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LINUX

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Oracle Linux: Maximize Value, Minimize Cost

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Introduction

Intense competitive and economic pressures are driving businesses to scrutinize costs and find efficiencies that help to increase profitability. In light of budget constraints, IT departments are challenged to deliver core business application services while reducing the total cost of ownership (TCO). To put it simply, IT managers must determine new ways to do more with less.

Many IT organizations seek efficiencies through cloud service delivery models that increase agility and utilization, simplify administration, and cut the complexity and cost of application delivery. To support emerging cloud-based solutions and critical business application workloads, IT architects are increasingly embracing Linux as the enterprise deployment standard. In fact, according to the Linux Foundation, Linux adoption for mission-critical and cloud-based application services is experiencing continual year-over-year growth in major corporations.[1] In many cases IT is standardizing on a single commercial Linux distribution because it can mean significant savings in comparison to proprietary UNIX technologies.

As companies shift away from supporting a wide array of Linux and UNIX variants and consolidate, Oracle Linux offers greater value at less cost than other commercial Linux releases. Backed by 24x7 support in 145 countries and deployed by thousands of customers worldwide, Oracle Linux is the proven enterprise Linux choice. It is the Linux development standard at Oracle, running on over 175,000 virtual and physical servers that power Oracle's engineering, business, and customer-facing cloud operations.

This paper describes the savings and efficiencies that an IT department can realize by choosing Oracle Linux as their enterprise standard. It highlights sample deployments and explains how deploying Oracle Linux can reduce operational costs and result in less downtime, improved productivity, and greater opportunities for revenue generation.

[1] Linux Foundation, "2013 Enterprise End User Report, Linux Adoption: Third Annual Survey of World's Largest Enterprise Linux Users", March 2013 (http://www.linuxfoundation.org/publications/linux-foundation/linux-adoption-trends-end-user-report-2013).

How Deploying Oracle Linux Reduces Costs

Some commercial Linux vendors require support subscriptions on every system to obtain the operating system software as well as patches and security updates. This points to a prominent difference between Oracle Linux and other commercial enterprise Linux distributions: **Oracle Linux is free to download, use, and redistribute without a support contract**. For companies that standardize on Oracle Linux, this can translate into significant savings. Oracle Linux binaries are freely available for download from https://edelivery.oracle.com/linux, the Oracle e-delivery site. No site or activation keys are required, so an administrator can deploy new servers without delay, even in the middle of the night. Source code for the Unbreakable Enterprise Kernel (UEK), which Oracle optimizes for performance especially for Oracle Database and Oracle applications, is also publicly available via the Oracle `git` repository (http://oss.oracle.com/git).

While support contracts are crucial for production servers that host business-critical application stacks, there are often many enterprise systems that don't require support, such as developer workstations and Quality Assurance (QA) systems. Oracle believes that IT should be able to select which Linux systems require support contracts. Oracle therefore makes patches and security errata for Oracle Linux freely available on a public `yum` server (http://public-yum.oracle.com/) — no contract is needed to download and install updates from this site, allowing administrators to apply the exact same errata across all Oracle Linux systems in the enterprise, regardless of whether or not they are supported. The public `yum` server makes these updates available at the same time as the Oracle Unbreakable Linux Network (ULN) does for systems under contract, so administrators have a single location from which they can retrieve errata for both supported and unsupported systems. This approach is distinctively different than that of other commercial Linux vendors.

IT departments can standardize on Oracle Linux and selectively choose which servers to place under contract, substantially decreasing operational expenses. For non-essential servers such as proof-of-concept and development systems, IT can deploy Oracle Linux without support, apply security errata, and still maintain compliance with Oracle licensing policies. In addition, Oracle permits the redistribution of Oracle Linux without requiring any secondary licensing terms or agreements.

Low-Cost Oracle Linux Support

Of course, Oracle recommends support contracts for servers that host business-critical application stacks. For these systems Oracle offers two levels of high-quality, enterprise-class support at low price points. The table below compares the Basic and Premier support levels, which can be assigned on a per-server basis. For one or two-socket server configurations (with unlimited virtual guests), Oracle also offers limited versions of the Basic and Premier support contracts at discounted prices.

BASIC SUPPORT	PREMIER SUPPORT
• 24x7 telephone and online support • Access to errata, updates, fixes and additional software channels on Oracle's Unbreakable Linux Network (ULN) • Access to "My Oracle Support" and the Oracle knowledgebase • Comprehensive indemnification • Oracle Clusterware for high availability and load balancing • Oracle Enterprise Manager 12*c* for Linux lifecycle management as well as support for Spacewalk	All benefits of Basic Support plus: • Zero-downtime kernel updates with Ksplice • XFS scalable file system • Premier backports • Lifetime sustaining support

To simplify migrations, Oracle supplies a Red Hat compatible kernel as well as the Unbreakable Enterprise Kernel (UEK). Oracle support subscriptions are kernel-independent, and customers migrating from Red Hat Enterprise Linux are not required to reinstall to receive support from Oracle.

When comparing the cost of Oracle Linux support to that of other commercial Linux vendors, **support costs for Oracle Linux are significantly lower**. Oracle publishes a Linux Cost Calculator tool (http://www.oracle.com/us/media/calculator/linuxtco/index.html) to contrast potential support costs. By entering a system configuration (the number of sockets and virtual guests), a server quantity, and the term of the subscription (one or three years), the tool generates estimated support expenses based on publicly available pricing data. As an example, for 100 two-socket servers running up to four virtual guests, Oracle Linux Basic Support for one year is about $50,000 — approximately one-third the cost of a comparable 24x7 support subscription from another vendor.

To analyze support costs for hypervisor and virtual server management, Oracle also publishes a similar cost calculator at http://www.oracle.com/us/media/calculator/vm/vm-home-2132015.html. This tool calculates enterprise support costs for a combination of Oracle Linux and Oracle VM technologies, demonstrating the savings possible over support contracts from other Linux and virtualization companies.

Lower Cost and Greater Value

Beyond the distinct advantage of lower cost, Oracle Linux support contracts supply greater value. Other vendors charge for add-ons that provide management and extended functionality like High Availability (HA), enterprise management, and more. With Oracle Linux Basic and Premier Support subscriptions, Oracle includes no-charge access to Oracle Clusterware (which provides HA) and Oracle Enterprise Manager 12*c* (which empowers comprehensive Linux lifecycle management). And when it comes to troubleshooting and maintaining systems, Oracle's Ksplice technology provides exceptional value for customers that purchase Oracle Linux Premier Support because it enables zero-downtime kernel updates.

High Availability Support at No Additional Cost

For mission-critical applications that require HA — including Oracle Database and Oracle applications as well as non-Oracle applications — Oracle Clusterware monitors and manages application clusters. In the event of a hardware or software failure, Oracle Clusterware supports failover of applications to a different cluster node. The software also distributes load across nodes to optimize performance.

An Oracle Linux Basic or Premier support contract includes Oracle Clusterware at no additional charge. Other Linux vendors require expensive add-ons to gain HA functionality. With Oracle Linux support, IT departments can realize this additional value from their support contracts and lower the cost of delivering application continuity.

No-Charge Linux Lifecycle Management

Oracle Linux Basic and Premier Support subscriptions also include Oracle Enterprise Manager 12*c* for end-to-end Linux lifecycle management. Oracle Enterprise Manager 12*c* supplies an intuitive interface for Oracle Linux provisioning, patching, monitoring, administration, and configuration management. The software takes a comprehensive approach to management, integrating Linux server management with controls that can extend to encompass application, virtual server, and hardware system management across the data center. Again, other commercial Linux vendors require an add-on (and charge additional fees) to obtain Linux server management functionality. Instead, an Oracle Linux Basic or Premier support subscription includes Oracle Enterprise Manager 12*c* licensing for free, enabling powerful management capabilities without imposing additional cost.

In addition to Oracle Enterprise Manager 12*c*, Oracle also supports Spacewalk, the open-source community project that is the basis for solutions such as Red Hat Satellite Server and SUSE Manager. Customers with Oracle Linux Basic and Premier Support subscriptions have access to a fully supported Spacewalk build, simplifying management during an evaluation or migration to Oracle Linux.

Dynamic Kernel Updates with Ksplice

When it comes to improving efficiency and finding cost savings, consider how system downtime and the associated expense can impact your organization and its profitability. When administrators take physical or virtual servers off-line to load a debugging kernel, apply updates, or install security patches, it results in outages and increased load on the remaining servers, yielding slower response times. The consequences of downtime are often direct losses in user productivity and missed revenue opportunities. When scheduling kernel updates, administrators must plan around business priorities, delaying and rescheduling outages to when it's most convenient, which can expose mission-critical systems to unplanned downtime because of potential kernel flaws or security issues.

To eliminate these risks, **Oracle Linux Premier Support features Ksplice technology that allows administrators to apply updated kernels without downtime.** Ksplice eliminates the need to take a server off-line when applying a debugging kernel for troubleshooting or to implement errata. Ksplice can be used in conjunction with both the Oracle Unbreakable Enterprise Kernel (UEK) and the Red Hat compatible kernel.

Ksplice greatly simplifies diagnostics and troubleshooting because an administrator can swap in a modified kernel without a reboot. When a developer is troubleshooting a potential kernel problem, Oracle support can supply a debugging kernel targeted specifically at gathering data about the issue. Ksplice dynamically applies the kernel module to the production system without a reboot. Not only can Ksplice apply a debugging kernel to identify an issue's root cause, but it can install an Oracle support hotfix as a stopgap measure as well as the final errata release, all with zero downtime.

Since Ksplice dynamically installs updates, administrators can choose to automate the delivery and application of kernel modules. As a kernel defect or security vulnerability is discovered, the Oracle support organization creates a new Ksplice kernel module and makes it available on the Unbreakable Linux Network (ULN). For Linux servers covered by Oracle Linux Premier Support, the updated

module can be automatically downloaded from the ULN site and applied, instantly overwriting the relevant portion of the running kernel to facilitate a "rebootless" update. Any kernel changes applied with Ksplice can also be reversed in a similar way without a reboot. Administrators can also opt to apply Ksplice kernel changes manually (rather than in an automated manner through ULN) and can create private software repositories by replicating packages from the ULN site. (A short video clip at https://www.youtube.com/watch?v=vzR7qLGVNKg describes Ksplice implementation options.)

Ksplice technology dramatically reduces administrative complexity since both physical and virtual servers running Oracle Linux can be updated without taking them off-line. Administrators can apply security and reliability patches without the complications and upheaval of planning and coordinating outages. Ksplice makes it easy to improve security compliance and keep systems up-to-date, reducing vulnerabilities since updates are applied in a timely and non-intrusive manner.

In addition, there are cases in which a few third-party software products have dependencies on proprietary third-party kernel modules. This can make it impossible to upgrade to a new Linux software version to obtain patches, which some Linux vendors require to implement a security fix. In these cases, Ksplice is often the only viable alternative since it can insert critical security patches into an existing kernel, allowing some third-party software applications to continue to function. A recent blog post (https://blogs.oracle.com/wim/entry/a_good_use_case_for) points out how Oracle makes security and critical fix errata available for **all the various Oracle Linux kernels via Ksplice**, which can help customers remain on a specific kernel over time and still apply fixes, all without a reboot.

As a matter of fact, Ksplice technology has been providing zero-downtime kernel updates for over eight years, allowing Oracle to create, distribute and dynamically apply over 1 million patches to production kernels around the world. Ksplice has a proven track record of supporting mission-critical applications and supplying updates without disruption, substantially increasing uptime and enhancing the value of Oracle Linux. For existing Red Hat Enterprise Linux customers, Oracle even offers a 30-day free trial of Ksplice technology (see https://www.ksplice.com/rhel-signup).

Oracle Linux Premier Support: Truly First-Class

Beyond zero-downtime kernel updates with Ksplice, the Premier Support level provides all the benefits of Basic Support — Oracle Clusterware, Oracle Enterprise Manager 12*c*, ULN access, and indemnification against intellectual property infringement claims — increasing the value of an Oracle Linux support subscription.

The Premier support level also includes these additional benefits:

- XFS scalable file system. Oracle Linux Premier Support subscribers receive free support for XFS, a journaling file system known for extreme scalability and near-native I/O performance. RPM packages are available on ULN that provide management utilities to deploy the XFS file system.
- Premier back-ports. For Oracle Linux Premier Support customers, Oracle can issue back-ports of individual patches to a version of a deployed package that is less than six months old. This capability gives customers more flexibility with respect to when they choose to upgrade. Other vendors force customers to upgrade to the latest Linux release to obtain bug fixes.
- Lifetime sustaining support. Maintenance and software upgrades are included for Oracle Linux and Oracle VM for ten years from a release's general availability date.

Oracle's comprehensive worldwide support provides extensive value and Linux expertise at an extremely affordable price point. Deploying Oracle Linux can bring additional value in the stability and performance that the release offers for your business-critical applications.

The integration of Oracle Linux into Oracle engineered systems (including the Oracle Exadata Database Machine, Oracle Exalytics In-Memory Machine, Oracle Exalogic Elastic Cloud, and Oracle Database Appliance systems) brings extensive testing, performance optimizations, and increased reliability, especially for Oracle workloads deployed on Oracle Linux. Customers can build their own solution stack with confidence, or turn to Oracle for a complete and integrated application-to-disk Linux solution. With an end-to-end Oracle solution, administrators gain the advantage of a single point of contact from a leading industry database and application expert for the most critical service and support issues.

Hardened within Oracle

Beyond the integration of Oracle Linux in Oracle engineered systems, Oracle is a huge consumer of Oracle Linux, deploying over 175,000 physical and virtual Oracle Linux instances across the company. Oracle Linux is used pervasively throughout the Oracle software and hardware engineering organizations as well as throughout Oracle's daily business operations.

Oracle applications and updates are developed, tested, and supported on Oracle Linux. Oracle Linux is certified for Oracle Database (including Oracle Real Application Clusters), Oracle Fusion Middleware, and every Linux-compatible Oracle product — including Oracle E-Business Suite, PeopleSoft, and the Siebel Customer Relationship Management (CRM) product lines. When internal and partner engineering teams develop new solutions that integrate database, middleware, and application products, they are usually developed, tested, and delivered first on Oracle Linux.

Because both internal and external customers rely on Oracle Linux for continuous application delivery, Oracle makes significant investments in testing the operating system. Internally at Oracle, Oracle Linux undergoes approximately 128,000 hours of testing per day within Oracle's engineering departments. If problems or defects are discovered, they are resolved and kernel changes are pushed back upstream to the Linux community, improving the reliability of open source Linux as well as that of Oracle Linux. The extensive testing and use of Oracle Linux within Oracle leads to greater stability, minimizing risk for your deployments.

Proven Savings

Among Oracle deployments of Oracle Linux, there are business units in which IT managers have analyzed the savings they've realized from using Oracle Linux. In particular, these organizations have calculated the savings they're achieved because of dynamic kernel updates with Ksplice technology. What follows captures the experience of two organizations, Oracle Compute Resources and Oracle Managed Cloud Services, which were both able to maintain application availability and protect revenue opportunities by using Oracle Linux with Ksplice.

Oracle Compute Resources

Part of Oracle's engineering organization, Oracle Compute Resources is an internal IT group that supports the engineering development labs as well as SPARC and systems microprocessor engineering (informally known as the "SPARC compute ranch"). This IT organization provides continuous

7x24x365 operations and supports over 1000 Oracle Linux machines distributed over three data centers (Santa Clara, Austin, and Burlington). More than 900 Linux systems function as a compute grid running Electronic Design Automation (EDA) batch and interactive jobs that are used to perform chip design verification and logic simulations. The longevity of these jobs is unpredictable, meaning that a job is queued, executes across a number of grid machines, and may run for ten days, a month, or even longer. Availability in the environment is key since a failure causes jobs to be restarted. Outages have a huge negative impact on engineering productivity and ultimately time-to-market for microprocessors used in Oracle systems.

Before the availability of Ksplice technology, it was a challenge for this IT group to keep up with Linux operating system patches and security errata, as it is for administrative teams in many corporate data centers. The Oracle Compute Resources operations team used a rolling upgrade approach in which roughly 10% of the systems were taken off-line at a time. Targeted machines were first prevented from taking new jobs from the queue. Then as machines completed jobs and became free, administrators applied kernel patches, rebooted, and brought the servers back into service.

In practice, the rolling update approach required significant planning, coordination, and intervention to free up machines that were in the middle of executing long-running jobs. Corporate security policy, of course, required administrators to apply patches in a timely manner and within a scheduled window. It was extremely difficult to keep pace with the cadence of errata and patch releases. The operations team estimated that for every kernel update, it took at least 54 hours of system administration time plus seven hours of lost user time because of system reboots. **On average, it would take as long as 28 days to upgrade all machines across all three data centers.**

After implementing Ksplice, upgrades became significantly easier and faster, with no interruption to users. Today the operations team mirrors the ULN `yum` repository locally, giving them precise control of the kernel modules used in the upgrade process. Using a test machine, an administrator can first apply a new Ksplice kernel module and validate the update's success. After this verification step, the administrator initiates the broader deployment across all grid machines. Because of Ksplice, **the wall clock time for a patch rollout has shrunk to less than an hour in most cases, down from an average rollout time of roughly one month.**

The savings associated with using Ksplice stems from the productivity gains and business opportunities it protects in comparison to the rolling method of patching. Chris Martin, an IT solutions architect in the Oracle Compute Resources group, summarizes the benefits in this way:

> "We estimate that a traditional reboot upgrade costs us 16,500 CPU days of compute time. While the capital cost of this is fairly minimal (about the expected lifetime of two typical blades), **the lost opportunity cost is substantial**."

Because time-to-market for innovative chip designs can influence the introduction of new Oracle SPARC processors and systems, the "lost opportunity costs" can mean delays in product releases that can significantly impact revenue generation for this line of business.

Oracle Managed Cloud Services

Oracle Managed Cloud Services is another IT organization in which Ksplice technology has prevented lost revenue opportunities. This organization supplies customers with Oracle Database instances, Oracle Fusion Middleware, and other Oracle software products deployed as cloud services, delivering applications to more than 5.5 million end-users. To deploy cloud-based services with the security,

availability, performance, and scalability that each customer requires, Oracle Managed Cloud Services manages over 15,000 virtual and physical servers using Oracle VM and Oracle Linux.

Recently, IT managers in Oracle Managed Cloud Services analyzed the impact of using Ksplice to apply a critical Linux kernel patch on approximately 200 virtual machines. The virtual servers were hosting mission-critical Oracle E-Business Suite applications and delivering them as cloud services to roughly 80 different companies. The patch corrected a networking problem that was standing in the way of meeting customer Service Level Agreements (SLAs) stipulating 99.9% uptime. Not only could there be economic consequences if SLAs were not met, the bug created a security vulnerability that could be exploited if it was not remedied quickly. **By using Ksplice kernel module updates, administrators saved an estimated 500-1000 hours for just this one kernel patch rollout, saving an estimated $25,000 to $50,000.** In addition, they were able to shrink the wall clock time for the rollout from six months to a matter of a few days. Perhaps most importantly, the updates occurred with no interruption of service to end users, enabling the application continuity fundamental to this revenue-generating Oracle business.

Conclusion

When it comes to getting the most value from your Linux release and support subscriptions, Oracle Linux is clearly your best choice. Oracle Linux is free to download and distribute, with the binaries, errata, and updates available from Oracle at no charge. Oracle supplies two kernel options — the optimized Unbreakable Enterprise Kernel and a Red Hat compatible kernel — and both are backed by the expertise of Oracle's global 24x7 support organization. A support subscription for Oracle Linux is extremely affordable and you can select coverage for just the business-critical servers that truly need it.

In addition, Oracle Linux support subscriptions include advanced functionality — High Availability and Linux lifecycle management — that other commercial Linux vendors package as expensive subscription add-ons. The Oracle Linux Premier Support level includes access to Ksplice, XFS, and support for patch back-porting. Ksplice technology provides a non-intrusive and seamless approach to troubleshooting and applying security errata, eliminating outages, slashing rollout cycles, and allowing administrators to keep pace with critical updates. As IT organizations (both within Oracle and externally) have found, Ksplice maintains application availability, preventing downtime and lost business opportunities that can impact revenue.

To analyze how much you can save by deploying Oracle Linux in your environment, run the Linux Cost Calculator at http://www.oracle.com/us/media/calculator/linuxtco/index.html. You can also compare the cost of virtual servers using Oracle VM and Oracle Linux against competitive offerings using the virtualization cost calculator at http://www.oracle.com/us/media/calculator/vm/vm-home-2132015.html. And of course, you can download a free copy of Oracle Linux today from https://edelivery.oracle.com/linux and get started with your own evaluation. Contact your Oracle representative to learn more, or visit http://www.oracle.com/linux.

For More Information

For more information, visit the resources listed below.

TABLE 1. RESOURCES FOR MORE INFORMATION	
WEB RESOURCES	**WEB URL**
Oracle Linux Home Page	http://www.oracle.com/linux
Download Oracle Linux	https://edelivery.oracle.com/linux
Oracle Linux public yum server	http://public-yum.oracle.com/
Oracle Linux Cost Calculator tool	http://www.oracle.com/us/media/calculator/linuxtco/index.html
Oracle VM Cost Calculator tool	http://www.oracle.com/us/media/calculator/vm/vm-home-2132015.html
Video about Ksplice implementation options	https://www.youtube.com/watch?v=vzR7qLGVNKg
Free 30-Day Trial: Ksplice Zero-Downtime Updates for Red Hat Enterprise Linux Customers	https://www.ksplice.com/rhel-signup
Oracle Enterprise Manager	http://www.oracle.com/us/products/enterprise-manager/
Oracle Validated Configurations	http://www.oracle.com/technetwork/topics/linux/validated-configurations-085828.html
WHITE PAPERS & DATA SHEETS	**WEB URL**
“Fast, Modern, Reliable: Oracle Linux”	http://www.oracle.com/us/technologies/linux/uek-for-linux-177034.pdf
“Ksplice: Zero Downtime Updates for Oracle Linux”	http://www.oracle.com/us/technologies/linux/ksplice-datasheet-487388.pdf
“Ksplice Offline“	http://www.oracle.com/us/technologies/linux/ksplice-offline-updates-ds-1898638.pdf
“Oracle Linux Management with Oracle Enterprise Manager 12*c*”	http://www.oracle.com/us/technologies/linux/linux-with-enterprise-manager-1959006.pdf
“Oracle Clusterware for Oracle Linux”	http://www.oracle.com/technetwork/database/database-technologies/clusterware/overview/clusterware-for-linux-088663.html?ssSourceSiteId=ocomen
“What Makes Oracle Linux the Best Platform for Oracle Database 12*c*”	http://www.oracle.com/us/technologies/linux/linux-for-oracle-database-wp-2068570.pdf





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