

Switching to Oracle Linux—a Total Value Analysis

By John Webster, Sr. Analyst at Evaluator Group

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Evaluator Group



Executive Summary

Linux is now a foundational operating system for enterprise IT organizations. Linux allows them to deploy a secure, full-featured, cloud native-compatible and production class operating system that is based on open source development processes. In fact, according to the Linux Foundation, Linux is the primary platform for building the cloud and is experiencing continual year-over-year growth. One reason this is the case is that a majority of enterprise IT organizations feel that Linux is more secure than most other operating systems.¹

Presently, 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, many enterprises, and especially Oracle database and application users, are now leveraging and in many cases consolidating, all of their Linux-based applications to Oracle Linux. This move simplifies their overall Linux application environment, increases security, while further reducing costs associated with a Linux operational and cloud-consistent environment. We have heard Oracle Linux users refer to this trend as a “One Linux” strategy.

Here 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 perceptions of Oracle Linux users. These users have all had experience with moving applications from RHEL to Oracle Linux and use Oracle Linux support. Among the benefits derived from the switch were:

- Increased application performance
- A reduction in annual OS support costs
- Increased operational automation leading to faster deployment of new IT resources
- Reductions in staff time required to manage and support large Linux server farms

We study these and other economic factors that are allowing these users to reduce cost for their Linux operating environments.

¹ Example: Linux is now more used on Microsoft’s Azure public cloud than **Windows Server**.

Oracle Linux Essentials

In 1998, Oracle Database 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. Oracle Linux was launched at Oracle OpenWorld in 2006 and in September 2010, Oracle announced the Unbreakable Enterprise Kernel (UEK) for Oracle Linux. Oracle Linux is 100% application binary compatible with Red Hat Enterprise Linux. 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. It is supported by third party hardware² and applications.

Oracle Linux can be run directly on bare metal or as a virtual guest on many virtualization technologies such as KVM, Xen, VirtualBox, Hyper-V, and VMware. Oracle Linux powers Oracle Cloud and Oracle Engineered Systems such as Exadata. Oracle Linux images are also available on other public clouds such as Amazon Web Service and Microsoft Azure.

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. UEK testing is widespread across IT development systems running the portfolio or Oracle Database applications. In addition, all of Oracle's x86-based engineered systems use the UEK. UEK is open source and available at github.com/oracle/linux-uek.

Red Hat Compatible Kernel (RHCK) for users requiring strict Red Hat compatibility. Oracle Linux includes both the UEK and RHCK which are included in the same Oracle Linux ISO. A configuration setting sets which kernel to boot.

The Oracle Linux customer base exceeds 18,000 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. For example, Oracle Reliable Diagram Sockets (RDS) offers a low-latency, connectionless protocol for delivering diagrams to thousands of endpoints. The

² For more information, on Oracle Linux hardware compatibility, visit: <https://linux.oracle.com/hardware-certifications>

implementation of RDS results in fewer data re-transmissions which thereby improves database performance on Linux during times of peak processing load. Oracle subsequently contributed RDS to the open source community and it is now part of the Linux kernel. Other enhancements stem from the growth of multicore processing and advanced systems architectures that include increasing main memory capacities. Query performance is enhanced via optimized libraries and system calls. The end result is that the UEK can now support expanding cloud environments that are characterized by heavy transaction-oriented workloads coupled with a growing list of database user groups.

UEK-specific Features

DTrace

DTrace is a dynamic tracing framework that owes its origins to the UNIX/Solaris environment. It provides robust monitoring and management of the operating system. IT administrators can explore an entire Oracle Linux system to understand how it works, track down problems across many layers of software, and locate the root cause of aberrant behavior. DTrace gives the operational insights into memory consumption, CPU time or what specific function calls are being made by an application – all in real time.

Database Smart Flash Cache

The Database Smart Flash Cache 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.

Oracle Linux Cloud Native Environment

The Oracle Linux Cloud Native Environment is an integrated suite of software and tools for the development and management of cloud-native applications. Based on the Open Container Initiative (OCI) and Cloud Native Computing Foundation (CNCF) standards, Oracle Linux Cloud Native Environment delivers a simplified framework for installation, updating, upgrading, and configuring key features for orchestrating microservices.

Oracle Linux Cloud Native Environment includes Kubernetes, Kata Containers, CRI-O, unified management, Helm, Istio and other open source services. The implementation of Kubernetes is Certified Kubernetes by the Cloud Native Computing Foundation (CNCF).

Support

As previously stated, Oracle Linux is free to download, use, and redistribute without a support contract. However, when a customer needs support, it is available at Basic and Premier levels via a yearly

subscription that includes support for the UEK and/or the RHCK. Both Basic and Premier support includes worldwide **24x7** phone and online support as well as access to enhancements, updates and errata. Support levels can be assigned on a per physical server basis. Customers can choose either Oracle's Enterprise manager or Oracle's release of Spacewalk for Oracle Linux (both included with Oracle Linux support subscriptions). 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

Basic support includes:

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

Spacewalk – provides a set of tools for managing the Oracle Linux software life cycle in small or large deployments. Spacewalk also helps customers automate a kickstart installation, system configuration, and maintenance tasks, which enables customers to deploy consistent software configurations for Oracle Linux systems

DTrace support – a comprehensive tracing framework for troubleshooting kernel and application problems on production systems in real time. (see above)

Oracle Linux Load Balancer – HAProxy is an application layer (Layer 7) load balancing and high availability solution used to implement a reverse proxy for HTTP and TCP-based Internet services. Keepalived uses the IP Virtual Server (IPVS) kernel module to provide transport layer (Layer 4) load balancing, redirecting requests for network-based services to individual members of a server cluster. IPVS monitors the status of each server and uses the Virtual Router Redundancy Protocol (VRRP) to implement high availability.

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.

Container Runtime for Docker – Oracle Container Runtime for Docker allows customers to create and distribute applications across Oracle Linux systems and other operating systems that support Docker. Oracle Container Runtime for Docker consists of the Docker Engine, which packages and runs the applications, and integrates with the Docker Hub and Oracle Container Registry to share the applications in a Software-as-a-Service (SaaS) cloud.

Premier support includes everything in basic support plus:

Ksplice zero-downtime updates – Ksplice is a unique technology provided as part of the Oracle Linux Premier Support subscription. Ksplice updates the Linux Operating System (OS) kernel, while it is running, without a reboot or any interruption to the application and work disruption to users. In addition, Ksplice protects against vulnerabilities in the Linux kernel and critical user-space components, including glibc and openssl through ongoing security patches. Exploit detection in Ksplice senses the occurrence of an attack targeted at specific OS vulnerabilities and keeps an audit trail of such attacks. 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 and is one of the most popular features with UEK users.

Oracle Linux Virtualization Manager – a comprehensive virtualization management solution that can be deployed to configure, monitor, and manage an Oracle Linux Kernel-based Virtual Machine (KVM) environment with enterprise-grade performance and support from Oracle.

Oracle Linux Cloud Native Environment – includes Kubernetes, Kata containers, Istio, and Helm. Oracle's Linux Cloud Native Environment is an integrated suite of software and tools for the development and management of cloud-native applications. Based on the Open Container Initiative (OCI) and Cloud Native Computing Foundation (CNCF) standards, Oracle Linux Cloud Native Environment delivers a simplified framework for installations, updates, upgrades, and configuration of key features for orchestrating microservices.

Gluster storage – a scalable, distributed file system that aggregates disk storage resources from multiple servers into a single global namespace.

Premier backports – backport of fixes, using commercially reasonable efforts, for any Oracle Linux program released from Oracle for a period of six months from the date the next release of the Oracle Linux program becomes generally available

High Availability Services – several open-source packages, including Corosync and Pacemaker, to provide the tools to achieve high availability for applications and services running on Oracle Linux.

Lifetime sustaining support - access to Oracle online support tools, upgrade rights, pre-existing fixes and assistance from technical support experts.

Oracle Linux Basic and Premier Subscription Pricing

Level	Price per year (in US\$)
Installable binaries and errata	Free
Basic Limited (24x7 unlimited support for up to 2 CPUs)	\$499
Basic (24x7 unlimited support for more than 2 CPUs)	\$1,199
Premier Limited 24x7 unlimited support for up to 2 CPUs	\$1,399
Premier⁴ 24x7 unlimited support for more than 2 CPUs	\$2,299

Customer Experiences

In preparation for our Total Value Analysis, Evaluator Group reviewed case histories of customers who had consolidated their Linux server environments to Oracle Linux. We found that they could reduce TCO by factors of 20 to 50%. Cost savings were realized in three main areas:

System Lifecycle management

Ksplice reduced total planned IT downtime by over 20% for one customer who manages 395 retail store locations with two servers per location. An airline was able preserve revenue by patching and updating their ticketing systems without any downtime and could continue operating without a reboot. They were able to automate patching for 1500 servers over a few nights – something that used to take months with seven hours of downtime.

Reduced Administration time

⁴ Included as part of Oracle's Premier Support for Systems

One customer reported sys admin time demands had dropped from 54 hours to 7 hours per cycle, and that patched or updated servers could continue to operate without requiring a reboot. Another reported a reduction of 35% in systems administration time per system.

Support

One customer saw a 50% reduction in their system support costs. Another cited saving \$100K in annual support costs and being able to implement a single portal for all Linux system user support. Another customer cited a reduction of 50% in time to resolution from opening a trouble ticket.

Next, to get a better understanding of actual user experience with both RHEL and Oracle Linux (OL), conducted in-depth interviews with OL customers from different vertical industry segments.

Healthcare Services

An organization delivering services to healthcare providers nationwide uses Oracle Linux to support their client services applications that are critical to everyday healthcare delivery—particularly so now with the stress placed on healthcare systems from COVID-19. The organization currently supports over 20,000 servers with an average of between 15-20 virtual machines per server and a future growth rate of between 10 and 15%. Prior to the migration of this environment to Oracle Linux, the organization was using RHEL but was looking for the most efficient way to host client software. Now the organization not only hosts these applications on Oracle Linux but has also moved DevOps services and specialized client solutions to this environment as well.

The client services applications are performance- and availability-sensitive, so they support these on the Oracle Linux UEK. This allows them to use InfiniBand (IB) connectivity between the server and storage environments. IB is fully tested and supported at the scale in use by this organization.

Regarding system availability and support, the organization has seen that Oracle has been quick to respond and resolve issues. They like the “all hands on deck” response they get with 7x24 support. In particular, clustering support is critical because they run client services applications in as close to a non-stop environment as possible. They also get support for large-scale, Gluster storage which they also need. In general, the sense they have is that Oracle has become a partner as opposed to a supplier. The size of the server environment coupled with their need for near non-stop operations made initial deployment challenging, but Oracle worked with them through the entire migration.

A major benefit derived from moving to Oracle Linux was a reduction in IT spend that positively impacted operating margins. However, the move also included implementation of a more automated operational environment. The organization was able to fully support healthcare clients under stress from the influx of COVID-19 patients. “We’ve stood up 1000s of servers over a weekend to support our healthcare clients. The work we did to automate totally paid off both in terms of security and time to service delivery. With automation, loyalty to a brand is becoming less important.”

Financial Services

We spoke to an Infrastructure Architect for a large financial services firm with responsibilities in the areas of Linux and containers. This customer was also managing “tens of thousands” of Oracle Linux instances in production, client, development, and quality assurance environments. All new installs are on Oracle Linux as they are focused on leveraging industry standards. Application stacks supported on Oracle Linux included those using Oracle, MySQL and Hbase. This customer migrated from RHEL and SUSE Linux to Oracle Linux and commented positively on Oracle’s support for the migration. 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

Consumer and Enterprise Software

We spoke to a large consumer and enterprise software provider with two large and several smaller data centers. The total server environment was 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.

The head of a group in charge of server updates and patches 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

A final interview with a large insurance carrier focused on Oracle support for Linux. This organization has an IT staff of 1,500. IT supports mainframe, Windows, and Oracle Database workloads in two data centers with disaster recovery capability. IT ported the RHEL-hosted applications to Oracle Linux and the environment grew to over 450 servers on Oracle Linux UEK. They reported encountering no issues when porting applications from RHEL to Oracle Linux. Since porting the Oracle applications to Oracle Linux with UEK, they have seen the following benefits:

- Both their Oracle Database and Veritas NetBackup workloads have seen 18% faster throughput
- The need to manually update ASM library modules was 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 Premier Support include:

- The additional licensing cost for RHEL clustering was eliminated because Oracle Clusterware is included at no additional charge with the Premier Support contract.
- The additional cost RHEL Satellite for management was 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 otherwise pay for.

From our interviews we see that:

- Oracle Linux is trusted in high-volume, transactional, mission critical production IT environments
- Oracle's Linux support is relied upon for applications that require continuous or near-continuous availability
- Application performance in general was enhanced as a result of the migration to Oracle Linux from RHEL
- Automation of processes that were previously done manually resulted in significant reductions in staff time devoted to these functions.

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.

Increased Security

We have noted that Ksplice enables live, non-disruptive patching for the kernel, hypervisor, and critical user space packages, detects attempts to exploit kernel vulnerabilities that have been patched in memory. Ksplice also proactively alerts an administrator if any compromised code tries to get executed

on a server. One customer was very specific regarding 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.

One Linux Strategy

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 housing 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. Many other components are included at no extra charge with Oracle Linux support options such as Virtualization, Docker, Kubernetes and Gluster storage.

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. For Oracle users developing hybrid cloud environments, we note that Linux is by far the leading OS choice and that Oracle Linux now supports Kubernetes for cloud-native application development. 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. Oracle is a platinum member of the Linux Foundation as well as

the Cloud Native Computing Foundation and Oracle Linux is supported on major public clouds such as AWS and Azure.

Therefore, switching 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 have spoken to directly 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 Engineered Systems and practice a “one Linux” strategy.

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