

A horizontal decorative bar consisting of five colored segments: a solid red segment on the left, followed by four segments with abstract, wavy patterns in light blue, yellow, green, and purple.

Deploying Oracle® Database 10g on Red Hat® Enterprise Linux® 4

Abstract

Red Hat Enterprise Linux has become the optimal platform for the deployment of high-performance, low-cost Oracle database solutions. This whitepaper examines the partnership between Red Hat and Oracle that led to these results and discusses the capabilities of Red Hat Enterprise Linux 4, released in February 2005.

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Introduction

Oracle is a Red Hat Premier Partner adding their efforts to the development and optimization of Red Hat Enterprise Linux as the optimal platform for deploying Oracle solutions in the enterprise. As a part of the Unbreakable Linux initiative, Oracle has ported and certified its major applications, including Oracle Database, Oracle Application Server, Oracle Collaboration Suite, the Oracle E-Business Suite, and Oracle Developer Suite, to Red Hat Enterprise Linux. Demonstrating its commitment to Linux, Oracle also offers direct operating system and Oracle application support to customers running Red Hat Enterprise Linux AS and ES.¹

Why Linux for Oracle10g?

It is not by accident or without reason that Oracle has placed such a central focus on Linux. Enterprise Linux offers several advantages, key among them the reliability, stability, and capability of UNIX, but on higher-performance, lower-cost industry standard hardware. As a result, the Total Cost of Ownership (TCO) for an Oracle solution is lower on Linux than on other operating systems. The open source nature of Linux offers practical benefits as well. It gives developers such as those at Oracle and other independent software vendors (ISVs) transparency into the inner workings of the operating system. This transparency allows them to more readily tune their applications for optimal performance and reliability.

These advantages led to a natural partnership between Red Hat and Oracle that extends back to the development cycle of Red Hat Enterprise Linux v.2.1 (originally known as Red Hat Linux Advanced Server 2.1). Working together, Red Hat and Oracle have been progressively adding, testing, and refining the capabilities of the Enterprise Linux operating system. For example, Oracle and Red Hat collaborated on developing and testing asynchronous I/O code for the Linux kernel.

Wim Coekaerts, director of Linux engineering for Oracle, is quick to point out the extent of Oracle's focus on Linux:

“We want to insure that Oracle products on Linux provide the same performance and stability characteristics as provided on other OS platforms, and it's in our best interest to see that happen. We're anxious to see Linux succeed as the premier Oracle database platform.”²

In fact Oracle itself has, over a period of two years, migrated its primary development platform from UNIX to Linux. Oracle's Wim Coekaerts notes that this has provided some important benefits:

“Internally for us, Intel hardware is cheap compared to what you would get from a proprietary [UNIX] vendor. From a development point of view, systems are so much faster. For example, if a developer has to write a patch and has a tight deadline to get the feature checked in, [we're noticing] it takes less time with Linux. We're seeing a reduction in many cases from twelve hours to four hours. Our feature queue is running two to three times faster on Linux.”³

Other customers have witnessed the benefits of better performance and higher reliability, all at a

¹ An active subscription to Red Hat Enterprise Linux AS or ES with Standard or Premium Support is required.

² <http://www.oracle.com/technology/oramag/Coekaerts.html>

³ http://searchenterpriselinix.techtarget.com/qna/0,289202,sid39_gci967664,00.html

lower cost than competing solutions. Lithonia Lighting, one of the largest industrial and commercial lighting manufacturers in the world, has enjoyed increased productivity at a lower cost than a proprietary RISC solution as result of their migration to clustered servers running Oracle Real Application Clusters (RAC) on Red Hat Enterprise Linux AS.⁴ Electronic Arts experienced similar results. Their deployment of Oracle RAC on Red Hat Enterprise Linux provided higher levels of reliability and scalability at a savings of \$3.4 million over a proprietary UNIX-based SMP configuration.⁵

Oracle RAC enables enterprise Grids. These are the data centers of the future. Enterprise Grids are built out of large configurations of standardized, commodity-priced components: processors, network, and storage. Oracle RAC's cache fusion technology provides the highest levels of availability and scalability. Oracle Database 10g and Oracle RAC 10g dramatically reduce operational costs and provide new levels of flexibility so that systems become more adaptive, proactive and agile. Dynamic provisioning of nodes, storage, CPUs and memory allow service levels to be easily and efficiently maintained while lowering cost still further through improved utilization.

Red Hat Enterprise Linux 4

Red Hat Enterprise Linux 4, released in February 2005, continues this partnership between Red Hat and Oracle. Close cooperation during the product's development and testing cycle enabled Oracle to announce certification and support for Red Hat Enterprise Linux 4 on the date of the operating system's release.

Sold as a subscription, Red Hat Enterprise Linux 4 includes the technology, maintenance, and support necessary for mission-critical Oracle deployments. Under the subscription model, customers have the freedom to choose from any of the available versions of Red Hat Enterprise Linux that are or become available for the duration of their subscription. This means existing customers have immediate access to Red Hat Enterprise Linux 4, without any additional upgrade fees. Customers are not compelled to upgrade and may freely choose to continue to deploy or maintain existing systems based on previous versions of Red Hat Enterprise Linux. Each version of Red Hat Enterprise Linux is supported for seven years from the date of release. Thus Red Hat Enterprise Linux v.2.1 will be supported through May 2009, version 3 through October 2010, and version 4 through February 2012.

When customers decide to upgrade from Red Hat Enterprise Linux version 2.1 or 3, an upgrade path to version 4 is available. To ease this transition, Enterprise Linux 4 also includes compatibility libraries for running applications originally developed for versions 2.1 and 3.

Red Hat Enterprise Linux 4 supports seven hardware architectures: Intel/AMD x86, AMD64, Intel EM64T, Intel Itanium, IBM POWER, IBM zSeries, and IBM S/390. Support for these architectures comes from a single, shared source code base, providing a consistent kernel, development toolchain, and feature set across architectures. This makes it easier for customers and ISVs to port their applications from one architecture to another. As of February 2005, Red

4 For the complete Lithonia Lighting case study, visit <http://www.redhat.com/solutions/info/whitepapers/#case>.

5 For more information, see the case study "Electronic Arts Runs The Sims Online Game Faster and More Reliably, Saves \$3.4 Million with Oracle Real Application Clusters on Linux", <http://www.oracle.com/customers/studies/roi/ea.pdf>.

Hat provides access to all available architectures⁶ with each Red Hat Enterprise Linux subscription, enabling customers to migrate between architectures without incurring additional subscription costs.

While formal benchmark results have yet to be published, Red Hat Enterprise Linux 4 is well-positioned to improve upon the impressive results offered by its predecessors. Enterprise Linux 3 contained a 2.4-based Linux kernel and a number of key features backported from the 2.6 Linux kernel tree. Red Hat, Oracle, and others have collaborated to make the 2.6 Linux kernel, released to the open source community in December 2003, ready for enterprise use. The inclusion of a full 2.6.9-based Linux kernel in Red Hat Enterprise Linux 4 provides features that have matured during this development cycle.

Traditionally new major versions of the Linux kernel have provided important performance and scalability improvements. In this regard, the 2.6 kernel is no exception. Red Hat Enterprise Linux 4 is able to support up to 32 CPUs on the x86, AMD64, and EM64T architectures, and up to 64 CPUs on Itanium 2. Physical memory support includes up to 64GB of RAM on x86, AMD64, IBM pSeries, and IBM zSeries, and up to 128GB of RAM on Itanium 2.⁷ Additional improvements include:

- Support for Read Copy Update, improving the performance of kernel functions that usually read, and rarely write, data structures
- Broader NUMA support
- An updated object-based reverse map VM, improving the performance of memory-constrained systems
- Enhancements to the scheduler for generic logical CPU support, enabling better performance on systems utilizing hyperthreaded or multi-core CPUs
- Support for `sys_epoll()`, for improvements to network I/O performance

The new block I/O subsystem in the 2.6 kernel is cleaner and more efficient, providing numerous performance optimizations. It also serves as the foundation for the support of larger file systems and file sizes. As a result, Red Hat Enterprise Linux 4 is now able to break the 2-TB limit formerly imposed by the 2.4 kernel; support for ext3 file systems now extends up to 8-TB in size. Aside from the larger file system size, there are other enhancements to ext3, including:

- A hash tree algorithm that improves performance in directories containing large numbers of files
- The addition of a block reservation feature that greatly improves overall read and write performance
- Locking changes that improve performance on SMP systems.

In addition to these performance enhancements, ext3 file systems can now be grown online.

⁶ This excludes the IBM s390 and zSeries mainframe architectures.

⁷ Certified CPU and physical memory limits can vary, depending on the hardware configuration chosen. A database of certified hardware for Red Hat Enterprise Linux is available at <http://hardware.redhat.com/hcl/>. Red Hat Enterprise Linux AS is required for the support of system configurations with greater than 2 CPUs and/or greater than 8 GB of RAM (32-bit architectures) or 16 GB of RAM (64-bit architectures). See <http://www.redhat.com/software/rhel/comparison/> for more information.

Red Hat Enterprise Linux 4 now includes LVM2, an improved logical volume manager. LVM2 is easier to use and more configurable than its predecessor. Snapshot scalability is improved: snapshots are now read and write, and multiple snapshots are practical without an excessive loss in performance. An update to Red Hat Enterprise Linux 4 will add support for LVM mirroring and multi-pathing.

Taken together many of these capabilities provided in Red Hat Enterprise Linux 4 improve the performance, scalability, and manageability of Oracle solutions on Enterprise Linux.

Red Hat Enterprise Linux 4 contains a large number of security enhancements, including Security Enhanced Linux (SELinux), Exec-Shield, and support for Position Independent Executables (PIE), described in *Red Hat Enterprise Linux 4 Security Features*.⁸

Version 4 also includes new technologies like NFSv.4 and improved crash dump capabilities. These features and technologies are detailed in *An Overview of the Red Hat Enterprise Linux 4 Product Family*.⁹

Red Hat Network Satellite Server

Each subscription of Red Hat Enterprise Linux includes an entitlement for Red Hat Network Update Module. This Module enables an administrator to register a Red Hat Enterprise Linux system with Red Hat Network (RHN), view relevant errata (security updates, bug fixes, and enhancements), and apply selected errata to that system. RHN Satellite Server extends this capability by moving the RHN server infrastructure behind the firewall onto the customer's premises. When combined with the Provisioning Module, RHN Satellite Server gives customers comprehensive systems management capabilities for their Red Hat Enterprise Linux systems, including bare-metal provisioning, reprovisioning of existing systems, multi-state rollback (including snapshot-based recovery), configuration management, and the ability to deploy and update custom and third-party RPM-based applications.

Beginning with version 3.6, released in December 2004, RHN Satellite Server includes a technology preview of the RHN Monitoring entitlement, which captures real-time and historical trending data on the Red Hat Enterprise Linux systems on the network. In addition to information about the status of the operating system itself (including CPU usage, disk I/O throughput and usage, memory usage, and process health), RHN Monitoring is capable of monitoring Oracle databases running on these systems, with probes for Oracle active sessions, Oracle buffer cache, tablespace usage, and other key indicators of Oracle database health.

For more information on the Red Hat Network, visit <http://www.redhat.com/software/rhn/>.

8 <http://www.redhat.com/f/pdf/rhel4/EL4SecurityFeatures.pdf>

9 <http://www.redhat.com/f/pdf/rhel4/EL4OverviewWP.pdf>

Conclusion

In summary, Red Hat Enterprise Linux 4 provides the ideal platform for the deployment of Oracle Database 10g and 10g RAC-based solutions. The 2.6 Linux kernel in Red Hat Enterprise Linux 4 improves upon the already impressive scalability and performance offered by Red Hat Enterprise Linux 3. Support for seven hardware architectures enables customers to choose from a plethora of certified industry-standard hardware platforms, whether it be large SMP systems or a grid of low-cost, high-performance systems as the foundation for Oracle 10g RAC. The close partnership between Red Hat and Oracle has borne many fruits, and Oracle's internal migration from UNIX to Linux for both their development and production platforms should serve as validation and guidance for Oracle customers who are making an operating system decision.