



An Oracle White Paper  
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## Fast, Modern, Reliable: Oracle Linux

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## Introduction to Oracle Linux

Oracle Linux brings the latest Linux innovations to market, delivering extreme performance, advanced scalability, and reliability for enterprise applications. Oracle Linux offers two Linux kernels to choose from:

- The Red Hat Compatible Kernel, for those who prefer strict Red Hat kernel ABI (kABI) compatibility or
- The Unbreakable Enterprise Kernel, for those who want to leverage the latest features from mainline Linux and boost performance and scalability.

Oracle's Unbreakable Enterprise Kernel is a fast, modern, reliable Linux kernel that is optimized for enterprise software and hardware. It is the default kernel since Oracle Linux 5 Update 6 and Oracle Linux 6. Oracle recommends the use of Oracle Linux with the Unbreakable Enterprise Kernel for all enterprise applications.

### Free to Download, Use and Distribute

True to the open source philosophy, Oracle has provided the Oracle Linux distribution as a free download from day 1. Anyone can download the binaries, installation media and the source code for free without a support subscription. This applies to errata (bug fixes, security updates) as well, making Oracle Linux the ideal enterprise Linux distribution for both your production and testing/development servers.

Oracle Linux DVD images (ISOs) can be obtained from <http://edelivery.oracle.com/linux>. Oracle provides free access to the individual RPM packages via public yum repositories from <http://public-yum.oracle.com/>. Source and debug information packages are available from <http://oss.oracle.com/>.

A new set of ISO images is made available for free download for every update release (e.g. Oracle Linux 6 Update 5) of Oracle Linux.

In addition to that, Oracle Linux is available in the form of virtual machine images for Oracle VM Server for x86 and Oracle VM VirtualBox. With Oracle Linux JeOS (Just Enough OS) – a secure, pre-packaged, small-footprint Oracle Linux image for x86 and x86-64 that is freely redistributable and fully supported – developers and ISVs can easily build Oracle VM Templates.

Oracle VM Templates are pre-installed and pre-configured software images which eliminate installation and configuration costs, reduce ongoing maintenance costs, and help organizations achieve faster time to market and lower cost of operations.

For more information on Oracle VM Templates, please visit this web page:

<http://www.oracle.com/technetwork/server-storage/vm/overview/templates-101937.html>

### Extensively Tested and Certified

Oracle invests significantly in testing and releasing critical bug fixes, making Oracle Linux an ideal option for enterprise deployments.

Packages released by Oracle as part of Oracle Linux undergo a long testing cycle which includes the routine testing of the full software stack with the help of the Oracle Linux Test Kit (<https://oss.oracle.com/projects/olt/>) and other test suites to ensure that the underlying operating system behavior is correct in all circumstances. Oracle's industry-leading QA team has worked with strategic customers for many years, and this depth of experience has helped build an extensive and ever-growing test matrix of real-life workloads.

Oracle Linux is certified for compliance with the Linux Standard Base (LSB Version 4.0 - [http://www.linuxfoundation.org/lsb-cert/productdir.php?by\\_lsb](http://www.linuxfoundation.org/lsb-cert/productdir.php?by_lsb)), which greatly reduces the costs involved with porting third-party applications to different distributions, as well as lowers the cost and effort involved in after-market support of those applications.

Oracle Validated Configurations are pre-tested, validated architectures with software, hardware, storage and networking components together with documented best practices for deployment. They offer guidance to customers deciding what should be run as a full system with an Oracle Database running on top of a Linux operating system, in turn running on top of hardware, and at the same time listing the most effective set of tuning parameters for their setups (for both kernel and Oracle Database), as well as workarounds for known problems. Oracle Validated Configurations include a full range of products, with the entire hardware-software stack tested.

For more information on Oracle Validated Configurations, please visit this web page:

<http://www.oracle.com/technetwork/topics/linux/validated-configurations-085828.html>

Besides testing with Oracle products, Oracle also works with key vendors such as AMD, Brocade, Cisco, Dell, EMC, Emulex, Fujitsu, HP, IBM, Intel, Microsoft, NetApp, QLogic, VMware

and many others, representing a wide range of server and storage product vendors, to make sure that a variety of fully integrated stacks are tested.

Oracle and its strategic partners offer and recommend these configurations to enable end-users to deploy fully tested solutions to achieve standardization with high performance, scalability and reliability while lowering infrastructure costs and speeding up deployment.

In general, many Unix OS vendors test their product in-house, focusing on testing the operating system specifically with the hardware and the associated enterprise software that runs on it, and doing so provides enough confidence in their product. However, in the case of Linux there are a large number of choices, forcing the distribution vendors to heavily rely on companies like Oracle to do the testing.

Such testing has been happening for many years and Oracle has been building out a very large test suite for this purpose, which runs everywhere. The full test suite for Oracle products on Linux (the Oracle Linux Test) runs 24/7 on thousands of systems at Oracle and is freely available for download from <http://oss.oracle.com/projects/olt/>. These tests are designed to verify stability and correct behavior of both the operating system and the Oracle applications running on top of it. The test suite includes installation, functional, stress and destructive tests, which are executed under varying workloads types (I/O intensive, CPU intensive, for instance) with various database sizes. Several parameters are varied during the full run of the test suites, which also include crash scenarios in Oracle Real Application Cluster configurations.

## Oracle Linux and the Unbreakable Enterprise Kernel

Traditional enterprise Linux distributions are mostly based on outdated, three-to-four-year-old kernels.

In September 2010, Oracle announced the new Unbreakable Enterprise Kernel for Oracle Linux as a recommended kernel to deploy with Oracle Linux 5 or Red Hat Enterprise Linux (RHEL) 5.

The Unbreakable Enterprise Kernel was introduced to deliver the latest innovations from upstream development to customers who run RHEL 5 or Oracle Linux 5 in the data center.

The Unbreakable Enterprise Kernel is included and enabled by default with Oracle Linux 6 and Oracle Linux 5 Update 6 and later versions. It can be installed directly on top of Oracle Linux 5 or RHEL 5, with Update 5, without having to re-install the entire operating system.

Oracle Linux with the Unbreakable Enterprise Kernel can be run directly on bare metal or as a virtual guest on Oracle VM or other virtualization technologies. The Unbreakable Enterprise Kernel version `kernel-uek-2.6.32-100.34.1` added support for paravirtualized drivers in a HVM guest on Oracle VM. Starting with this kernel version, the default is to present only paravirtualized drivers when running in a hardware virtualized guest. To run `kernel-uek` – including the drivers – fully hardware virtualized, an additional kernel boot parameter `"xen_emul_unplug=never"` must be added to the boot parameters in `/etc/grub.conf`.

The latest version of the Unbreakable Enterprise Kernel (Release 3) is based on the 3.8 mainline Linux kernel. It includes optimizations developed in collaboration with Oracle's Database, Middleware, and Hardware engineering teams to ensure stability and optimal performance for the most demanding enterprise workloads. For example, Oracle Linux is used as the base operating system for Oracle Exadata, Oracle Exalogic and other engineered systems. Oracle engineers developed a number of enhancements and improvements to make Linux perform better on these large systems, namely in the area of scalability, memory management and better Infiniband support. See the following section in this document for more details. All contributions and patches from Oracle on top of the mainline kernel are open source and available in this git tree: <https://oss.oracle.com/git/?p=linux-uek3-3.8.git;a=summary>.

Oracle Linux ships with two sets of kernel packages:

- Unbreakable Enterprise Kernel (`kernel-uek`), which is installed and booted by default
- Red Hat compatible kernel, compiled directly from RHEL source. It is also installed by default and can be selected at boot time

This means you have a choice at boot time: a system tested and optimized for running Oracle workloads, or strict RHEL kernel ABI (kABI) compatibility. Binary kernel modules built for any RHEL 6 kernel will also load on any Red Hat compatible kernel released for Oracle Linux 6.

Oracle's build and QA systems for the Oracle Database and many other Oracle products use Oracle Linux with the Unbreakable Enterprise Kernel exclusively. Furthermore, Oracle Linux with the Unbreakable Enterprise Kernel is now used in all benchmarks on Linux that Oracle participates in. Some benchmark results that were run using Oracle Linux include:

Oracle Achieves Record TPC-C Benchmark Result on 2 Processor System

<http://www.oracle.com/us/corporate/press/1853058>

Oracle Delivers World Record x86 Performance on Industry Standard Java Middleware and Transactional Database Benchmarks

<http://www.oracle.com/us/corporate/press/1570421>

Oracle Achieves World Record Two Processor Result with SPECjEnterprise2010 Benchmark

<http://www.oracle.com/us/corporate/press/1584316>

Oracle Delivers World Record x86 Performance on Industry Standard Java Middleware and Transactional Database Benchmarks

<http://www.oracle.com/us/corporate/press/1570421>

Oracle Weblogic Server Standard Edition Release 10.3.4 on Cisco UCS B440 M1 Blade Server

<http://www.spec.org/jEnterprise2010/results/res2011q1/jEnterprise2010-20110223-00019.txt>

Oracle Weblogic Server Standard Edition Release 10.3.4 on Dell PowerEdge R910

<http://www.spec.org/jEnterprise2010/results/res2011q2/jEnterprise2010-20110323-00021.txt>

Oracle Linux Delivers Top CPU Benchmark Results on Sun Blades

[http://blogs.oracle.com/linux/entry/oracle\\_linux\\_delivers\\_top\\_cpu\\_benchmark\\_results\\_on\\_sun\\_blades](http://blogs.oracle.com/linux/entry/oracle_linux_delivers_top_cpu_benchmark_results_on_sun_blades)

Oracle highly recommends deploying Oracle Linux in your environment, especially if you are running enterprise applications.

## Features and Performance Improvements

Oracle Linux with the Unbreakable Enterprise Kernel includes many enhancements, including bug fixes to improve virtual memory performance, network and disk I/O performance as well as improvements for large NUMA (Non-Uniform Memory Access) systems. In addition to performance improvements for large systems, Oracle Linux contains many features that are relevant to Linux running in the data center.

### Integration of the DTrace Dynamic Tracing Framework

DTrace is a comprehensive dynamic tracing framework that was initially developed for the Oracle Solaris operating system. DTrace provides a powerful infrastructure to permit administrators, developers, and service personnel to concisely answer arbitrary questions about the behavior of the operating system and user programs in real time.

DTrace support is integrated with the Unbreakable Enterprise Kernel Release 3 and now includes user-space statically defined tracing (USDT) supports SDT-like probes in user-space executables and libraries.

For more information, refer to the chapter *Statically Defined Tracing for User Applications* in the *Oracle Linux 6 Dynamic Tracing Guide*, which you can find in the Oracle Linux 6 documentation library at [http://docs.oracle.com/cd/E37670\\_01/index.html](http://docs.oracle.com/cd/E37670_01/index.html).

### Linux Containers (LXC)

Linux Containers (LXC) allow running multiple isolated Linux instances (containers) on the same host. A container is a way to isolate a group of processes from the others on a running Linux system. By making use of existing functionality like the Linux kernel's new resource management and resource isolation features (Cgroups and name spaces), these processes can have their own private view of the operating system with its own process ID (PID) space, file system structure and network interfaces. Containers are lightweight and resource-friendly, which saves both rack space and power.

Containers share the same kernel with anything else that is running on it, but can be constrained to only use a defined amount of resources such as CPU, memory or I/O. By combining containers with other features like the Btrfs file system or the Open vSwitch, it will be possible to quickly set up multiple lightweight isolated Linux instances with their own virtual network segment on a single host.

For more information on features, installing and configuring Linux Containers on Oracle Linux, please refer to Chapter 9: Linux Containers in the Oracle Linux Administrator's Solution Guide ([http://docs.oracle.com/cd/E37670\\_01/E37355/html/ol\\_containers.html](http://docs.oracle.com/cd/E37670_01/E37355/html/ol_containers.html)).

### Btrfs File System

Btrfs (B-tree file system) is the “next generation file system” for Linux. Pronounced as “Butter FS” or “B-tree FS”, it is a GPL licensed file system first developed by Oracle’s Chris Mason in 2007. Today, its development is still coordinated by Chris Mason in collaboration with many contributors from the Linux community. Btrfs provides a number of features that make it a very attractive file system solution for local disk storage. Oracle is committed to making Btrfs the most reliable and feature-rich file system for Linux.

Btrfs is designed for:

- Large files and file systems from the ground up
- Simplified administration
- Integrated RAID and volume management
- Snapshots
- Checksums for data and meta-data

### Latest Infiniband Stack (OFED) 2.0

OpenFabrics Enterprise Distribution (OFED) implements Remote Direct Memory Access (RDMA) and kernel bypass mechanisms to deliver high-efficiency computing, wire-speed messaging, ultra-low microsecond latencies and fast I/O for servers, block storage and file systems. This also includes an improved RDS (reliable datagram sockets) stack for high speed, low latency networking. As an Infiniband Upper Layer Protocol (ULP), RDS is used to send IPC datagrams (up to 1MB) reliably, and is used currently in Oracle RAC and Exadata/Exalogic products.

### **Receive/Transmit Packet Steering and Receive Flow Steering**

Overall networking performance has been improved – especially at high loads – due to the inclusion of receive/transmit packet steering.

RPS distributes the load of received network packet processing across multiple CPUs and ensures that all packets for a specific IP address/port combination are handled by the same CPU

core. This allows protocol processing (e.g. IP and TCP) to be performed on packets in parallel and avoids performance penalties that can occur due to the resulting cacheline bouncing. This solution removes a bottleneck where a single CPU core could be saturated from processing network interrupts. This feature has initially been back-ported into Unbreakable Enterprise Kernel Release 1 (2.6.32) from the mainline Linux 2.6.35 kernel, it is included by default in the second release of the Unbreakable Enterprise Kernel (2.6.39). To enable receive packet steering, you have to place a CPU mask into `/sys/class/net/xxx/queues/rx-0/rps_cpus` where `xxx` is your interface name. The CPU mask takes the same form as the masks for the `taskset` command.

For example:

```
echo 0x55 > /sys/class/net/eth0/queues/rx-0/rps_cpus
```

Transmit packet steering (XPS) is the counterpart to RPS on the transmit side. Where RPS selects a CPU based on the receive queue, XPS selects a transmit queue based on the CPU.

Each transmit queue can be associated with a number of CPUs which will use the queue to send packets. This is configured as a CPU mask on a per queue basis in `/sys/class/net/eth<n>/queues/tx-<n>/xps_cpus`.

Receive Flow Steering (RFS) can be considered the second stage of receive packet steering. Developed by Tom Herbert at Google, RFS is an extension of RPS that makes sure that now that processing of network packets is happening in parallel, it's done in a coordinated fashion.

Instead of performing an IP/Port match, it is doing an application match, directing the flow of traffic to where the application is waiting for it. If an application issues some system calls that trigger network packets to be sent and received, its footprint will be logged to the CPU currently executing it and any incoming packets for this application will always meet up on the same CPU, thus improving CPU locality and minimizing the performance penalty.

This is more directed than receive packet steering alone. Together with RPS, this can result in tremendous performance improvements – Oracle-internal tests have shown 50% faster IP over Infiniband results on a two socket system.

### **Advanced support for large NUMA systems**

The Unbreakable Enterprise Kernel includes a number of additional patches to significantly improve performance on NUMA systems with many CPUs and cores. These include:

- A patch to list message signaled interrupts (MSI) for each device in the sysfs file system. Before, when MSI-X mode was enabled for a PCI device, there was no entry in sysfs that displayed the IRQs. The interrupts were only displayed in `/proc/interrupts`, but it was impossible to determine which interrupts were used by which device when there were multiple identical devices in the system. With the help of a modified `irqbalance` utility, this ensures to keep IRQs on NUMA local CPUs.
- Reduced runqueue lock contention by making improvements around IPC semaphores. This patch tries to reduce the runqueue lock contention by ordering the wakeups based on the CPU the waiting process was on when it went to sleep.

### IO affinity

This is a feature in the block layer for controlling the IO completion CPU of either all requests on a queue, or on a per-request basis. A sysfs variable (`rq_affinity`) is exported which, if set, migrates completions of requests to the CPU that originally submitted it. This can have a fairly large impact on performance, especially on large NUMA machines.

IO affinity is turned on by default, but it can be controlled via the tunable in `/sys/block/xxx/queue/rq_affinity`

Example to enable it:

```
echo 1 > /sys/block/sda/queue/rq_affinity
```

### Improved asynchronous writeback performance

The process of writing out “dirty” (modified) memory from the Linux kernel page cache to the disk is called “writeback”. It is performed by the `pdflush` kernel thread, based on configurable values defined in `/proc/sys/vm`. Depending on the amount of data and the storage subsystems involved in this activity, the previous implementation had some drawbacks. A new flushing system was designed and developed by Oracle engineers, which addressed these deficiencies and improved the performance for various workloads:

- Per-device asynchronous dirty page writeback. The `pdflush` subsystem was replaced with dedicated threads on a per-device basis. This allowed buffered writeback to scale to much faster storage.

- Per-device buffered write accounting. The accounting for dirty pages has been reorganized, removing stalls and inefficient writeback when devices of different speeds are mixed together.

### **Task Control Groups**

TCG can track and group processes into user-defined cgroups so that the operating system can treat them as whole and perform scheduling, accounting, and resource allocation accordingly. For example, using TCG, you can associate a set of CPU cores and memory nodes to a group of processes that makeup an application or a group of applications. This enables subsetting larger systems, more fine grained control over memory, CPUs and devices, and isolation of applications.

### **Hardware fault management**

Hardware fault management helps to avoid system crashes and improve application uptime.

Oracle Linux includes support for Advanced Error Reporting. The AER kernel driver allows the kernel to gather error information from PCI Express devices if errors occurred, to report these errors to the administrator and to perform error recovery actions. When an error occurs, the driver captures the error and a message will be printed on the console or a log file.

Machine Check Exception (MCE) is a feature of AMD / Intel 64 bit systems which is used to detect an unrecoverable hardware problem. MCE can detect:

- Communication errors between CPU and motherboard
- Memory errors, e.g. ECC problems
- CPU cache errors

mcelog is a daemon to handle MCE events on x86-64 machines running Oracle Linux. It accounts and logs CPU and memory errors, supports triggers on error thresholds, and can predictively offline memory pages and CPUs based on error trends. It should be run regularly as a cron job on any x86-64 Linux system. The mcelog package is included in the distribution and will add an hourly cron job to `/etc/cron.hourly/mcelog.cron` upon installation, to check for new MCEs. If mcelog locates a MCE, a log message will be written to `/var/log/mcelog`. This is useful for predicting server hardware failures before an actual server crash occurs.

### **Power management features**

The Unbreakable Enterprise Kernel is tickless. In the tickless kernel, timer interrupts are performed on demand rather than at a predetermined frequency. This allows the CPUs to stay in a low power state when the system is idle, reducing overall power consumption.

By supporting Aggressive Link Power Management (ALPM), SATA links to disks that are currently idle are being put into a low-power mode on SATA controllers that support the AHCI specification. The controller automatically puts the link back into active power state when new I/O requests are being scheduled.

### **Data integrity features**

T10 Protection Information (T10-PI) enables applications or kernel subsystems to attach metadata to I/O operations, allowing devices that support T10-PI to verify the integrity before passing them further down the stack and physically committing them to disk. Data Integrity Extensions or DIX is a hardware feature that enables exchange of protection metadata between host operating system and HBA and helps to avoid corrupt data from being written, allowing a full end-to-end data integrity check.

### **Oracle Cluster File System 2 (OCFS2)**

Oracle Linux includes full support for the Oracle Cluster File System (OCFS2 - <http://www.oracle.com/us/technologies/linux/025995.htm>), an open source cluster file system included in the mainline Linux Kernel.

The Unbreakable Enterprise Kernel includes OCFS2 version 1.6. New features include:

- JBD2 support
- Extended attributes
- POSIX ACLs
- Security attributes
- Metadata checksums
- Indexed directories
- REFLINKs

For more details, see the OCFS2 1.6 User's Guide:

[http://oss.oracle.com/projects/ocfs2/dist/documentation/v1.6/ocfs2-1\\_6-usersguide.pdf](http://oss.oracle.com/projects/ocfs2/dist/documentation/v1.6/ocfs2-1_6-usersguide.pdf)

### Latencytop

Latencytop helps to identify where latency in the system is affecting the performance of an application. The point is to locate a resource that is either busy or non-responsive. It is included in Oracle Linux – for a description of this utility, please see the following article on the Oracle blogs:

[http://blogs.oracle.com/devpartner/entry/whats\\_new\\_in\\_oracle\\_linux\\_part\\_2\\_latencytop](http://blogs.oracle.com/devpartner/entry/whats_new_in_oracle_linux_part_2_latencytop)

### Strict Binary Compatibility

Tremendous effort has gone into assuring that there is no divergence from the original Red Hat source code, given that the main goal of Oracle Linux and the Oracle Linux Support program is to not fragment the Linux code base, but to improve Linux quality and support.

Oracle Linux is built from the very same source code as Red Hat Enterprise Linux (RHEL). The distribution consists of several thousand packages. A byte-by-byte comparison of the source code against RHEL will reveal no difference, the only changes being the removal of trademarks and copyrights.

The Oracle Linux source code is recompiled into binaries and made available for download and produced into CD images. Oracle also applies a number of bug fixes on top of the original code. These fixes are critical for customers to have as soon as possible in their production deployment.

The Linux operating system is a modular system in which the kernel interacts with the hardware and controls and schedule access to resources on behalf of applications. Applications run in what's called *user space* and only call a stable set of system libraries to ask for kernel services. Figure 1 is a simplified diagram of the Linux operating system. Using the Unbreakable Enterprise Kernel instead of the Red Hat compatible kernel changes only the box labeled “Kernel.” – and nothing changes in the “user space”.

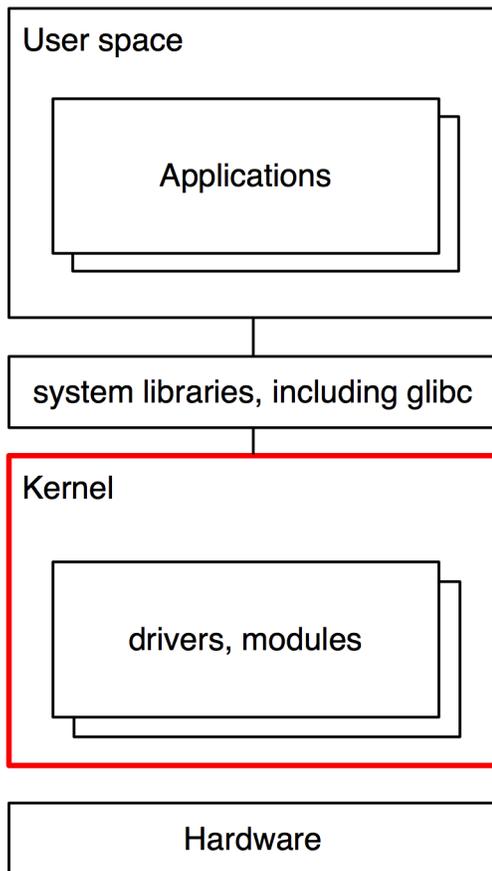


Figure 1. The Linux Operating System

As you can see, using a different kernel does not change system libraries such as *glibc*, the interface that nearly all applications, including Oracle Database use. The *glibc* version in Oracle Linux 6 is 2.12, regardless of the kernel version you run underneath.

The `sysctl` infrastructure to control kernel settings is also unchanged when you use the Unbreakable Enterprise Kernel.

In contrast, device drivers and other kernel modules are tightly coupled with the kernel and will usually have to be recompiled when a new kernel is introduced.

### Fully Compatible Updates and Errata

Oracle synchronizes bug fixes at regular intervals with RHEL to maintain full compatibility. Whenever a new version of an individual package (an errata) gets released by Red Hat, not just as part of an update release, the corresponding package for Oracle Linux is made available very quickly, usually within in a matter of hours. If a package has no trademarks and no Oracle specific patches, it will simply be recompiled and reissued for Oracle Linux immediately after going through testing.

If a package has trademarks or Oracle Linux specific changes, Oracle will examine the source code and compare it against the bug fixes that have been already applied and released as part of Oracle Linux. If the Oracle patches are still relevant, then they are reapplied, but if the problems have been fixed in the Red Hat version, whether in the same or in a different way, the Oracle specific patches are dropped and the package recompiled (always checking for trademarks and copyrights issues) and released as part of Oracle Linux via the Unbreakable Linux Network (ULN) and the public yum repository

For official updates of existing major releases, for example RHEL 6 Update 5, Oracle re-bundles the Red Hat patches in the update and reissues them as Oracle Linux 6 Update 5, including free ISOs, usually within 5-7 business days.

Bug fixes and security errata are delivered via the Unbreakable Linux Network and the public yum repository and announced via the `el-errata` mailing list (<http://oss.oracle.com/mailman/listinfo/el-errata>). It is important to point out that keeping your system fully up to date does not require purchasing a support subscription; these updates are provided free of charge.

As a new major RHEL release is issued, there is usually the need to do some additional testing before Oracle can consider it an official Oracle Linux version since Red Hat does not conduct Oracle related testing. For instance, when RHEL 5 was released, Oracle ensured that the corresponding Oracle Linux product had been well tested before issuing its own version of it, since in the past, we've discovered critical bugs and fixed them during this process.

For more information on compatibility, download an independent third-party white paper from the Edison Group, Oracle Linux: True Enterprise-Quality Linux Support:

<http://www.oracle.com/us/technologies/linux/ubl-edison-066204.pdf>

### Zero downtime updates with Ksplice

Ksplice is an exciting technology provided as part of the Oracle Linux Premier Support subscription. Available exclusively on Oracle Linux, it updates the Linux Operating System (OS) kernel, while it is running, without a reboot or any interruption. Only Oracle Linux offers this unique capability, making it possible to keep up with important Linux kernel updates without burdening you with the operational cost and disruption of rebooting for every update to the kernel. Ksplice allows system administrators to deliver valuable patches for both the Unbreakable Enterprise Kernel as well as the Red Hat compatible kernel with lower costs, less downtime, increased security, and greater flexibility and control.

### Third Party Solutions

Partners including OEMs, ISVs and other third party vendors strongly endorse and support Oracle Linux. Oracle has a long history of working with industry-leading companies such as AMD, Brocade, Cisco, Dell, EMC, Emulex, Fujitsu, HDS, HP, IBM, Intel, NEC, NetApp, Microsoft, Qlogic, VMware and many others. See the Partners Support Oracle Linux page for more details:

<http://www.oracle.com/technetwork/server-storage/linux/partners/index.html>

No re-certification is necessary for Oracle Linux, because of the compatibility between Oracle Linux code and RHEL code, therefore anything that was certified on RHEL is also certified on Oracle Linux.

- Discover detailed comparisons of Oracle Linux and Red Hat Enterprise Linux and certification information for partners

<http://www.oracle.com/technetwork/server-storage/linux/partners/default-1742089.html>

If customers have an application deployed on Red Hat Enterprise Linux, it will continue to run “as-is” on Oracle Linux. From a software vendor and a hardware vendor point of view, Oracle certifies and supports all the applications that are certified on RHEL. Many software vendors certify and support their software on Oracle Linux, including BMC, Computer Associates, EMC, Quest, SAP, Sungard, and Symantec.

For a detailed overview of the considerations and best practices for certifying RHEL-supported applications with Oracle Linux read the following technical articles:

- Certification with Oracle Linux 6  
<http://www.oracle.com/technetwork/articles/servers-storage-dev/linux6cert-400781.pdf>
- Certification with Oracle Linux 5  
<http://www.oracle.com/us/technologies/linux/027626.pdf>
- Certification with Oracle Linux 4  
<http://www.oracle.com/us/technologies/linux/027625.pdf>

## Oracle Linux Support Program

Oracle delivers enterprise-class support for Oracle Linux with premier backports, comprehensive management, cluster software, indemnification, testing and more. Oracle supports Oracle Linux and existing Red Hat Enterprise Linux installations at significantly lower cost than competing vendors. From operating system to applications, Oracle provides support for the full software stack running on Linux.

Oracle Linux Support (<http://www.oracle.com/us/technologies/linux/support-439829.html>) leverages Oracle's support infrastructure and provides a premier level of scope, experience, and quality. Oracle has more than 30 years of experience providing enterprise-quality support, and we serve the needs of our customers with a worldwide 24/7 support organization consisting of more than 7,000 professionals in 145 countries.

Oracle is the only vendor in the industry that offers a complete Linux-based solution stack – applications, middleware, database, management tools, operating system and hardware. With Oracle as your Linux support provider, you have a single point of contact for all your support needs. Oracle is committed to delivering high quality, comprehensive, and integrated support solutions to help ensure that organizations succeed with Oracle Linux.

Oracle's Sun Server systems include Oracle Linux support. When you purchase Oracle's Sun x86 systems with Premier Support for Systems, Oracle Linux Premier support is included (as well as support for Oracle VM and Oracle Solaris). Read more about:

Oracle Premier Support for Systems  
<http://www.oracle.com/us/support/systems/premier/>

Many of Oracle's database support analysts and applications developers are used to working with Linux, and the talent and experience of Oracle's support organization is reflected in numerous awards, including Service and Support Professionals Association (SSPA) Awards.

Complete support for the complete software and hardware stack has other advantages in addition to the technical expertise of Oracle's support professionals. When a customer logs into MyOracleSupport, (Oracle's issue tracking system) they can see all their issues, whether related to the Linux OS or any Oracle products, and the same diagnostic tools that are used to pull information from systems running Oracle products are also used for the Linux OS as well.

## Oracle's Linux Commitment and Leadership

Oracle has a dedicated Linux operating system development team in house, and a large number of the engineers are community members and are fully focused on making Linux operating system contributions, rather than the Oracle products.

The Oracle Linux engineering team focuses on contributing enterprise-class functionality to the operating system. All the development done by the team is performed in collaboration with the upstream maintainers and the Linux community directly, and integrated in the upstream repositories from the start.

Oracle's involvement with Linux began in 1998, when Oracle Database Release 8 became the first commercial database to be ported to that operating system. Even though there was a still relatively small amount of interest in Linux at the time, it was already used for development and testing environments and Oracle recognized its potential as a viable operating system.

In 2002, a program called Oracle Unbreakable Linux was launched, underscoring Oracle's commitment to Linux as a viable enterprise operating system. Under this program Oracle started providing direct support for the Linux operating system for customers running Oracle products, with the endorsement of Red Hat and Novell. Any fixes in the OS produced by Oracle for priority one bugs were contributed back to the vendors on whose distribution they manifested and incorporated in their official Linux releases.

Oracle also created a fully open source Linux Cluster File System – Oracle Cluster File System (OCFS) – which was geared towards helping Oracle Real Application Clusters adoption with Oracle 9i. The second version of this, OCFS2, was the first cluster file system to become part of the Linux mainline kernel (in version 2.6.16 - <http://www.oracle.com/us/technologies/linux/025995.htm>). At the time, Oracle also started sponsoring the Linux security evaluations, because they are important for government contracts and some customers require such level of certification.

Within the company, there are scores of Linux production deployments as well, making Oracle itself a significant Linux user. Oracle Linux is Oracle's Linux development and production environment, with thousands of production systems running Oracle Linux and several thousand developers using it as their development platform.

Learn more about Oracle's support, commitment, and leadership with Linux on the following page:

<http://www.oracle.com/technetwork/server-storage/linux/technical-contributions-1689636.html>

## Conclusion

Oracle is the only vendor in the industry that offers a complete Linux-based solution stack – applications, middleware, database, management tools, operating system and hardware, along with a single point of support. Users of Oracle Linux benefit greatly from the latest Linux innovations as well as rigorous testing with real world workloads. The availability of free DVD images and binary RPM packages (including updates/errata) from the public yum repositories make it easy to evaluate, use and distribute Oracle Linux without buying support subscriptions. Third party applications do not need to be re-certified with the Unbreakable Enterprise Kernel in Oracle Linux.

## References and Additional Resources

For more information about Oracle Linux, please access the following resources:

**Oracle Linux Home Page**

<http://www.oracle.com/linux>

**Download Oracle Linux**

<http://edelivery.oracle.com/linux>

**General FAQ on Oracle Linux**

<http://www.oracle.com/us/technologies/027617.pdf>

**Oracle Validated Configurations**

<http://www.oracle.com/technetwork/topics/linux/validated-configurations-085828.html>

**Purchase Oracle Linux support**

<http://www.oracle.com/store>

**Oracle Linux Data Sheet**

<http://www.oracle.com/us/technologies/linux/oracle-linux-ds-1985973.pdf>

**Oracle Technical Contributions to Linux**

<http://www.oracle.com/us/technologies/linux/026042.htm>

**Unbreakable Linux Network**

<http://linux.oracle.com/>



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