



Oracle VM—Built for Virtualizing Enterprise Applications

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Introduction

Enterprise applications—like order entry, financials, human resources, customer management, and logistics—are the foundation of a successful business. Such Tier-1 applications provide strategic value, streamlining operations, facilitating revenue generation, and advancing profitability. These applications are often Oracle applications such as Oracle E-Business Suite, Oracle's PeopleSoft, JD Edwards EnterpriseOne, Siebel Customer Relationship Management or other applications built on Oracle technologies such as Oracle Database, Oracle Real Application Clusters, or Oracle Fusion Middleware. Because Tier-1 applications are fundamental to business success, IT departments strive to deliver continuous access that satisfies user demand, shifting priorities, and new initiatives.

Virtualizing enterprise applications provides significant advantages. It reduces costs since it eliminates the need for a physical machine for each operating system release. It also allows IT organizations to consolidate enterprise workloads, boost utilization, and realize efficiencies while improving service levels and speeding time-to-production. But not every virtualization product is designed specifically to support Tier-1 applications. Unlike traditional virtualization techniques typical of commercial virtualization products on the market, Oracle VM is an **application-driven** technology designed explicitly for enterprise application deployments.

Oracle VM is built to support business-critical applications throughout the application lifecycle—from initial VM and application provisioning through development, test, production, ongoing maintenance, and retirement. Oracle engineered this virtualization technology to power strategic data-driven applications, providing rigorous security, scalable and responsive performance, supportability, product stability, and “always-on” availability. This short paper highlights design decisions and features that make Oracle VM the optimal virtualization solution for deploying Tier-1 applications.

In addition to providing premium capabilities for virtualizing Oracle Databases and enterprise-class software services, Oracle VM is a cost-effective virtualization technology. The Oracle VM software is free to download and use—there are no licensing fees and customers pay only a low annual fee for enterprise support. This cost model lowers operational expenses (OPEX), allowing companies to strategically redirect spending to other business challenges.

Enterprise-Scale Architecture

The Oracle VM architecture (Figure 1) encompasses industry-leading enterprise technologies: MySQL Database, Oracle WebLogic, Oracle Linux, and the open source Xen hypervisor. Installation scripts help to automate the installation and configuration of these components. Along with Oracle VM Templates and Oracle Virtual Assembly Builder, it's easier and faster than ever to set up Oracle VM, virtual machines (VMs), and application instances.

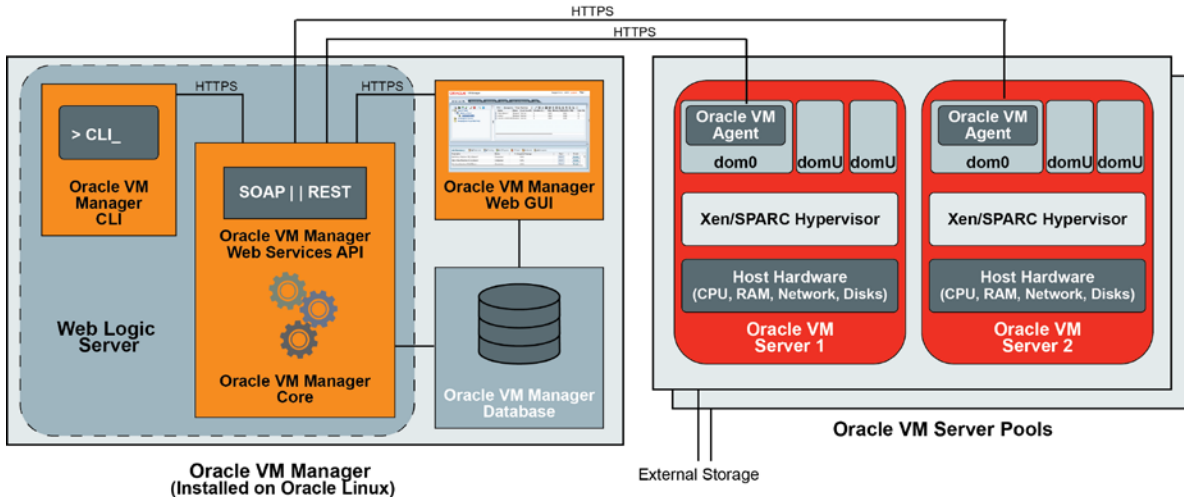


Figure 1. The Oracle VM architecture incorporates state-of-the-art enterprise technologies.

As shown in Figure 1, there are two primary functional blocks within the architecture: pools of Oracle VM Servers (Oracle VM Server for x86 and Oracle VM Server for SPARC) and Oracle VM Manager, which supplies comprehensive management through graphical, command line, and new programmatic interfaces (Oracle VM Web Services APIs).

Oracle VM Manager consists of two Oracle WebLogic Server applications—the management Core and the management GUI—that run on an independent Oracle Linux server to control all aspects of x86 and SPARC virtualization environments. The Oracle VM Manager Core stores configuration and status data in a MySQL Enterprise database that is backed up automatically at regular intervals for reliability. Building Oracle VM Manager on such leading-edge technologies adds to the stability and scalability of the overall virtualization solution and applications deployed in virtual guests.

In engineering the product, Oracle made design decisions that have inherent advantages when virtualizing enterprise applications. Both Oracle VM Server for x86 and Oracle VM Server for SPARC are Type-1 virtualization technologies, meaning the hypervisor layer runs directly on the hardware.

Oracle VM Server for x86 (Figure 2) incorporates the lightweight Type-1 Xen hypervisor, a thin layer of code written exclusively for purpose of virtualization. Domain 0 (Dom0) is the control domain and runs a minimized Oracle Linux Unbreakable Enterprise Kernel (UEK). Dom0 manages the guest “user” domains (domUs) that host instances of Linux, Oracle Solaris, or Microsoft Windows™ operating systems. The hypervisor acts as a traffic cop, controlling privileged accesses from all guests to the dom0 kernel and device drivers.

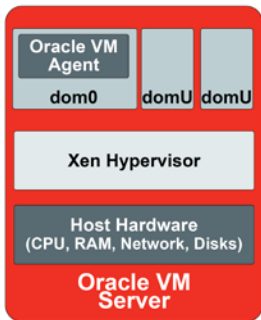


Figure 2. The Xen hypervisor provides near-native performance while securely isolating the kernel and device drivers.

The separation between the hypervisor, dom0, and domU guests offers distinct security and performance advantages. Since device drivers are a leading cause of stability issues, isolating them in dom0 or entirely in a separate guest yields a more secure and robust environment for enterprise applications. Virtual guests make privileged system calls through the hypervisor to access drivers and hardware resources. The technique of making system calls through the hypervisor (rather than explicitly emulating device hardware in each guest) is known as “paravirtualization.” Oracle VM takes advantage of paravirtualization because it yields performance close to bare metal (in contrast to device emulation, which is extremely slow).

The minimal size and open source basis of the Xen hypervisor also contributes to the security and reliability of Oracle VM. The Xen hypervisor is a widely deployed commercial hypervisor based on open source, which means that it receives extensive community use and review to produce exceptionally strong and robust code. The current Xen project is less than 150,000 lines of code,¹ creating a small attack surface and imposing a small memory footprint. Since the Xen open source code is so compact, it’s especially easy for Oracle and other developers in the community to inspect the source, directly identify defects, and add fixes and enhancements.

Oracle is actively engaged in contributing to both Xen and Linux open source development. As Oracle makes improvements to the upstream Xen and Linux open source projects, those changes receive community review and approval before they are pushed down into actual Oracle VM and Oracle Linux product releases. Oracle is intensely focused on open source enhancements that increase performance, scale, and reliability for virtual guests hosting Oracle Database and data-driven applications.

Paravirtualized Device Drivers for Optimal Speed and Scale

One of the key Oracle contributions is optimizations for paravirtualized device drivers. Recently Oracle VM engineers teamed with developers in the Oracle Real Application Clusters (Oracle RAC) group to improve performance of Linux drivers for block and network I/O. As a result of that collaboration, Oracle VM engineers achieved strong performance gains for multiple (versus single) disk attachments to guest VMs. This effort significantly improved Oracle Automatic Storage Management (Oracle ASM) performance, increasing disk I/O speeds for virtual guests to near-native performance. Similar work on networking drivers made it possible to saturate the full bandwidth of a 10GB Ethernet link. As a result of these I/O engineering efforts, the Oracle VM team also developed internal profiling tools that help them identify bottlenecks and analyze performance of virtualized enterprise applications.

¹ wiki.xenproject.org/wiki/Xen_Project_Software_Overview

Designed for Enterprise-Level Security

In building a virtualization solution to support Tier-1 applications, Oracle paid particular attention to security. Since Oracle VM Manager controls the state and lifecycle of all virtual guest machines, a core design goal was to minimize risk while implementing comprehensive management functionality. To this end, all communications with Oracle VM Manager are tightly secured. In Oracle VM Release 3.3, the agent in the Oracle VM Server uses SSL certificates internally to authenticate Oracle VM Manager requests. Communication to the Command Line Interface (CLI) via SSH requires username and password authentication or certificate-based authentication. Release 3.3 also publishes the Oracle VM Web Services API (programmatic interfaces to the management functionality), and all API requests are authenticated with SSL certificates. Oracle VM engineers used the API to streamline and consolidate internal services, reducing the number of exposed communication ports—which in turn decreases the number of potential attack vectors.

Designed for Scalability and Performance

Optimizations of the Xen hypervisor and Oracle Linux Unbreakable Enterprise Kernel make Oracle VM Server the most scalable x86 server virtualization solution available today. Oracle has extensively tested Oracle VM and core features (such as Live Migration of virtual machines between servers) at extreme scale. Specifically Oracle has tested scalability limits on the Oracle Sun Server X4-8 system, an 8-socket x86 enterprise-class server. Oracle VM 3.3 supports up to 240 physical CPU threads and 6 TB memory, and each guest VM supports up to 256 virtual CPUs for paravirtualized virtual machines (PVMs) or 128 virtual CPUs for a hardware virtual machines (HVMs).² Although guests of such scale are rare in most deployments, the testing proves that Oracle VM can effectively support extremely large use cases (such as large in-memory Oracle Databases). The proven scalability of Oracle VM gives IT managers peace of mind since they know that virtualized enterprise applications can scale with the headroom that they might need for future requirements.

New IT initiatives tend to push the bounds of yesterday's project parameters, so Oracle continues to focus on scalability enhancements, testing environments with more disks, more Oracle VM Servers, and more virtual machines. Recent development work has been targeted at rewriting parts of Oracle VM to increase performance. In Oracle VM Release 3.3, engineers rewrote the entire statistics and events model to gain performance and bandwidth efficiencies.

Integrated Design for Reliability and Stability

Oracle VM forms the virtualization tier of an end-to-end Oracle solution stack (Figure 3). To optimize the reliability and stability of enterprise applications, Oracle invests heavily in integration and testing across the layers in the Oracle stack: applications, middleware, database, operating systems, virtual machines, servers, and storage. To manage stack layers and components, Oracle Enterprise Manager is a comprehensive framework that is fully integrated with Oracle VM Manager. In addition, Oracle also validates the software stack on certain non-Oracle server and storage components (see www.oracle.com/technetwork/topics/linux/validated-configurations-085828.html for a list of validated third-party hardware configurations).

² See configuration limits at docs.oracle.com/cd/E50245_01/E50246/html/vmrms-limits.html.

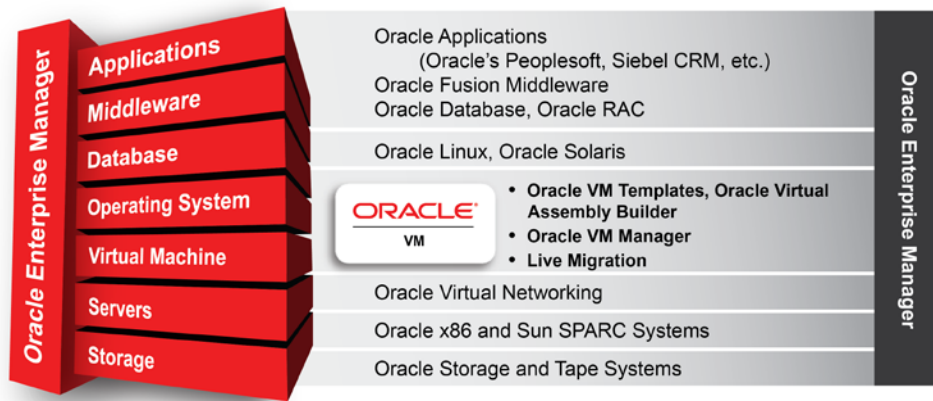


Figure 3. Oracle VM forms the virtualization tier of an integrated Oracle stack.

Oracle VM is extensively deployed throughout Oracle. Using Oracle VM and Oracle Linux, Oracle's IT organization deploys more than 182,400 virtual guests on 22,700 Oracle x86 servers for internal development and corporate infrastructure. Running workloads that include Oracle Database, Oracle Fusion Middleware, Oracle software, and third-party applications, these virtual machines undergo more than 26,700,000 test and production hours each week.

When enterprises deploy mission-critical applications on Oracle VM, they can do so with confidence since Oracle fully integrates Oracle components across the stack. In addition to broad internal use, Oracle tests Oracle Database, Oracle Fusion Middleware, and Oracle applications extensively on Oracle VM in virtualized deployments. **In fact, Oracle VM is rigorously tested and fully certified for Oracle Database in both single- and multiple-instance virtualized configurations.** This means that if IT deploys an Oracle Database on some other x86 virtualization technology and there's a problem, then the DBA must replicate the issue and eliminate virtualization as a potential root cause. Oracle's certification of Oracle Database on Oracle VM makes it the optimal solution for virtualizing data-driven applications. IT can deploy Oracle VM across all environments—from test and development through production—and choose which environments to place under Oracle VM support contracts to keep operational costs low.

Designed for Application Supportability and Manageability

Since new applications can bring new opportunities for revenue generation, Oracle VM supplies two methods of fast VM and application provisioning: Oracle VM Templates and Oracle Virtual Assembly Builder. Both allow parameter and script-driven deployments of Oracle stack components, speeding software provisioning and creating reliable and repeatable configurations.

Oracle VM Templates are pre-configured, pre-tested, and pre-patched guest VMs developed by Oracle and based on Oracle best practices and standards. Templates automate the provisioning of complete production-ready application environments and can install operating systems, Oracle Database 11g or 12c releases, Oracle Fusion Middleware, and even Oracle applications in fully configured virtual machines.

To create an Oracle VM Template for JD Edwards EnterpriseOne, for example, Oracle builds a fully optimized reference implementation, capturing all of the required servers and virtual machines needed for deployment (Figure 4). After the template is fully tested, it is published to the Oracle Software Delivery Cloud at edelivery.oracle.com/oraclevm. Customers that wish to deploy JD Edwards EnterpriseOne can download the template to automate the installation of database, middleware, web, and application services needed for a complete implementation.

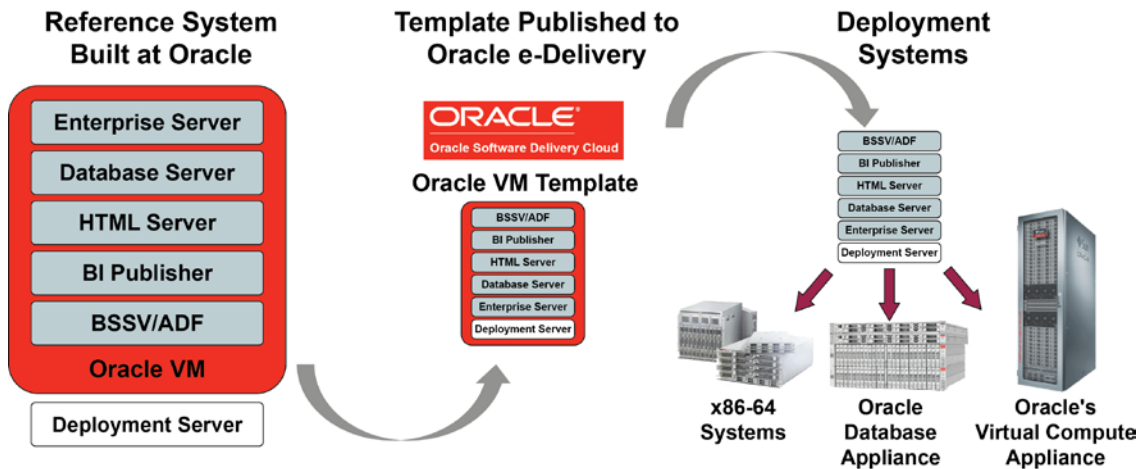


Figure 4. Oracle VM Templates automate the deployment of entire application stacks, as in this example of an Oracle VM Template for JD Edwards EnterpriseOne.

With predefined Oracle VM Templates, even novice administrators can install a single instance Oracle Database in minutes or a production-ready Oracle Real Application Clusters (RAC) configuration (with any number of nodes) in a few hours. A fully configured, production-ready, two-node Oracle RAC cluster can be built in less than a half-hour. The webcast “[Oracle VM Templates: Best Practices for Rapid Oracle Database Deployment](#)” shows just how fast and easy it is to deploy a single instance database (5-6 minutes) or a 100-node Oracle Database 12c Flex Cluster (in a few hours). A variety of Oracle VM Templates are available to accelerate application deployments (see the complete list at edelivery.oracle.com/oraclevm).


To easily replicate and scale complex multi-tier application topologies, administrators can also use Oracle Virtual Assembly Builder. The tool maps out application components (Oracle as well as non-Oracle products) and configuration parameters that connect the components, producing an application blueprint or “assembly.” Administrators can then customize assemblies to create multiple unique deployments to replicate datacenters or test or development environments.

Templates and Oracle Virtual Assembly Builder streamline the deployment of complex application stacks into standardized images for reuse. These provisioning methods automate the creation and replication of fully patched and tested solutions, reducing the possibility of human error, increasing reliability, and lowering the expertise barrier for complicated configurations. Developers can also use the Oracle VM Web Services API to automate VM provisioning programmatically. The Web Services API allows developers to integrate existing self-provisioning tools, for example, with Oracle VM provisioning and management.

Manageability over the Full Lifecycle of Virtualized Applications

Oracle VM makes it easy to manage virtualized applications over the entire application lifecycle. Its Live Migration feature moves a running virtual machine from one Oracle VM Server to another without downtime impact, increasing the availability of business-critical applications and services. Oracle VM uses Live Migration to balance server loads automatically based on resource and power management policies. Clustered server pools enable High Availability, restarting a guest automatically on an alternate server when necessary.

Oracle VM Manager gives administrators a comprehensive management tool to control pools of guests on both x86 and SPARC servers. It includes graphical, command line, and Web Services API interfaces that access a transaction-based job queue and integrated database. Both the intuitive web-based graphical interface (which runs



on a choice of browsers) and the command line interface were developed using the Web Services API. The API exposes the rich capabilities of Oracle VM Manager to client applications that use SOAP or REST interfaces.

Configured on a dedicated server, the Oracle VM Manager implementation is robust. Because it runs on an independent server, Oracle VM guests can continue to function even if the management server experiences downtime. All virtual machine functionality, including High Availability and VM Live Migration, is still available even if there is a management server outage. This separation avoids recovery issues that can occur with other competitive virtualization technologies—if a product implements the management plane as a guest VM, it can be problematic if the server containing the management guest won't start.

Oracle VM includes (at no cost) Oracle Enterprise Manager. Oracle Enterprise Manager supplies the same VM management capabilities as Oracle VM Manager—both access the same Core functionality and database. Oracle Enterprise Manager, however, supplies a “single-pane-of-glass” interface for managing all components in the end-to-end Oracle stack: Oracle Database and applications as well as hardware, firmware, virtual servers, and operating system instances, including patching, VM migrations, and updates. By adding other software in the Oracle Enterprise Manager family, such as Cloud Management Packs for Oracle Database or Oracle Middleware, administrators can also gain fine-grained control of Oracle Databases and Oracle applications from a fully integrated enterprise management tool.

Conclusion

Virtualization technologies offer well-established benefits: consolidation, improved utilization, and greater IT flexibility in applying resources to workloads. But Oracle VM is the only virtualization solution that Oracle tests extensively at extreme scale and fully certifies for Oracle Database deployments on x86 servers.

Oracle VM is designed specifically for Tier-1 applications deployed as virtual guests. Oracle continues to make design decisions in line with enterprise requirements for security, performance, scalability, stability, and supportability. The lightweight Xen hypervisor offers clear advantages for security, reliability, and performance. Open source Xen and Linux technologies enhance the product's stability, providing a strong code base to which Oracle and other community developers can contribute ongoing security, performance, and reliability improvements. And lastly, the cost model for Oracle VM helps IT managers conserve today's shrinking budgets. Oracle VM is free to download and use, and Oracle charges only a low annual fee for enterprise support.

Rethink virtualization! See how quickly and easily you can deploy enterprise applications on Oracle VM. Get started now by downloading the Oracle VM software and deploying a proof-of-concept environment. Downloading your choice of Oracle VM Templates can speed the process of configuring guests and Oracle Database, Oracle Fusion Middleware, and a variety of Oracle application products. Visit the Oracle Software Delivery Cloud at edelivery.oracle.com/oraclevm and get started today.

For More Information

For more information, visit the resources listed below





Web Resources	Web URL
Oracle VM and Oracle VM Template downloads	edelivery.oracle.com/oraclevm
Oracle VM E-Book	oracle.com.edgesuite.net/ebook/ovm/index.html
Oracle VM Home Page	oracle.com/virtualization
Oracle VM Virtual Assembly Builder	oracle.com/technetwork/middleware/ovab/overview/index.html
Oracle VM Cost Calculator	oracle.com/us/media/calculator/vm/index.html
Oracle VM – Rethink Virtualization video trailer	medianetwork.oracle.com/video/player/3701896320001
Oracle Validated Configurations for Oracle Linux and Oracle VM	oracle.com/technetwork/topics/linux/validated-configurations-085828.html
Oracle Enterprise Manager	oracle.com/us/products/enterprise-manager/
Oracle Linux	oracle.com/linux
Webcasts	Web URL
"Top 5 Reasons why Oracle VM is Best for Oracle Database"	event.on24.com/r.htm?e=725350&s=1&k=1512E332202610FE9518AB8B01354C6A&partnerref=OVMonDemand
"Oracle VM Templates: Best Practices for Rapid Oracle Database Deployment"	oracle.com/technetwork/server-storage/vm/database-templates-12c-11qr2-1972804.html
White papers	Web URL
"Why Use OVM for Oracle Databases" (Revera Limited)	oraclenz.org/wp-content/uploads/2013/07/Why-use-OVM-Revera.pdf
"Oracle VM – Quantifying The Value of Application-Driven Virtualization" (Evaluator Group)	oracle.com/us/technologies/virtualization/oraclevm-validation-report-final-1741583.pdf
"Oracle Real Application Clusters in Oracle VM Environments"	oracle.com/technetwork/database/clustering/oracle-rac-in-oracle-vm-environment-131948.pdf



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