Migrating to Oracle Linux—an Economic Value Analysis

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October 2015

Evaluator Group

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Executive Summary

Linux is now a foundational operating system in many if not most enterprise IT organizations because it allows them to deploy a full-featured, stable, and production class operating environment while reducing costs. It is also becoming a popular OS environment for private and public clouds. In fact, according to the Linux Foundation, Linux is the primary platform for building the cloud and is experiencing continual year-over-year growth in major corporations. One reason this is the case is that 78 percent of enterprises feel that Linux is more secure than most other operating systems.[1]

Enterprises have choices when it comes to acquiring Linux and related support services, the most common of these being Red Hat with Red Hat Enterprise Linux (RHEL). However, because Oracle Linux is binary compatible with RHEL and therefore general purpose in nature, users can consolidate all of their Linux-based applications to further reduce costs associated with the Linux operational environment. We have heard Oracle Linux users refer to this trend as a "One Linux" strategy.

Here, at Oracle's request, we review Oracle Linux which is free to download, use, and redistribute without a support contract. We highlight its features and compatibility with the Linux standard. We then look at the features and competency of Oracle Linux support which is available on a yearly subscription basis. We further illuminate our research with the results of three Oracle Linux users from different businesses. These users have all had experience with migrating applications from RHEL to Oracle Linux and use Oracle Linux support. They reported an increase in application performance coupled with a reduction in annual support costs. We study these and other economic factors that are allowing these users to reduce cost for their Linux operating environments.

Oracle Linux Essentials

In 1998, Oracle Release 8 became the first commercial database to be ported to Linux in spite of barely discernable interest in Linux by enterprise users at the time. To ensure critical Linux bugs were fixed for Oracle customers, a program called Oracle Unbreakable Linux was launched in 2002. At this time Oracle started providing direct support to its customers running RHEL. This support included contributing bug fixes back to the Linux community as well as submitting all work to the mainline kernel.

The Oracle Linux distribution was launched at Oracle OpenWorld in 2006 and in September 2010, Oracle announced the Unbreakable Enterprise Kernel (UEK) for Oracle Linux. It is the default kernel in Oracle Linux, assuring application-level compatibility in userspace. It is developed and continually updated using the latest stable kernel release including the latest features and is optimized for Oracle enterprise software and Oracle Engineered Systems hardware[2] as well as other enterprise applications.

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[1] Linux Foundation 2014 Enterprise End User Trends report published December, 2014
[2] For more information, on Oracle Linux hardware compatibility, visit: http://linux.oracle.com/hardware.html

Oracle Linux can be run directly on bare metal or as a virtual guest on Oracle VM or other virtualization technologies including VMware. Oracle Linux is also available in the form of virtual machine images for Oracle VM Server for x86 and Oracle VM VirtualBox.

Oracle offers two different kernels for Oracle Linux:

> **Unbreakable Enterprise Kernel** (UEK) which is developed using the latest stable Linux kernel release from the mainline/upstream source;

> **Red Hat Compatible Kernel** version (RHCK) for users requiring strict Red Hat compatibility.

Oracle Linux includes both the UEK and RHCK. UEK is the default kernel in Oracle Linux, but if the user prefers to default to RHCK, they can make a simple GRUB modification to do so. In addition, all of Oracle's x86-based engineered systems use the UEK.

Oracle Linux is available as a free download that includes binaries, installation media and the source code. All errata are also freely available. Again, Oracle Linux is binary compatible with RHEL, regardless of which kernel is in use.

The current Oracle Linux customer base now exceeds 13,000 enterprise users. Many are attracted to Oracle Linux specifically because of the UEK which we profile in more detail below.

UEK

The Oracle Linux Unbreakable Enterprise Kernel (UEK) is optimized for software performance, especially in Oracle database and applications environments, as well as for use with Oracle optimized hardware (storage for example – see Evaluator Group Technical Insight Papers entitled The Oracle ZS3 Storage Appliance and Backing up the Oracle Stack).

UEK 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. All system libraries remain the same.

Below is a summary of some of the unique features developed in conjunction with the UEK, but some of these features are also supported when using the RHCK and are noted where applicable.

UEK-specific Features

Data Integrity

The UEK implements Oracle's Data Integrity Extensions (DIX) for application-to-SAN data integrity checking on Linux. DIX extends the ANSI T10 PI standard up to the application layer to protect against data corruption in the application-to-storage software stack. HBA and Storage vendor support for DIX is required.

DTrace

DTrace is a dynamic tracing framework that is now integrated with the UEK. Initially developed for the Oracle Solaris operating system, it allows IT administrators to monitor and manage the behavior of the operating system and supported applications in real time.

Database Smart Flash Cache

The Database Smart Flash feature can be integrated with server-based PCIe Flash storage devices such as the Oracle Sun Flash Accelerator PCIe Card or other supported server-based flash storage devices. Performance gains can be realized for I/O intensive database applications. Database Smart Flash Cache works with either the UEK or RHCK kernel.

Pre-install Package

The pre-install package aids in the installation of the Oracle Database or other Oracle products on Oracle Linux with the UEK. The pre-install package download includes software package and specific versions needed for application installation.

Ksplice

Ksplice is a unique technology provided as part of the Oracle Linux Premier Support subscription. Ksplice updates the running kernel image with the latest security errata and other critical updates. It does so while the kernel is running, without a reboot or any interruption to the application and work disruption to users. Unlike an on-disk change that only takes effect after a subsequent reboot, a Ksplice update takes effect immediately as it is applied. With Ksplice IT administrators can keep up with important Linux kernel updates, patches for both the Unbreakable Enterprise Kernel as well as the Red Hat compatible kernel.

Linux Containers (LXC)

LXC allows users to run a complete copy of Linux in a container with less processing overhead required by the typical virtual machine (VM). Use cases include production, test/dev environments, running different releases of Oracle in parallel, and running many copies of application configurations on the same system.

Docker Containers

In addition to Linux Containers, Oracle Linux also supports the use of Docker Containers deployed on UEK R3 with either Oracle Linux 6 or 7. Docker Containers are fully supported with Oracle Linux Premier Support. Using Docker, an administrator can capture the precise configuration of an application as well as its software dependencies into a virtual container that can then be rapidly deployed across any number of the same or different Linux servers. Use cases are similar to those of Linux Containers.

Support

Oracle Linux support is available at Basic and Premier Levels via a yearly subscription that includes support for the UEK and/or the Red Hat Compatible Kernel. Support levels can be assigned on a per physical server basis. Customers can choose either Oracle's Enterprise manager (included with Basic and Premier Support licenses) or Oracle's release of Spacewalk for Oracle Linux. Full indemnification against intellectual property claims is included with all support licenses. Pricing is calculated on a per-system basis and varies with the level of support from Basic to Premier.[3] A free support option is also available (see below).

Basic support includes:

Oracle Enterprise Manager 12c—management application for Oracle-based application environments, Oracle Fusion Middleware, Oracle database management, and cloud management. For cloud environments, Enterprise Manager includes self-service provisioning, policy-based resource management, integrated chargeback, and capacity planning.

Oracle Cluster File System 2 (OCFS2)—open source clustered file system developed by Oracle and accepted into the Linux kernel 2.6.16.

Oracle Clusterware—portable software for clustering independent servers into a single system. Clusterware is foundational to Oracle Real Application Clusters (RAC)

Spacewalk—the Linux open source-based systems management solution

DTrace support (see above)

XFS support—included in Basic and Premier Support for Oracle Linux 7 because XFS is now the default Oracle Linux file system starting with release 7. XFS support is also included in Premier Support only for Oracle Linux 6 users**.**

Premier support includes everything in basic support plus:

Ksplice zero downtime kernel updates for UEK and RHEL (see above)

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[3] A system is defined by Oracle as the computer on which the Oracle Linux programs are installed. Where computers/blades are clustered, each computer/blade within the cluster is defined as a system.

Oracle OpenStack for Oracle Linux

Premier Backports

Docker Containers (see above)

Oracle Linux Basic and Premier Subscription Pricing

Level	Price per month
Installable binaries and errata	Free
Basic Limited **(24x7 unlimited support for up to 2 CPUs)**	$499
Basic **(24x7 unlimited support for more than CPUs)**	$1,199
Premier Limited **24x7 unlimited support for up to 2 CPUs**	$1,399
Premier[4] **24x7 unlimited support for more than 2 CPUs**	$2,299

Customer Interviews

To get a better understanding of actual user experience with both RHEL and Oracle Linux (OL) we interviewed three OL customers from different vertical industry segments.

Financial Services

The first interview was conducted with a large financial services firm. We spoke to an Infrastructure Architect with responsibilities in the areas of UNIX, Linux, OpenStack and Hadoop.

Currently, this customer is managing "tens of thousands" of OL instances running on 2, 4, and 8 socket servers in production, client, development, and quality assurance environments. All new installs are on Oracle Linux Red Hat Compatible Kernel (RHCK) as they are focused on leveraging industry standards and see RHCK as such. VMware and KVM are used for server virtualization with a 50/50 split between physical and virtual.

Application stacks supported on OL include:

- Database: Oracle, MySQL

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[4] Included as part of Oracle's Sun x86 Premier Support for Systems

- App Server: Tomcat, Websphere
- Middleware: MQ Series, Rabbit MQ, Kafka
- Analytics: Hadoop, Hbase
- Search: Novus, Elastic Search

This customer migrated from RHEL and SuSE Linux to OL RHCK and commented on the fact that Oracle support for the application migration effort that included critical applications was trusted made the migration decision easier to make. They achieved the following results:

- Consolidation of different versions of Linux to one resulted in increased management simplification and a more stable operating environment
- Consolidation of all Linux systems support to one Oracle support contract resulted in a "significant" reduction in support costs for business critical SMP and other secondary systems
- Increased application performance
- "Very satisfied" with Oracle support

Updates and patches are done using a custom solution that is scheduled by a 3rd party. Configuration management is also done with a custom solution. However, they are currently reviewing the use of Oracle Enterprise Manager and Ksplice for faster security updates and downtime reduction, as well as Spacewalk.

Consumer and Enterprise Software

The second interview was conducted with large consumer and enterprise software provider with two large and several smaller data centers. The total server environment is 80% Linux—approximately 22K servers running 400 different applications. Oracle Linux supports the Oracle applications and Oracle VM is used extensively. In addition, they use Oracle to support the entire Linux server base (RHEL plus Oracle Linux) and make extensive use of Ksplice.

We spoke to the head of a group in charge of server updates and patches who reported that application performance improved when the Oracle applications were ported from RHEL to OL. However, he was particularly familiar with the use of Ksplice and its benefits.

His group makes extensive use of Ksplice as well as home-grown scripts for the entire Linux environment in order to leverage whatever is common to both RHEL and OL environments. They use the same methods to update/patch both environments.

His group does OS patching monthly. Ksplice is used to avoid application outages. No matter how brief these outages may be, they are nevertheless disruptive to application users. Before the use of Ksplice, updates/patching processes would sometimes require downtime on all 22K servers/400 applications. Using Ksplice yields two significant benefits:

- They no longer have to notify application users of downtime periods required for updates/patches—previously a continual source of friction
- They save 500 man-hours per month

Insurance

The third interview was conducted with a large insurance carrier with an IT staff of 1,500. IT supports mainframe, Windows, and Oracle DB workloads in two data centers with disaster recovery capability. Prior to Linux, the Oracle applications (Oracle Financials and others) were run on AIX. These were ported over to RHEL Linux on x86 between the years 2008 and 2009 resulting at the end of 2009 with 130 RHEL servers as well as hosting some SuSE Linux applications on the mainframe. In 2011, IT decided to port the RHEL-hosted applications to OL, an environment that has grown to 450 servers today on OL UEK. Virtualization is used where possible with the exceptions of the Oracle RAC and analytics applications that remain on physical servers. The Linux support team consists of 12 staff members.

They reported encountering no issues when porting applications from RHEL to OL. However, some ancillary tools (BMC Patrol and EMC PowerPath) took longer than expected to certify.

Since porting the Oracle applications to OL with UEK, they have seen the following benefits:

- Both their Oracle DB and Symantec NetBackup workloads have seen 18% faster throughput
- The need to manually update ASM library modules is eliminated. Because these libraries are built into UEK, the UEK automatically updates the ASM libraries.

They are also using Oracle to support the Linux environment and the resulting benefits from Premium Support include:

- The additional licensing cost for RHEL clustering is eliminated because Oracle Clusterware is included at no additional charge with the Premier Support contract.
- The additional cost RHEL Satellite for management is also eliminated through the use of Oracle Enterprise Manager—also included with the Premier Support contract. Because Enterprise Manager collects performance and other data in an Oracle database, it can be easily exported to other management and analysis applications.
- They now have single console for management that is shared by administrators as well as having the ability to give multiple customized views to DBAs
- Remote server management that once required complex planning around limited maintenance windows is now simplified

In general, for this environment, the significant savings realized from using Oracle Support for their Linux environment resulted from implementing the management pack components and clustering software that they would have to pay for otherwise.

Economic Implications and Analysis

From our review of Oracle Linux software and support, we believe that tangible economic benefits can be realized from consolidating the enterprise Linux environment to Oracle Linux. These benefits, gathered from our own analysis as well as the customer interviews outlined above, can be further expressed as line items in a cost justification model or investment proposal:

Increased Performance

All of our interview candidates reported seeing an increase in application performance as a result of moving to Oracle Linux. For transaction-oriented Oracle database applications, this increase in performance equates to increased productivity among business users. Productivity gains translate directly to an immediate economic return on the investment in administrative time spent in migrating applications to Oracle Linux. A positive ROI can also be seen on the customer side of the equation. For business user groups and corporate executives wanting to engage with customers via cloud-based applications, better performance delivers a more positive application experience, thereby enhancing revenue generation.

One Linux Strategy

Two of the three interview candidates reported that consolidation of Linux systems support to one Oracle Support contract resulted in significant reductions in support costs for Linux systems environments that included servers hosing critical as well as secondary applications. For one, consolidation of different versions of Linux to one resulted in increased management simplification and a more stable operating environment. We note that, because all IT enterprise environments are architected and managed differently, quantification of operational expense (OPEX) savings will vary from one to the next. However, it is clear from the interviews that:

- OPEX devoted to annual Linux support costs can be reduced, possibly significantly, leading to an immediate return on investing in a single source for Linux support strategy
- Management staff time expressed as OPEX can also be reduced through simplification resulting in increased management staff efficiency
- A more stable operating environment will result in lowering the cost of outages. Application stability is also an additional factor for determining ROI resulting from application user productivity and customer satisfaction.

Oracle Linux Added Value Features

One of our interview candidates reported that, for his environment, the greatest value gained from implementing Oracle Linux resulted from implementing the management pack components and clustering software that they would have to pay for otherwise. Another was very specific with regard to the value of Ksplice. In this case, using Ksplice for monthly updates and patches in a 22K server environment saved 500 man-hours per month. Assuming a full time employee (FTE) cost of $125K per

year, reducing IT administrative staff time by 500 hours a month equates to a savings of $375K per year or the equivalent of three IT administrators.

Evaluator Group Assessment

We note that Oracle has made a substantial effort to assure compatibility with the other Linux kernels and distributions and believe that will continue to be true. The only area that users reported a compatibility issue was in getting some of their other third party vendors to support the migration. At least one user also reported that the migration effort for 20K plus servers took longer than originally expected—not surprising given the scale of the effort.

For Oracle users developing private cloud environments, we note that Linux is by far the leading OS choice and that Oracle Linux now supports OpenStack for cloud deployment. In keeping with the practices of the open source community, Oracle Linux source code is directly and completely published in public git repositories with all patches and commit logs left intact.

Therefore, migrating from RHEL or SuSE Linux to Oracle Linux is clearly an option worth examining by IT administrators who manage Oracle environments and have a substantial commitment to Linux-based servers. As mentioned, all users we interviewed reported an increase in application performance after they migrated. And all reported the realization of substantial savings but in varying ways and for different reasons. However, the ROI resulting from increased user productivity and OPEX saved was immediate in all cases. For Oracle hardware and software customers, Oracle Linux is a way to leverage the synergy Oracle has built into its Sun-based Engineered Systems and practice a "one Linux" strategy.

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