching	Relies on Linux in dom0 management partition Impact: more code to patch and secure; introduces single point of failure
Driver model	Direct, purpose-built drivers in hypervisor Impact: more efficient I/O path; utilizes drivers	Indirect I/O handled by generic drivers in management OS Impact: I/O bottlenecks; single point of failure from non-optimized drivers

Table 3. Architecture Comparison

Appendix 2: Oracle Support for Oracle Products Running on VMWare

MyOracleSupport Note 249212.1

Support Position for Oracle

Products Running on VMware Virtualized Environments [ID 249212.1]

Modified08-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.

Reprint of Oracle policy. Not authored by VMware.

https://www.vmware.com/files/pdf/solutions/oracle/VMware-Oracle-Support-Affirmation.pdf

https://www.vmware.com/support/policies/oracle-support

Appendix 3: VMware Support for Oracle Products Running on VMware

VMware Oracle Support

VMware is committed to the success of its customers in deploying simplified, cost-effective, and better Information Technology services. To further this, we recently announced expanded support for Oracle Database technical issues with the VMware vSphere platform. This expanded technical support is driven by our VMware customers' choice to deploy increasing amounts of their Oracle Database software with VMware products.

This expanded support is targeted at Oracle Database usage "above and below" vSphere, where the Oracle database is:

• used as a data store for VMware products

• run within a virtual machine on vSphere/ESX™

• VMware Oracle Support provides customers the following new advantages as part of the existing Support and Subscription contract at no additional charge:

• Total ownership of Oracle Database technical issues reported to VMware Support

• Access to a team of Oracle DBA resources within VMware Support to troubleshoot related to Oracle Databases used as a data store or run within a VM

• Performance tuning and best practices related to Oracle Database used as a data store or run within a VM

• Faster resolution of technical issues in VMware environments via a collaborative support arrangement between VMware Support and Oracle Support

Total Ownership

VMware Support 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.

In the rare situation that another vender is unable or unwilling to provide a satisfactory technical resolution, VMware Support will immediately notify the customer, assist in escalation and explore other potential technical workarounds with the customer.

VMware will also assist its customers with technical issues for other Oracle software products, besides the Oracle Database and provide similar escalation assistance if needed.

Besides technical assistance, VMware Support will advocate on the customer's behalf to:

• Provide any relevant evidence that virtualization does not play a part in the Oracle product technical problem

• Engage Oracle Support in resolving the customer's technical issue, escalating management attention as appropriate

Summary

VMware's business mission is to reduce complexity, lower costs, and improve information technology service delivery for customers. This extended support perform delivers this, by driving resolution of customer technology issues that involve multiple product venders. VMware is committed to its customers' success and supports their choice to run Oracle software in modern, virtualized environments.

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i   Access the filing as follows. Be aware that documents may only be downloaded from the Register of Actions via a Flash-enabled browser.

By case number:

   1. http://www.sfsuperiorcourt.org

   2. Click on Online Services

   3. Click on Case Number Query

   4. Complete the anti-robot test

   5. Enter case number cgc15548606 and click Submit

By name search (as of the time of this writing):

   1. http://www.sfsuperiorcourt.org

   2. Click on Online Services

   3. Click on Name Search Query

   4. Complete the anti-robot test

   5. Enter "Oracle"

   6. Select the first entry "Oracle America, Inc."

   7. Mars vs. Oracle filed October 23, 2015 is the first case listed

ii http://houseofbrick.com/wp-content/uploads/2017/02/Declaration_Backer_Mars-v-Oracle.pdf.

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