

WHITEPAPER

RED HAT ENTERPRISE LINUX – THE ORIGINAL CLOUD OPERATING SYSTEM

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Linux is twice as popular as Windows on Amazon Web Services. It was running on 67 percent of machines, compared to Windows' 33 percent

*Cloud Radar Report:
Linux vs. Windows on AWS
Cloud, Cameron Peron,
Newvem, October 25, 2012*

EXECUTIVE SUMMARY

The operating system (OS), which runs applications on top of physical infrastructure, has served as the foundation of traditional IT for decades. The OS has since emerged as the cornerstone for new technology innovation, transforming enterprise IT with robust applications that deliver a more personalized experience, are available from a wide variety of devices, and are accessed by more users around the world.

Despite the innovation it is driving now, the OS has had a tough recent history. Over the past five years, naysayers have touted the demise of the OS. Many believed that a distinct OS would soon become totally irrelevant, and not needed for any use case. A blog posting titled "The Cloud Will Kill the OS" lays out the rationale behind this prediction, "the OS is the main monolith that the cloud will eventually break up into multiple discrete units of functionality."¹

It is safe to say this prediction has not materialized, and Linux continues to gain market share at a double-digit rate² Linux adoption is growing against a number of measures, such as the number of supercomputers that run Linux and the size of the contributing development community³. Linux is the original cloud OS. Its popularity as a cloud architecture remains high, and we expect it to continue to be the cloud OS. Linux, unlike competing OSes, was designed and built using the Internet, making it a natural fit for cloud.



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¹ The Cloud Will Kill the OS: a Syllabus, by Jon Stokes, Wired, November 11, 2011. <http://www.wired.com/insights/2011/11/the-cloud-will-kill-the-os/>

² Linux Leads Server Growth, by David Nagel, Campus Technology, June 5, 2012. <http://campustechnology.com/articles/2012/06/05/linux-based-systems-lead-server-growth.aspx>

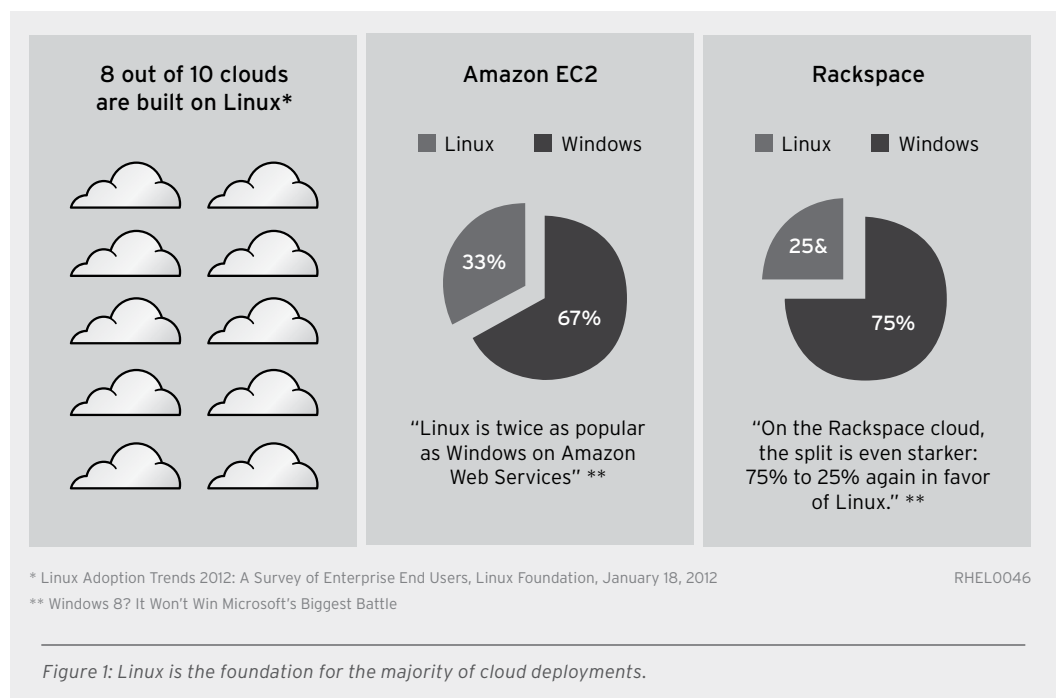
³ Linux Then and Now, The Linux Foundation, <http://content.linuxfoundation.org/20th/images/linuxthenandnowinfographic.jpg>

Red Hat® Enterprise Linux® powers many of the world's largest clouds – including clouds mounted by Amazon.com, Fujitsu, IBM, NTT Communications, salesforce.com, and Telstra.

LINUX LEADS IN CLOUD DEPLOYMENTS

Today, Linux is the primary platform for a majority of cloud-based applications. In its 2012 adoption trends survey, the Linux Foundation found that 66% of clouds are built on Linux.⁴ As a case in point, an October 2012, Wired magazine cited a report by Newvem which illustrated Linux's dominant position on Amazon Web Services:

At Wired's request, Newvem – a company that sells management services to Amazon cloud customers – took a look at about 41,000 cloud machines run by several hundred customers. Its conclusion: Linux is twice as popular as Windows on Amazon Web Services. It was running on 67 percent of machines, compared to Windows' 33 percent.⁵



With Linux as the go-to OS for many cloud users, we are also seeing workloads migrate to Linux for public, private, and hybrid clouds because of efficiency and flexibility of deployment. Companies at the cutting edge of cloud computing and the Internet are choosing Linux and open source, and often choose Red Hat Enterprise Linux. In fact, Red Hat® Enterprise Linux® powers many of the world's largest clouds – including clouds mounted by Amazon.com, Fujitsu, IBM, NTT Communications, salesforce.com, and Telstra.

⁴ Linux Adoption Trends 2012: A Closer Look, by Amanda McPherson, The Linux Foundation, January 19, 2012. <http://www.linuxfoundation.org/news-media/blogs/browse/2012/01/linux-adoption-trends-2012-closer-look>

⁵ Windows 8? It Won't Win Microsoft's Biggest Battle, by Robert McMillan, Wired, October 25, 2012. <http://www.wired.com/wiredenterprise/2012/10/epic-microsoft-windows-fight/>.

But why? Let's explore this by considering some of the attributes that are important in the cloud according to the U.S. National Institute of Standards and Technology.⁶ They are summarized in Table 1:

TABLE 1. U.S. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY CLOUD COMPUTING ATTRIBUTES

ESSENTIAL CHARACTERISTICS	SERVICE MODELS	DEPLOYMENT MODELS
On-demand self-service	Software-as-a-Service (SaaS)	Private cloud
Broad network access	Platform-as-a-Service (Paas)	Community cloud
Resource pooling	Infrastructure-as-a-Service (IaaS)	Public cloud
Rapid elasticity		Hybrid cloud
Measured service		

David Nielsen, founder of IBM's CloudCamp lists a similar set of fundamental attributes: on-demand, self-service, scalable, and measurable, or OSSM.⁷ Red Hat believes that additional attributes are equally important: portability, consistency, application readiness, and flexibility protected by commitment to open standards.

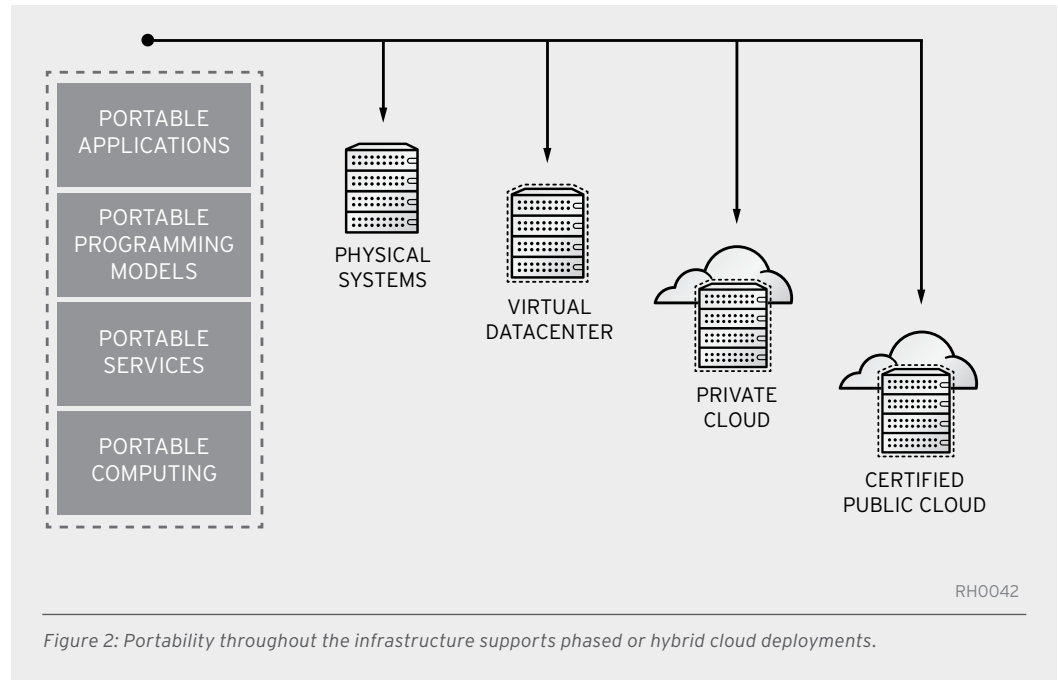
With the strength of Linux in the datacenter and its dominance as a cloud OS, Red Hat Enterprise Linux has emerged as a natural and leading choice. Why? Because in order to ensure that the underpinnings which made Red Hat Enterprise Linux so strong in the datacenter (that is, support for standards, consistency, and portability are not the only necessary traits – a company like Red Hat must also facilitate the process of open development and carefully anticipate the trends and needs of customer, partner, and contributor communities.

RED HAT ENTERPRISE LINUX IS PORTABLE

The cloud's potential for transformation is built on the premise that users, developers, and managers of applications have complete freedom to move, expand, replicate, and decommission those applications. The ability to run applications on any cloud or move across multiple cloud infrastructures requires more than just a set of offerings that fits each category of cloud-public, hosted, and private.

⁶ The NIST Definition of Cloud Computing, csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf

⁷ Podcast, <http://www.ibm.com/developerworks/podcast/dwi/feature040611-dnielsen.html>



OS portability requires:

- architectural support that transcends hardware
- long and stable life cycle
- deployment flexibility

Portability of the operating system requires many things:

1. Architectural support that transcends specific hardware vendors
2. A commitment to maintaining stability during a long product life cycle- stability for the application binary interface (ABI), and for the application programming interface (API)
3. Deployment flexibility that lets you provision an application instance on a physical server for development and testing, and easily move the instance to a virtual datacenter or even a public cloud

When Linux was born in 1991⁸, it never aspired to achieve portability. Ultimately however, Linux did exactly that, and the resulting portability drove Linux to grow and expand, predominantly based upon the adoption of industry standard x86 architectures. Red Hat Enterprise Linux embraced this portability and has been delivering applications in a range of environments and configurations for more than five years.⁹ Red Hat Enterprise Linux has been helping applications consume compute, storage, and network resources using a broad range of virtualization solutions and cloud services from many vendors, and is committed to further stability with a year life cycle.¹⁰

⁸ Linus Torvald's Original Announcement on Usenet, <http://www.learnlinux.ie/content/linux-torvalds-original-announcement-usenet>

⁹ Red Hat Infrastructure Strategy Spans Virtualized, Cloud and Appliance Deployments, November 7th, 2007. <http://www.redhat.com/about/news/press-archive/2007/11/virtualized-cloud-appliance-deployments>

¹⁰ Red Hat Enterprise Linux: Stability Drives Demand for More Flexibility in Long-term Operating System Deployments, January 31, 2012. <http://www.redhat.com/about/news/press-archive/2012/1/red-hat-enterprise-linux-stability-drives-demand-for-more-flexibility-in-long-term-operating-system-deployments>

“Once enterprises deploy Linux, they stick with Linux and plan to add more Linux, because the platform provides sustainable benefits that include a broad feature set, security, cost-savings and flexibility.

THE LINUX FOUNDATION, LINUX
ADOPTION TRENDS 2012: A SURVEY OF
ENTERPRISE END USERS

RED HAT ENTERPRISE LINUX IS CONSISTENT

Portability is further enabled by consistency. The ability to deploy applications and web services any where (and everywhere) across cloud resources is contingent on a target operating system and platform that creates consistent underlying infrastructure. For example, Just ask the ISVs that create the applications customers use, and they will validate the design goal of having a single target that works across all cloud environments. A single, well-known deployment environment makes application development faster, and eliminates the extra development, testing, and maintenance associated with porting.

Because Red Hat Enterprise Linux operates consistently no matter where it is deployed, the portability of applications into a cloud environment is straightforward because a consistent target operating system exists.

RED HAT ENTERPRISE LINUX IS A PLATFORM FOR APPLICATIONS

A prominent role of the OS is to provide an application platform and runtime environment. This requires libraries, APIs, and runtime components for applications. This role doesn't go away in the cloud or in Platform-as-a-Service (PaaS) models where the operating systems are part of the underlying foundation.

Specifically with OpenShift, Red Hat's PaaS offering, Red Hat Enterprise Linux serves as the underlying operating system. In the application platform for the cloud, the operating system and its associated tools and components are critical. Figure 3 illustrates the dependencies cloud applications have on the OS.

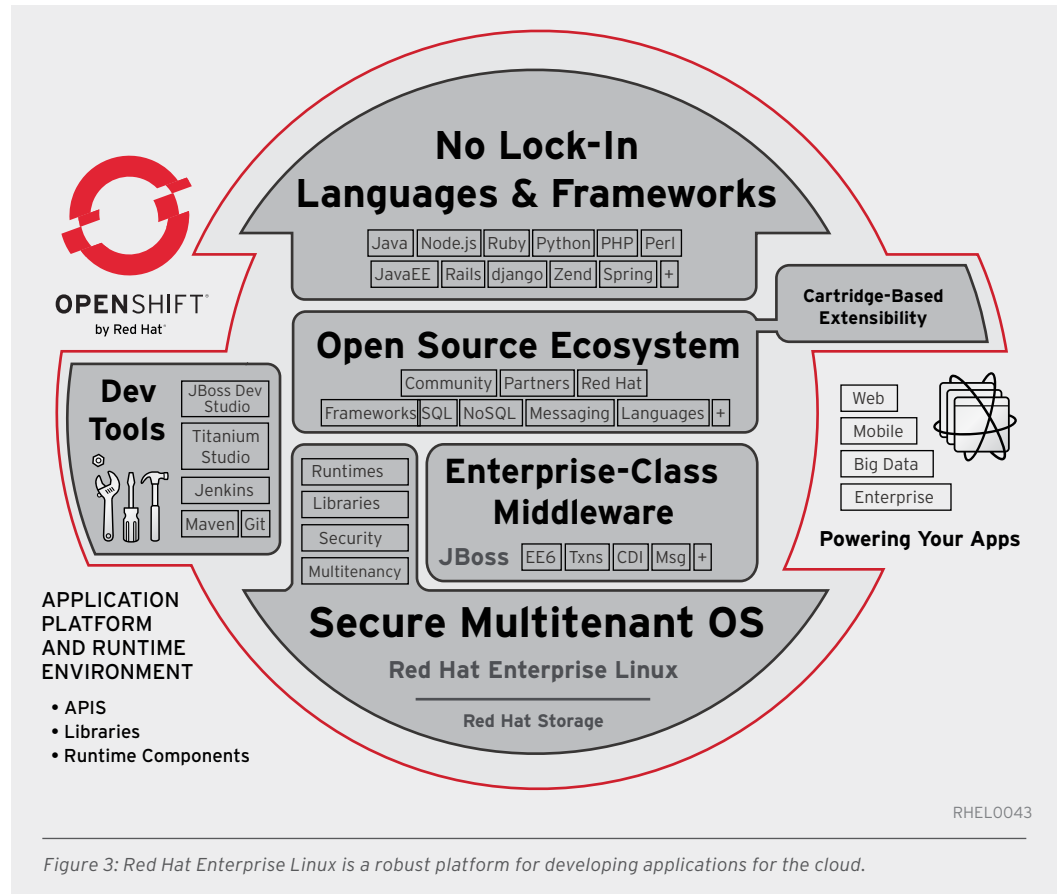


Figure 3: Red Hat Enterprise Linux is a robust platform for developing applications for the cloud.

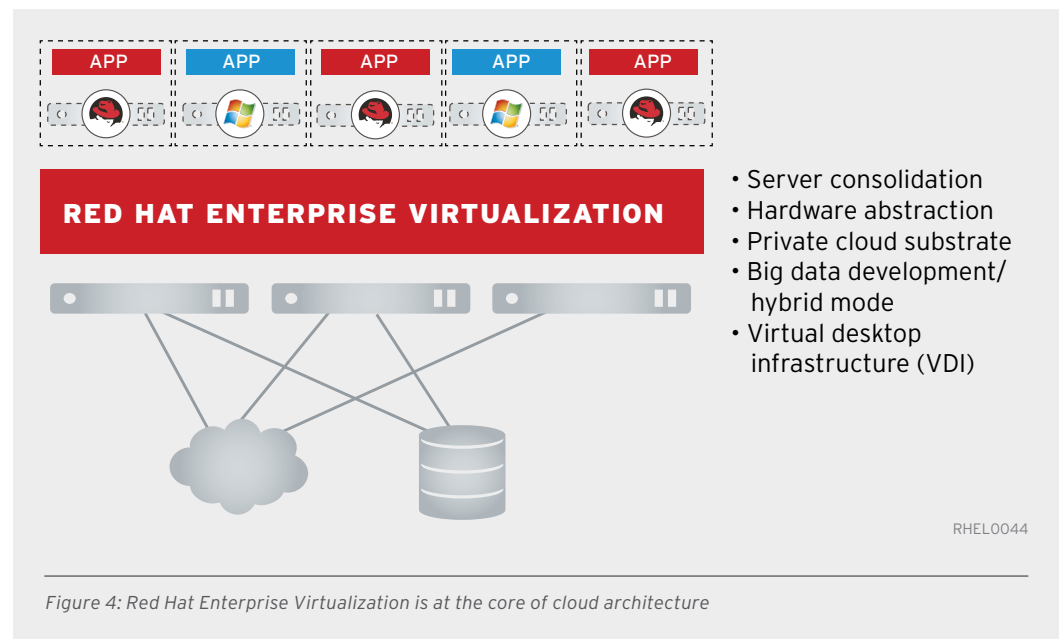
YOU CAN AUTOMATE RED HAT ENTERPRISE LINUX TO SCALE

Cloud-scale deployments require automation, which can mean many different things. In the context of the operating system, this means having automation tools and utilities applied to provisioning, deployment, and management tasks. Automation allows cloud-scale deployments to be built and managed with efficiency.

Automated tasks for servers are often tackled through the use of shell scripts, APIs, and access to a command-line interface (CLI). Red Hat Enterprise Linux has had scripting and shell capabilities from the beginning, as well as a powerful CLI that can be used for remote management. These tools and capabilities have always been an advantage for Linux. They helped make Red Hat Enterprise Linux the default platform for some of the most demanding scale-out and large-scale, mission critical applications. This capability for automation has also made Red Hat Enterprise Linux a popular choice for cloud deployments.

YOU CAN VIRTUALIZE RED HAT ENTERPRISE LINUX AND POOL RESOURCES

Virtualization is the technology underpinning of any cloud, and gets to the heart of how resources are managed on the underlying physical infrastructure. When it comes to hypervisors, Kernel-based Virtual Machine (KVM) is leading the industry in terms of performance, scalability, and hardware support. KVM is part of Red Hat Enterprise Linux, backed by hundreds of companies in the Open Virtualization Alliance, and is the foundation of Red Hat Enterprise Virtualization.



RED HAT ENTERPRISE LINUX IS OPEN SOURCE AND STANDARDS-BASED

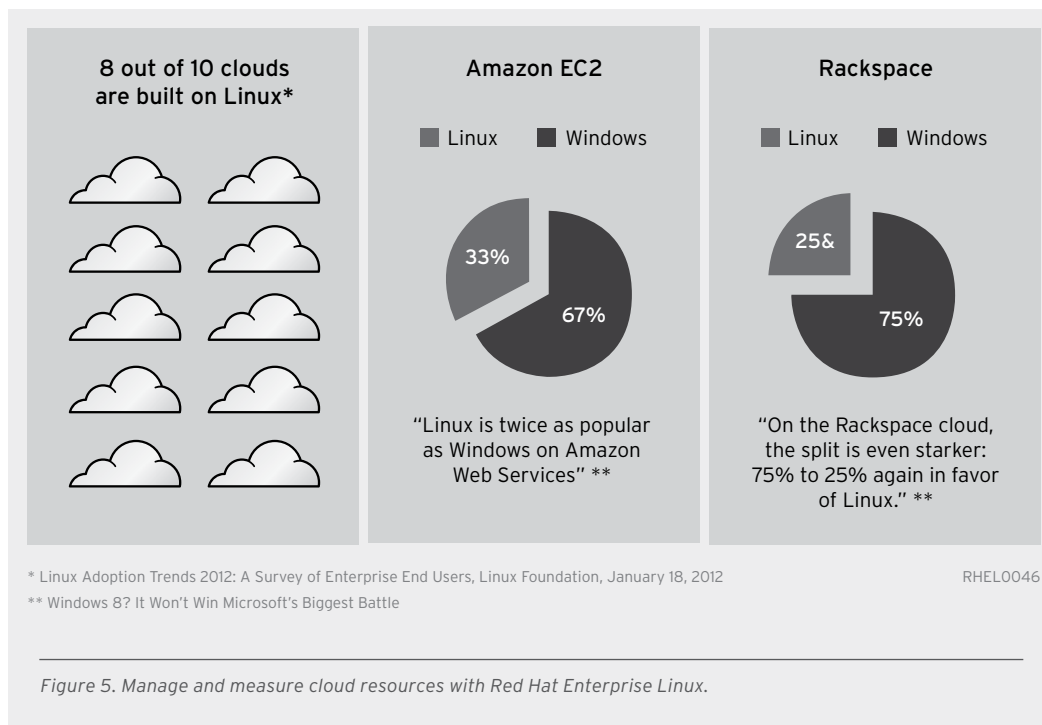
The OS for the open hybrid cloud should be ubiquitous. Multiple examples exist across disciplines that the best ideas are not built by one or few, but by many. Linux is the strongest proof that the open source model works, and has resulted in many of the world's most useful and innovative projects such as Apache Web Server, JBoss Application Server, and others.

We see the cloud also moving in this direction. OpenStack – a technology consortium that includes multiple, standards-based, public and private cloud infrastructure projects from a community that includes organizations like Rackspace, NASA, IBM, HP, and Red Hat – is quickly gaining support. Activity associated with OpenStack increased between 15 and 35 percent percent for commits, file touches, repos, and committers in the second half of 2012 alone.¹¹

Linux and Red Hat Enterprise Linux have been open from the very beginning. This starts with the Linux kernel. Red Hat is the leading corporate contributor to the Linux kernel, as of April 2012.¹² The openness continues with hundreds of independent upstream projects like GCC, Python, LVM, KVM, GNOME, IPtables, SELinux, and disciplined and innovative efforts inside of Fedora. These contributions are driven by active communities involving hundreds of thousands of individuals and entities whose ultimate mission is to deliver better technology. Through this transparent and open development model, and by embracing open standards, a flexible and interoperable platform was born.

¹¹ How the new release of OpenStack was built, Bitergia's blog, September 27, 2012. <http://blog.bitergia.com/2012/09/27/how-the-new-release-of-openstack-was-built/#more-183>

¹² Who Writes Linux, The Linux Foundation, by Jonathan Corbet, Greg Kroah-Hartman, and Amanda McPherson, March 2012. go.linuxfoundation.org/who-writes-linux-2012



YOU CAN MANAGE AND MEASURE YOUR RESOURCES WITH RED HAT ENTERPRISE LINUX

In cloud environments, shared services are provided to customers who can be internal, external, or both—depending on whether the cloud is private, public, or hybrid. Because of this flexibility, measurement and metering are critical.

Successfully managing resource pools that exist in cloud infrastructure depends on the ability to isolate, control, and measure these resources at a granular level. Red Hat Enterprise Linux includes several tools that accomplish this. Control groups (cgroups) and Linux Containers (LXC) provide the foundation for resource monitoring and reporting, which allows billing and chargebacks for service consumers.

Cgroups allocates various system resources like CPU, memory, and network I/O (or a combination of these resources) to the many processes running on a system. With cgroups, the system administrator can monitor, configure, and dynamically adjust resources on a running system.

LXC is a lightweight, low-footprint virtualization technology currently available as a preview feature within Red Hat Enterprise Linux. With LXC, system administrators can take advantage of Linux process management with the added benefit of process isolation. This isolation allows administrators to share file system hierarchies between containers, and can secure isolated processes. Linux Containers provide a compelling architectural building block for multi-tenant cloud infrastructure.

RED HAT ENTERPRISE LINUX IS FLEXIBLE AND CUSTOMIZABLE

Cloud providers are building highly complex, next generation services and often require source code access as well as the ability to modify the base code to their highly specific needs. Linux has gained traction among cloud providers because of its ability to be customized in this way.

Additionally, cloud architects require a deep set of capabilities that can build flexibility into the platform. Specifically, these architects require multi-tenancy and security for the applications. Features like SELinux and Linux containers are great examples of flexible capabilities that empower the architect. Platform offerings like OpenShift run in a multi-tenant model, not only at the hypervisor level but also at the OS level. This provides tremendous benefit, from portable security for applications to improved operational efficiency. This ultimately lowers the costs for Red Hat Enterprise Linux-based cloud infrastructure.

CONCLUSION

At the end of the day, the operating system is a critical component of cloud infrastructure. And in the cloud, the operating system of choice is often Linux. It's easy to understand why: Red Hat Enterprise Linux is an extremely compelling platform for cloud. It offers a consistent, stable, flexible environment in both physical and virtualized deployments, whether they're on-premise, hosted or in hybrid environments. This offers customers choice, a unique freedom rooted in the transparent, collaborative nature of the Red Hat development model and its commitment to open source and open standards.

Successful cloud deployments require long-term choice and flexibility. We believe that is what positions Linux – specifically Red Hat Enterprise Linux – as the cloud operating system today – and well into the future.

WHITEPAPER Red Hat Enterprise Linux – the original cloud operating system



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ABOUT RED HAT

Red Hat is the world's leading provider of open source solutions, using a community-powered approach to provide reliable and high-performing cloud, virtualization, storage, Linux, and middleware technologies. Red Hat also offers award-winning support, training, and consulting services. Red Hat is an S&P company with more than 70 offices spanning the globe, empowering its customers' businesses.

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