WHITE PAPER

Red Hat Enterprise Virtualization

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IDC OPINION

With virtual machine (VM) deployments already exceeding physical server shipments and virtualized workloads exceeding nonvirtualized workloads in the installed base, virtual is clearly the new normal in IT. As mature as the virtualization market already is, the competition is actually just about to heat up. IDC data shows that a significant portion of the market is open to using a combination of hypervisors for various factors of cost and diversity. IDC expects that over the next one to two years, several vendors will release major new versions of their virtualization products that will vastly boost their competitiveness.

One such product is Red Hat Enterprise Virtualization (RHEV), a commercial package of the open source KVM hypervisor and the open source oVirt management tools. Red Hat is a key leader in Linux and open source, and its history of successfully commercializing open source bodes well for KVM and oVirt. With customers over the next few years keeping a careful eye on virtualization alternatives, RHEV is poised to be an important and open platform.

SITUATION OVERVIEW

Server virtualization has grown into a mainstream technology in a very short time. The initial "1.0" era of server virtualization, around 2005, revolved primarily around test and development workloads as basic technology issues related to performance, reliability, and compatibility were being worked out. Fast-forward three years to 2008, the "2.0" era, where production usage began to become the focus. The industry had solved many of the fundamental technology issues around the hypervisor, and people had begun to trust virtualization for increasingly critical production workloads. In addition, VM mobility, the ability to move virtual machines on the fly, was introduced and began to shape the vision of the dynamic datacenter. These two initial eras of server virtualization primarily focused on the capex benefits of consolidation, hardware savings, power and cooling, and real estate.

Today, the industry has moved on to the third era of virtualization, the "3.0" or cloud era. The goal is to take virtualized servers as the foundation of a larger virtualization initiative (across the entire datacenter) and leverage the instantaneous nature of virtualization to create agile higher-level services that can be provisioned quickly and billed on a granular level. The drivers for the virtualization 3.0 era shift from capex to opex, focusing on availability, manageability, flexibility, and agility. Using cloud computing requires a holistic approach to virtualization, encompassing all datacenter areas including storage, networking, and security, as virtualization affects every datacenter decision.

Few technologies have seen a ramp in enterprise IT like virtualization. According to IDC's latest data:

☑ There are already more virtual workloads than physical workloads. The end of 2010 was the crossover point where virtual overtook physical. By the end of 2013, more than two-thirds of all workloads will be virtual.

☑ 75% of virtualization customers have a "virtualization first" policy for new workloads.

While the success of virtualization is undeniable, the virtualization market is largely ruled by one vendor that was first to market and had a technology advantage thanks to that early-mover status. Many competitors were late to market and needed time to mature their technology.

The Rise of Multihypervisor Deployments

IDC data shows that as far back as 2008, customers have been receptive to adopting a second hypervisor, with approximately one-quarter to one-third of customers in a given year indicating that they plan to use a combination of hypervisors. IDC sees several factors priming the market to be more competitive and diverse over the next few years:

☑ **Lower pricing.** Competitors are offering lower prices with competitive feature sets to tempt customers. While initially the products simply weren't up to par, regardless of price, alternatives have already reached "good enough" status. While the bleeding edge of the market tends to look at best of breed, the mainstream of enterprise IT looks for "good enough" solutions at the best value point. With the ever-increasing cost pressures on IT, eventually many customers will no longer be able to ignore the potential for considerable cost savings.

☑ **Fears of overreliance on a single vendor.** Customers regularly look at their mix of vendors, and there is often concern when a single vendor dominates a certain area of IT. Overreliance on a vendor can worry customers when it comes to contract negotiation and getting the most competitive pricing. In addition, it can have technical consequences due to lock-in issues and the dangers of running a homogeneous environment, such as security (though there are benefits to homogeneity as well). While too much diversity can also be problematic, customers need to find the right blend to manage risk and complexity.

☑ **Improving competitor solutions.** While virtualization is already a mature technology, in some sense, the virtualization wars have only just begun. Major releases of virtualization software from several vendors in the space recently have changed the dynamics of the virtualization market. These solutions are much improved, highly competitive, and enterprise ready.

☑ **Better multihypervisor management solutions.** In recent years, management software capable of managing multiple hypervisors has become more readily available and capable. This can help resolve the complexity of managing heterogeneous environments and prevent siloing. In addition, the rise of private cloud has led to the emergence of cloud system software, which can provide abstraction across multiple hypervisors to create a cloud system.

- ☑ **Inevitability of multiple hypervisors.** Many forward-thinking customers are already preparing for a multihypervisor world, realizing that a second hypervisor may be thrust upon them in certain scenarios. A second hypervisor could come from a merger or an acquisition, divergent units in the same company, or a hybrid cloud scenario where the provider is running a different platform.

KVM BACKGROUND

KVM is the latest hypervisor to be introduced into the market. It is an open source project that allows Linux to become a virtualization host. Being open source has many implications and benefits, such as:

- ☑ As a community project, it is not under the control of a single vendor, and customers themselves can participate in and help determine the future of the platform. With KVM, not only the hypervisor but also, very importantly, the management tools (such as oVirt) are open source.

- ☑ Open source software can mature very quickly if a large community forms and contributes resources. KVM, being part of Linux, can tap into one of the largest open source projects and has already shown remarkable maturation.

- ☑ Open source software offers many consumption models to customers. Some will take the raw open source code and deploy it, modify it, and support it themselves. Others will want a commercially tested and supported version, and the open nature of open source software means that any vendor can offer it commercially, which leads to customers being able to source from multiple vendors to reduce their risk.

KVM is a loadable kernel module within the Linux kernel that allows the Linux operating system to function as a Type 1 bare metal hypervisor. A hypervisor can be thought of in many ways as a very specialized operating system (OS) designed to run VMs instead of arbitrary applications. Other than the virtualization aspect, the rest of a hypervisor deals with standard OS tasks such as managing memory, scheduling processes, handling drivers, doing I/O, etc. The KVM module implements within Linux the essential capabilities to do the magic that allows virtual machines to function, but it adopts the philosophy of not reinventing the wheel and uses the established and proven Linux OS functions for the rest. By not having to rewrite basic functions, developers can focus their efforts on optimizing Linux for VM processes — not replicating those functions within the hypervisor code stack. The integration of KVM into the Linux kernel and the resulting architecture has many implications:

- ☑ KVM is now an integral part of Linux and will eventually become part of all Linux distributions once those distributions pick up the later version of the kernel. In reality, today, most Linux distributions are on kernel versions newer than 2.6.20 and therefore have KVM capabilities — regardless of whether KVM is formally supported in the commercialized versions or not. The integral connection with Linux brings long-term viability and support from multiple vendors.

☑ KVM is able to leverage the entire Linux development community as any improvements to Linux in general also benefit KVM. It also means that Linux developers can now presume that KVM is available to be utilized.

☑ KVM revs with the Linux kernel and does not have any easily determinable version of its own. Commercial Linux vendors, though, may attach their own version numbers to their KVM releases.

☑ KVM inherits the drivers and broad hardware compatibility of Linux, allowing it to run nearly anywhere Linux for x86 runs, and no unique effort is required to produce new drivers specifically for KVM. While KVM was originally developed for x86, ports are in progress for other architectures.

RED HAT ENTERPRISE VIRTUALIZATION (RHEV) 3.1

Red Hat, a leading Linux provider, has been a central figure in fostering the development of KVM and has brought a commercial version to market with RHEV. With Red Hat's influence with Linux and open source and its long history of successfully commercializing many open source projects, KVM is rapidly building steam as an open virtualization platform.

The Hypervisor: RHEV-H

RHEV is Red Hat's commercial, enterprise implementation of the KVM hypervisor and management tools. The hypervisor portion is available in two different forms:

☑ **As part of Red Hat Enterprise Linux (RHEL).** This full Linux OS is Red Hat's flagship product. KVM is integrated into Linux as previously discussed, and RHEL features the complete Linux kernel, tools, and applications typical of a full Linux distribution. KVM first became available in RHEL 5.4 and is a major component of the current RHEL 6. The full RHEL deployment model is generally chosen if customers want to access the full Linux OS for some reason, say for agent compatibility.

☑ **Standalone, as Red Hat Enterprise Virtualization Hypervisor (RHEV-H).** RHEV-H is a subset of RHEL, including only the necessary components required to run KVM. It strips out unnecessary items, such as some kernel drivers, tools, and applications that aren't relevant to KVM, to reduce the overall distribution size and also the attack surface for greater security. It runs off a read-only file system, ensuring that the system always boots secure, unmodified code. It also supports PXE, USB, and hard drive booting.

Linux integration brings enterprise-grade features, including SELinux and sVirt security, memory overcommitment through Kernel SamePage Merging (KSM), NUMA support, and other technologies. Red Hat Enterprise Virtualization shares the same base KVM hypervisor technology as Red Hat Enterprise Linux and maintains common ABI compatibility, enabling customers to easily leverage either or both platforms.

The RHEV 3.1 hypervisor (based on RHEL 6's KVM) features many improvements from the previous version, including:

☑ **Enhanced scalability.** RHEV 3.1 supports hosts with up to 160 CPUs and 2TB of memory and guest VMs with up to 160 vCPUs and 2TB of vRAM. The theoretical limits are even higher, with 4,096 CPUs and 64TB for the host and 64TB of RAM for guests in preparation for future needs. RHEV 3.1 also adds support for the latest x86 processors.

☑ **Red Hat Storage integration.** Red Hat Storage is a scale-out, open source storage software solution for the management of data, including file and object as well as structured and unstructured. Based on the GlusterFS technology Red Hat received from its October 2011 acquisition of Gluster Inc., Red Hat Storage Server 2.0 became available in June 2012.

☑ **Storage live migration (tech preview).** Disk images can be relocated on a different storage domain while the VM is running (no downtime).

☑ **Live snapshots.** Snapshots of VMs can now be made while the VM is running, without having to shut down the VM.

☑ **The following networking features** have been added since the release of Red Hat Enterprise Virtualization 3.0:

❏ **Hot plug support for virtual network interface cards (vNICs).** Hot plugging and unplugging of vNICs attached to a virtual machine are now supported. It is no longer necessary to stop the virtual machine before adding or removing vNICs.

❏ **Bridge-less network support.** It is now possible to define logical networks on a virtualization host without requiring a bridge to support that network. A bridge is now required only if the logical network is marked as a virtual machine network; other logical network types do not require a bridge.

❏ **New network setup dialog.** The network setup dialog box has been updated to better support complex networking operations. It is now possible to add or remove networks, add or remove bonds, and attach networks to bonds or detach networks from bonds in a single transaction.

Virtualization Management: RHEV-M

Red Hat Enterprise Virtualization Manager (RHEV-M) is Red Hat's management system for KVM and allows organizations to define hosts, configure datacenters, add storage, define networks, create virtual machines, manage user permissions, and use templates from one central location. Based on the open source oVirt project, RHEV-M is a JBoss Java application, allowing it to run on a fully open source stack of Linux and Java.

RHEV-M includes features such as:

☑ RHEV-M 3.1 supports up to 200 hosts; the theoretical limit for future expansion will be over 400 hosts.

☑ The RHEV User Portal is a self-service portal that allows users to provision and manage VMs through a Web-based interface, a critical part of building a cloud. RHEV-M 3.1 enhances the portal with resource quota functionality.

☑ RHEV Reports, based on the Jaspersoft JasperReports engine, allow reporting and dashboards on key RHEV metrics. Over 25 prebuilt reports/dashboards are included, and users can also create their own custom reports. Reporting functionality is now exposed from within the Administration Portal itself. While the standalone Reporting Portal is still available, it now offers single sign-on support, allowing the same authentication credentials to be used for both systems. Additionally, reporting dashboards for the system, specific datacenters, or specific clusters are now available from the Dashboard tab.

☑ The RHEV API, based on the REST model, allows comprehensive scripting and automation and third-party integration.

☑ RHEV-M 3.1 features new advancements for the platform's VDI capabilities, including a new virtual desktop autostart policy, improved WAN optimizations, and an improved virtual desktop client.

☑ Red Hat Enterprise Virtualization 3.1 includes an updated user interface that features usability improvements and wider Web browser compatibility. With 3.1, Red Hat Enterprise Virtualization also expands its localization enablement with support for English, French, Spanish, Simplified Chinese, and Japanese, enabling the platform to be used even more widely around the globe.

Red Hat—Microsoft Interoperability

Even though KVM is a Linux-based virtualization solution, Windows is treated as a first-class guest. Red Hat and Microsoft have entered into an interoperability and support agreement that ensures that customers will be able to use a combination of solutions from the two companies and that support will be available from both vendors.

Within the RHEV environment, Windows VMs are able to leverage the same full scalability features as Linux VMs in terms of number of vCPUs and amount of vRAM. In addition, Red Hat provides Windows drivers for RHEV, which are conveniently available through the Windows Update service. Red Hat has attained Microsoft Server Virtualization Validation Program (SVVP) certification, which means that Windows and all Microsoft software is validated for and supported on RHEV. At this writing, RHEV supports Windows Server 2003 up to and including Windows Server 2008 R2, with support coming soon for Windows Server 2012.

RHEV also supports Windows XP 32-bit and Windows 7 32/64-bit for desktops and will support Windows 8 later this year.

In addition, Red Hat certifies RHEL and all Red Hat software on Hyper-V and currently supports RHEL 5.2 up to and including RHEL 6.4. Red Hat Enterprise Linux 6.4 includes the Microsoft Hyper-V Linux drivers, which were recently accepted by the upstream Linux community, improving the overall performance of Red Hat Enterprise Linux when running as a guest on Microsoft Hyper-V. Installation support for the Hyper-V paravirtualization drivers enables easy deployment of Red Hat Enterprise Linux as a guest in these environments.

RHEV Licensing Model

Like all Red Hat products, RHEV is available through a subscription model that includes software access, support, patches, and community participation. The RHEV subscription is a single edition that consists of the RHEV Manager and the RHEV Hypervisor and includes all enterprise features (live migration, high availability, user portal, reports, etc.) built in. The RHEV subscription has two available support SLAs: Standard (business hours) and Premium (24 x 7 mission critical).

FUTURE OUTLOOK

Red Hat, along with its partner and community ecosystems, continues to expand and mature the RHEV technology aggressively. Red Hat has committed to revving RHEV at a rapid rate, with point releases every six months and major releases every one to two years. While KVM is the latest hypervisor to enter the market, the architecture and open source model have allowed it to advance quite rapidly, and Red Hat is committed to further engineering efforts in order to continually improve RHEV.

oVirt: Open Sourcing KVM Management

Red Hat has also released the RHEV 3 code to the oVirt open source project to build a unified user and development community around the KVM hypervisor and management tools. This is key to avoiding the fracturing that occurred with Xen. oVirt will be the open source upstream code for RHEV, as the Fedora Project is for RHEL. This will bring the final piece of the RHEV stack into open source and allow the RHEV management system to take advantage of the open source development model and community that also drive the KVM hypervisor and is consistent with Red Hat's fundamental approach to software development.

One example of community contribution to oVirt is the development of a plug-in by storage vendor NetApp. Using plug-ins allows vendors to extend oVirt functionality and streamlines the number of tools for a workflow. NetApp is developing a plug-in that will feature:

◻ **A NetApp-specific tab in the oVirt user interface.** This will contain many of the initial and future tools for discovering and managing NetApp controllers, provisioning new storage, and eventually auto-configuring/confirming storage best practices and policies.

☑ **Context-specific menus.** These menus will allow context-specific actions to be taken. For example, when users right-click on a VM, they will have the option to "NetApp Clone" the VM, thereby offloading the cloning from the hypervisor to the storage array. A similar action is planned for cloning offload of entire data stores.

OpenStack: The Foundation for IaaS Clouds

OpenStack is a rapidly growing open source project for cloud system software to build infrastructure-as-a-service (IaaS) clouds. It has tremendous momentum and participation from the IT industry, reminiscent of how Linux started. Red Hat is offering a commercially supported version of OpenStack, currently in tech previews, that will be the infrastructure foundation for many cloud initiatives such as big data and Red Hat's OpenShift platform as a service (PaaS). While OpenStack supports multiple hypervisors, KVM is currently the overwhelming choice for OpenStack deployments.

IaaS: CloudForms Hybrid Cloud Management

CloudForms is Red Hat's enterprise cloud operations management solution that enables organizations to deploy, manage, automate, and optimize private and hybrid clouds and virtualized datacenter infrastructures. CloudForms allows organizations to address virtual environment problems such as monitoring, tracking, capacity management, resource utilization/optimization, VM life-cycle management, and policies to govern access and usage while allowing customers to evolve to a private or hybrid cloud model when ready. CloudForms delivers self-service cataloging with policy-based control to manage requests. The solution also features quota enforcement, dashboards, reports, policies, approval workflows, alerts, usage, chargeback, and cost allocation for full control over an IaaS cloud.

CloudForms' Adaptive Management Platform provides a single pane of glass for unified monitoring, management, and automation across enterprise clouds and globally distributed public clouds. Enterprise customers can use CloudForms to transform the management of their IT infrastructures, enabling IaaS operating models that accelerate service delivery and maximize resource investments and allowing customers to use existing platforms or adopt new ones (Red Hat, VMware, and Microsoft virtualization; Amazon EC2 cloud).

The Open Virtualization Alliance

To promote KVM in the marketplace, Red Hat spearheaded the formation of the Open Virtualization Alliance (OVA) in May 2011. The initial seven vendors were BMC Software, Eucalyptus, HP, IBM, Intel, Red Hat, and SUSE; HP, IBM, Intel, and Red Hat are the governing members. The goal of the alliance is to promote KVM in the marketplace by growing the ecosystem, educating the market about KVM, and documenting best practices and case studies. The OVA has grown dramatically since its inception and currently has hundreds of members.

CHALLENGES/OPPORTUNITIES

Challenges

☑ **Expanding beyond the Linux install base.** KVM's close ties with Linux create some challenges in that customers perceive RHEV as a solution for Linux only, though Windows is well supported. Customers not familiar with Linux may be hesitant to try RHEV, fearing that they don't have Linux skills and knowledge, though Red Hat has worked to package RHEV to be consumable by non-Linux customers.

☑ **Hypervisor competition.** The competition among hypervisors is intense today, with large and formidable vendors such as VMware and Microsoft jockeying for the market. RHEV is relatively new and will have to fight hard to be heard above the noise in the market.

☑ **Building ecosystem and ISV support/certification.** The ecosystem is critical in adding value to a virtualization platform, and RHEV must gain the attention of partners. With many other virtualization platforms also vying for ecosystem attention and given the practical resource limits of most vendors, RHEV may be further down on the priority list.

Opportunities

☑ **Cloud providers.** Open source has had great early success in the cloud as service providers have liked the customizability of the code and the low cost. While this does open doors for commercial open source vendors, it has also been historically challenging to convert these service providers to use paid subscription support services for solutions based on open source software.

☑ **The reach of Linux.** As an integral part of Linux, the KVM hypervisor therefore exists wherever Linux exists. Eventually, Linux users will expect KVM virtualization services to always be available to them. The wide and varied distribution model for Linux will spread KVM broadly, with Linux vendors now tasked with getting users to embrace it and pay for it. oVirt and RHEV will help drive the adoption of commercially supportable open source virtualization management, just as Fedora and RHEL have with Linux.

☑ **Demand for a lower-cost, open alternative.** The current virtualization market leader is perceived by some as premium priced and as a tightly controlled platform. A successful alternative in the market has yet to arise, but other platforms such as RHEV are maturing fast. The rising interest in these platforms indicates that there is a market for a lower-cost and more open competitor.

☑ **New hypervisor for private clouds.** Enterprises view private cloud as a separate environment from their virtualized servers, and more than half are willing to adopt a new hypervisor underneath their cloud deployments.

CONCLUSION

RHEV is an emerging force in the virtualization market that builds on the open source projects KVM and oVirt. Red Hat's history of commercializing Linux and other open source software positions the company to be a leader in bringing KVM to enterprises.

OpenStack, a hot new open source project, builds on top of KVM and Linux to offer a full IaaS cloud. Red Hat is a major contributor to the project and also is in the process of developing a commercially supported enterprise version of OpenStack.

As virtualization enters the mainstream of IT and the cloud era, the ecosystem and integrations it brings are essential to the success of any virtualization platform. There are many indications that the virtualization market is primed for change, and the makeup of the market could look dramatically different in a few years. RHEV is poised to be a strong contender, building on the success of Linux and Red Hat to become an open alternative.