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Authors:
Ashish Nadkarni
Gary Chen

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Cloud Accelerates Linux Adoption

IDC OPINION

Cloud has become a crucial foundation for digital transformation (DX) initiatives and is shaping the IT strategy of enterprises today. Companies are extending their IT infrastructure into the cloud for running business-critical applications, developing new applications, and delivering new cloud-based services. Applications are the lifeblood of modern enterprises. They are the foundation on which businesses maintain their existing revenue streams while examining ways to create new ones. A sound application strategy is a must for firms to be successful in expanding their competitive differentiation in the digital economy. Operating systems (OSs) provide a common foundational layer that enables IT to run current and new generations of applications in traditional IT environments, on its own private cloud, and in public clouds and utilize a variety of computing options such as bare metal, virtualization, and containerization. The increased reliance of IT on the cloud has accelerated the adoption of open source operating systems, Linux being the chief among them. Over the past decade, Linux has evolved to be a versatile platform for current- and new-generation applications — a platform that can run in the cloud or on-premises and can include open source tools and frameworks used in modern application development.

Enterprise platform functionality and support have enabled commercial Linux to be the preferred operating system for enterprise wide application deployments in the cloud and on-premises. The key differentiators for Oracle Linux, a leading commercial Linux distribution, are:

- Binary-level feature parity with leading open source Linux distributions for flexible custom application development
- Packaged support for Oracle VM, Docker, and OpenStack for running applications inside virtual machines and in containers or bare metal on any hardware platform
- Unique capabilities such as zero-downtime patching with Ksplice and comprehensive tracing and diagnostics with DTrace
- Support for development tools and frameworks that enable enterprises to develop new-generation applications in the cloud and on-premises
- Commercial “single vendor” service and support for the entire stack all the way from the Linux platform to the business-critical applications deployed on it
- An extensive network of independent software and hardware vendors that certify their products on Linux
- Proven for running enterprise workloads in the cloud, powers the Oracle Cloud

The choice of a leading commercial distribution like Oracle Linux can make a big difference in the ability for IT to meet its service levels for all application tiers.

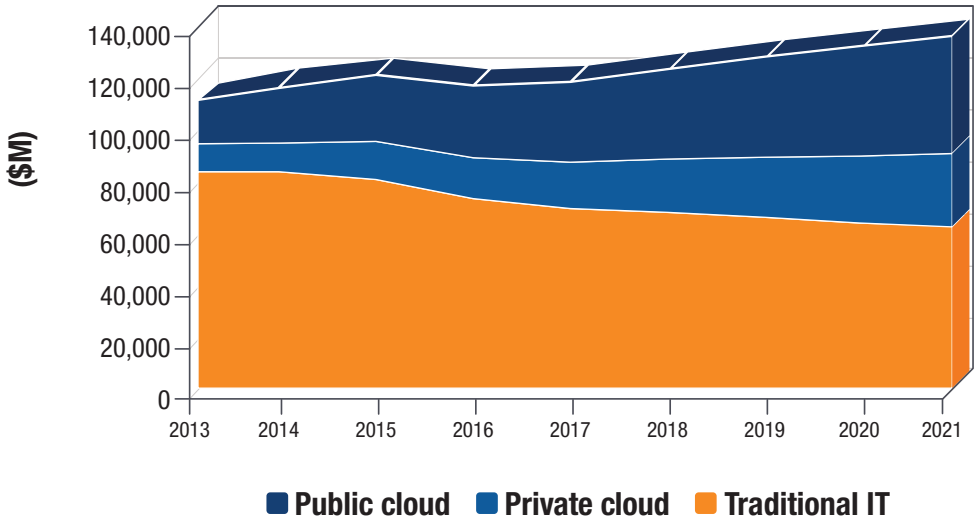
SITUATION OVERVIEW

Firms large and small have embarked, or are imminently embarking, on a digital transformation journey. DX is essential for survival, mostly because it enables the firm to compete in the digital economy. For existing firms, DX is a means by which they must disrupt themselves or be disrupted by newer entrant competitors that did not exist before. Applications are the lifeblood of modern enterprises. They are the foundation on which businesses maintain their existing revenue streams while examining ways to create new ones.

As Figure 1 illustrates, over the past few years, cloud has become a crucial component of IT strategies to:

- Use infrastructure, platform, and application cloud services to gain a level of elasticity and on-demand scalability that is the bedrock of all company wide DX initiatives
- Extend the IT infrastructure into the cloud for running business-critical applications and to develop and deliver new cloud-based services
- Support new-generation applications that are born in the cloud and designed to run natively in the cloud and increasingly use open source frameworks

FIGURE 1 Worldwide Cloud Infrastructure Revenue, 2013–2021: The Growth of Cloud



Note: Cloud revenue includes storage, compute, and networking.

Source: IDC, 2017

Cloud Accelerates Adoption of Linux

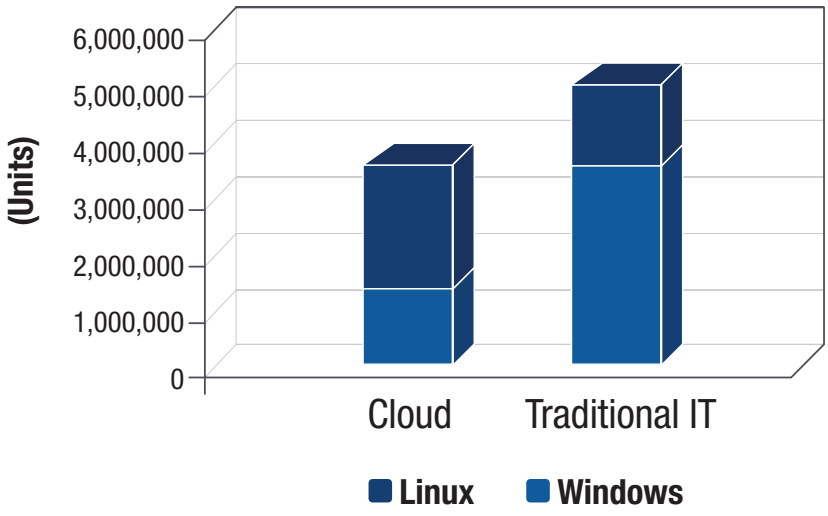
Operating systems provide a common foundational layer that enables IT to run current and new generations of business-critical applications in traditional IT environments, on its own private cloud, and in public clouds.

Open source–based and community-supported operating systems have enabled the adoption of development frameworks, automation and orchestration tools, and cloud frameworks, accelerating the shift toward (open source–based) clouds and applications that run on them. In other words, cloud has accelerated the adoption of open source operating systems, primarily Linux. Linux today is a de facto standard for enterprises and cloud builders alike:

- Native support for open source application development tools and frameworks and cloud frameworks like OpenStack makes Linux a preferred platform for building private and public infrastructure, platform, and application cloud services.
- Support for virtualization software like hypervisors, container hosts, and function as service, in addition to providing a platform-independent hardware abstraction layer, makes it easier to host current- and new-generation applications.

Figure 2 illustrates the traction that Linux has gained in the cloud, given the propensity by cloud builders and enterprises toward using open source tools and frameworks. Developers find Linux appealing for application development, while IT administrators find it to be a great choice as a common platform for the entire IT environment. Linux is deployed on bare metal to host applications, virtual machines (hypervisors), and containers (container engines).

FIGURE 2 Worldwide Server Shipments by Infrastructure Type and Operating System, 2016



Note: Server units include bare metal, virtualized, and containerized servers.

Source: IDC, 2017

Commercial Linux distributions are preferred by enterprises as those distributions fit into the service and support mold that enterprises are used to using with other commercial applications and infrastructure. In the past, Linux distributors claimed that proximity to the open source code base was a key differentiator of their commercial Linux distributions in the market. More recently, commercial Linux distributions have largely caught up with free distributions, thanks to the maturity of the Linux code base and kernel. Distributors are thus increasingly focusing on the versatility of their commercial Linux platforms to support both current- and new-generation business-critical applications, especially as the applications get replatformed, refactored, or repackaged to run natively on Linux.

Enterprise platform support has thus become a crucial focus area for Linux vendors, which have shifted their focus to cloud-based business-critical applications.

ORACLE LINUX — THE FOUNDATION FOR THE OPEN CLOUD

Oracle is a full-service Linux vendor. Figure 3 illustrates Oracle's approach to open source software that spans four key areas:

- Product development and updates for the entire stack
- Enterprise-grade support and consulting services
- Customer certifications, which include training and knowledge base development
- Independent software vendor (ISV) and IHV partner services for a wide variety of vendor platforms

FIGURE 3 Oracle is a Complete Full-Service Linux Vendor

Source: Oracle, 2018

As a core component of Oracle Infrastructure Software, Oracle Linux is a part of Oracle's vision for an open foundation for the cloud. Accordingly, Oracle Linux emphasizes the following value propositions:

- **Cloud-integrated and open platform.** Oracle Linux is first and foremost an open operating system. Oracle Linux is a full Linux stack and includes binary compatibility with leading commercial Linux distributions. In the true spirit of open source software, Oracle Linux is an operating system with no vendor or product lock-in. It also provides the widest choice of Linux deployment options, with support for major public clouds and x86 hardware platforms. Oracle Linux is supported as a guest operating system on **Oracle VM Server for x86**, which is built on the Xen Project hypervisor. It also comes bundled with **OpenStack** that makes it easier for IT to build an open private cloud. This provides maximum business flexibility, both contractually and architecturally. Oracle is also active in the Linux community and is one of the largest contributors to Linux.
- **Enterprise ready and cost effective.** Oracle Linux includes a choice of kernels — including the Unbreakable Enterprise Kernel (UEK), which applies decades of expertise from Oracle as a systems vendor. UEK is especially well suited for databases, middleware applications, and other workloads with stringent availability requirements. Tools such as Ksplice for zero-downtime patching and DTrace for comprehensive tracing and diagnostics add unique values to the UEK. Oracle Linux is also one of the most secure operating systems in the market today and comes bundled with kernel-level resiliency and encryption features not found in other Linux distributions. Oracle Linux is **cost effective** with no licensing cost and flexible support options — even more so when it is considered as a part of the overall solution that includes application licensing costs, virtualization, and cloud enablement. Oracle Linux Premier Support is included with Oracle Cloud Infrastructure (OCI) subscriptions at no additional cost, making it the most cost-effective operating system for Oracle Cloud.
- **Integrated operating system for Oracle Cloud Infrastructure.** Oracle Linux is integrated with Oracle Cloud Infrastructure, which, according to Oracle, provides the best platform experience for Oracle and non-Oracle applications alike. With Oracle Cloud Infrastructure subscriptions, Oracle Linux for Oracle Cloud Infrastructure offers access to complete and latest packages and updates for Oracle Linux, 24 x 7 expert Linux support, an extensive Linux knowledge base, Oracle Ksplice zero-downtime security updates, and the use of Oracle Enterprise Manager Cloud Control to manage and monitor Oracle Linux instances. In addition, IT buyers now have a single point of contact for cloud infrastructure, operating system, and Oracle software support. Oracle Linux becomes the logical choice as the OS for hybrid cloud deployments as customers can run the same OS environment in the cloud or on-premises.
- **Engineered for business-critical applications.** Oracle has been specifically engineered for business-critical workloads, on-premises and in the cloud. Oracle Linux is Oracle's primary platform for the company's own application portfolio and cloud initiatives. Furthermore, Oracle Linux benefits from the comprehensive testing, validation, and certification processes for third-party applications and support from a vendor that has years of experience supporting thousands of business-critical environments worldwide.
- **DevOps friendly.** Oracle Linux supports Docker and Kubernetes for cloud-native application development. Using Oracle VM and containers, it eliminates the need for porting and migration, whereas the use of Oracle OpenStack provides developers with access to an open standards–based feature set.

- **Extensively tested and used.** Oracle Linux is a proven, secure, and reliable platform that is already used extensively by tens of thousands of Oracle customers worldwide, and independent software vendors certify their software on Oracle Linux. Oracle's ISV catalog can be found at **www.oracle.com/linux/isvcatalog**. Oracle develops its vast set of enterprise applications on Oracle Linux, which also powers the Oracle Cloud with over 65 million active users and over 60 billion transactions in a given day.
- **Backed by a world-class support organization.** Oracle has a full engineering and support organization dedicated to Linux product development and maintenance. Oracle's development and support infrastructure parallels that of every commercial Linux vendor. Furthermore, Oracle's support organization fully understands Linux and the Oracle software portfolio for both on-premises and cloud. This simplifies support for customers that can call one source for support of their entire OS, middleware, and application stack. It provides IT organizations the peace of mind in having a vendor that can support stringent service levels for all application tiers and across hybrid cloud configurations.

Oracle VM

With over 85% of logical servers being virtualized, virtualization is considered the de facto mechanism to consume compute in the datacenter and public cloud today. Hypervisors continue to serve as the software-defined compute foundation, whether deployed in a traditional virtualization environment, private cloud, or public cloud or with containers. The reality for many operating systems is that either they are deployed on a hypervisor or they enable a hypervisor that is used to host virtual machines. Good virtualization support is therefore an essential feature of modern operating systems.

Oracle offers several virtualization solutions. The primary x86 virtualization solution is Oracle VM for x86, which is based on the open source Xen hypervisor. Linux plays a key role in Xen as the privileged OS used for management within the hypervisor, and Oracle VM leverages the UEK kernel. Being based on Xen, Oracle VM offers the expected features of a modern and mature hypervisor such as high performance, scalability, and availability; broad guest OS support; and live migration. Oracle VM, however, offers the following unique features:

- Free to download and use; customers pay only for support
- Oracle VM Templates, which are prebuilt templates that include the Oracle Linux operating system and Oracle software pre-installed to help rapidly deploy Oracle enterprise applications
- Compatible with OpenStack
- Integrated with Oracle OpenStack, which is included with Oracle Linux
- Certified for use with Oracle Linux and Oracle applications but also supports non-Oracle operating systems and applications
- Support for Oracle clustering technologies such as Clusterware and RAC for high availability
- Extensively tested by Oracle as a full stack, including the hypervisor, operating system, OpenStack, and applications to ensure performance and compatibility

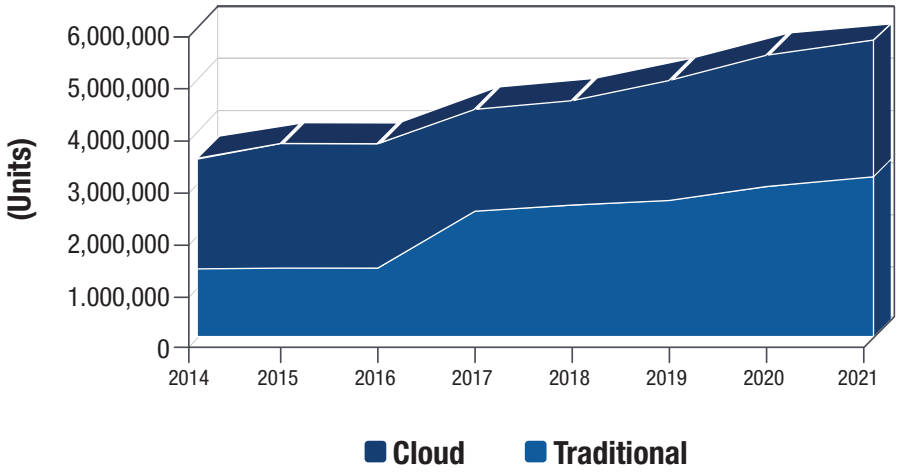
Oracle also supports the popular KVM hypervisor on Oracle Linux as an option, although it is not certified for Oracle applications.

Another very popular virtualization solution offered by Oracle is Oracle VM VirtualBox cross-platform virtualization software. It enables enterprises to run multiple operating systems on Mac, PC, Linux, and Oracle Solaris with secure remote access to server-hosted applications and desktops, all with affordable support and licensing terms.

OUTLOOK

Linux and Linux-based virtualization continue to show growth in the enterprise — for both on-premises and off-premises, cloud, and traditional IT deployments. Figure 4 shows the growth of Linux-based servers in the cloud.

FIGURE 4 Worldwide Linux Server Shipments by Infrastructure Type 2014–2021



Source: IDC, 2017

Linux, specifically commercial Linux, will continue to gain strategic importance as a "cloud platform" as firms embark on a multipronged business transformation strategy to remain competitive in the digital economy. This includes:

- Deployment of various public and private clouds — for both general-purpose and industry-specific use
- Existing application modernization initiatives that require replatforming, refactoring, or repackaging to run natively on Linux
- New development efforts as a part of a bigger effort to embrace the Internet of Things (IoT), information technology (IT), operational technology (OT), and communications technology (CT) convergence and embrace newer ways to examine customer engagement and retention

Linux is a preferred platform for modern application delivery, regardless of whether it is deployed in a bare metal, virtualized, or containerized environment; in the public or private cloud; or in a traditional IT infrastructure.

A strong Linux supplier is one that supports a modern digital business stack and commercial and open source platforms, all the way from the operating system to the application layer. It is a vendor that not only understands the nuances of application development and delivery but also can provide a single-stop shop for IT administrators and developers alike.

Advice for the Technology Buyer

The transformation of a firm's application portfolio is disruptive to the entire firm. Nowhere is the impact of disruption felt more than on IT. From a technology perspective, companywide DX initiatives mean investments in new infrastructure platforms. Organizationally, it is the ability to support new technologies while changing how they interact with customers including line-of-business application owners and developers.

Firms must constantly evolve their IT infrastructure strategy to be successful at expanding their competitive differentiation in the digital economy, and operating systems form a core component of such a strategy. Along with their applications portfolio, their IT infrastructure platform mix must be constantly infused with new-generation components that are cloud first and are increasingly infrastructure platform independent. Here the role played by the operating system in supporting the application stack is crucial.

IT organizations should also ensure that their stakeholders have an easy path to the cloud and that their on-premises environment is easily supported in the cloud. Here they need to ensure that their OS vendor is focused on enterprise-grade workloads in the cloud, with security as the underpinning of this support model.

The more versatile and open the operating environment, the better equipped IT is to support the firm's application portfolio and for the firm to take on the digital economy.

CHALLENGES/OPPORTUNITIES FOR ORACLE

A challenge for Oracle, given its reputation as a provider of industry-leading applications and data management solutions, is to continue to lead in the market for operating systems, virtualization, and cloud frameworks with commercialized open source variants.

Oracle Linux has gained and continues to gain traction with its existing base of customers that have Oracle databases, applications, hardware platforms, or engineered systems in their environment. For such customers, embracing Oracle Linux and Oracle VM is an extension of their strategy to have the best-of-breed "Oracle on Oracle" stack.

Outside of this base is where Oracle has the greatest opportunity to effectively compete in the market on the merits of its Linux and virtualization platforms. Other commercial open source stack vendors cannot match the global presence of Oracle in terms of sales and support and its expertise in managing the full stack, giving Oracle the leg up in this journey.

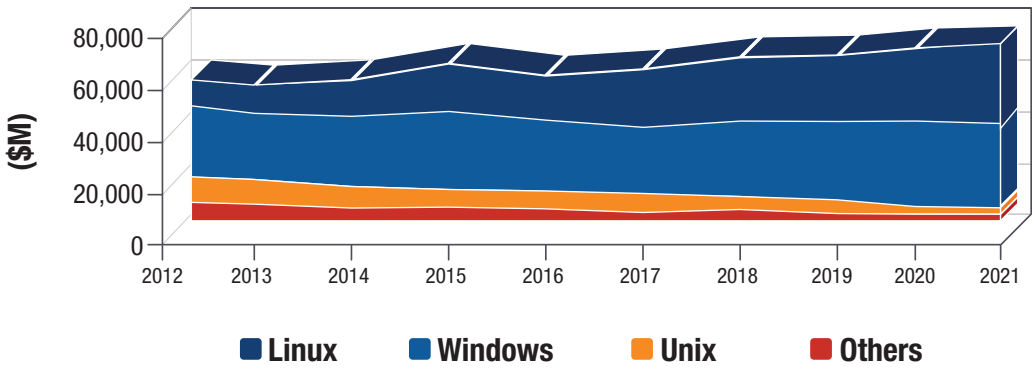
Oracle Linux also presents a large opportunity for Oracle to get its customers to adopt Oracle Cloud Infrastructure with Oracle Linux as the preferred Linux choice for their apps as

it continues to integrate with OCI, enhance the Oracle Linux experience on OCI, and provide Oracle Linux platform tools for OCI customers that choose Oracle Linux, for which there is no additional cost for support. This puts Oracle at a competitive edge over other cloud services providers for Linux platform users and from a cost-effectiveness perspective.

Figures 5 and 6 show the revenue opportunity associated with Linux operating systems, using shipments of servers worldwide. Figure 7 shows the revenue opportunity with commercial Linux license shipments worldwide.

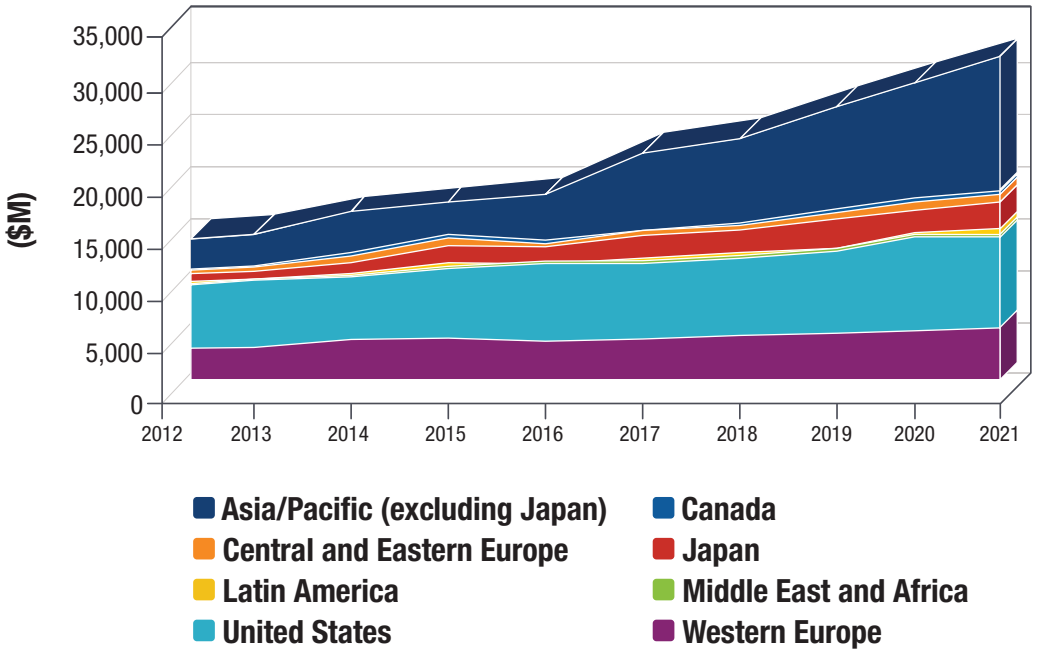
IDC recommends that Oracle partner with its clients to assist them on their DX journey. Furthermore, Oracle can enable its customers to seamlessly mobilize their applications in and out of the public cloud by using Linux and the Oracle VM solution as a common platform in the cloud and on-premises.

FIGURE 5 Worldwide Server Value of Shipments by Operating System 2012–2021



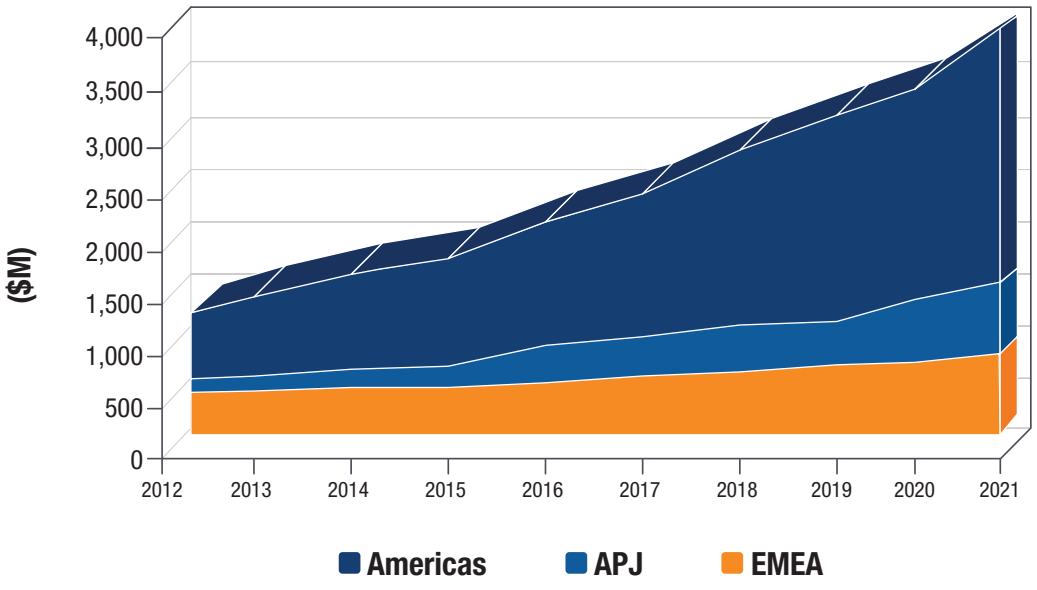
Source: IDC, 2017

FIGURE 6 Worldwide Linux Server Value of Shipments by Region 2012–2021



Source: IDC, 2017

FIGURE 7 Worldwide License Revenue of Commercial Linux Operating Systems by Region, 2012–2021



Source: IDC, 2017

CONCLUSION

IDC believes that vendors like Oracle are in a good position to meet the stringent demands of their customers. Given the trend by most enterprises toward open source–based application stacks, vendors that are truly committed to open source communities and ecosystems (such as Linux) will be the ones that survive.

Enterprise platform functionality and support have enabled commercial Linux to be the preferred operating system for enterprisewide application deployments in the public cloud and on-premises.

The key differentiators for Oracle Linux, a leading commercial Linux distribution, are:

- Binary-level feature parity with leading open source Linux distributions for flexible custom application development
- Packaged support for Oracle VM, Docker, and OpenStack for running applications inside virtual machines and in containers or bare metal on any hardware platform
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- An extensive network of independent software and hardware vendors that certify their products on Linux
- Proven for running enterprise workloads in the cloud, powers the Oracle Cloud

Cloud will continue to accelerate Linux adoption. Vendors that fail to make their Linux distributions cloud-friendly may be forced to seek alternative strategies. This could lead to further consolidation in the market.

IDC Global Headquarters

5 Speen Street
Framingham, MA 01701
USA
508.872.8200
Twitter: @IDC
idc-community.com
www.idc.com

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