WHITEPAPER

RED HAT ENTERPRISE VIRTUALIZATION FOR SERVERS: VMWARE MIGRATION

USE CASE

Over 70% of customers surveyed are considering a dual virtualization strategy.

INTRODUCTION

A recent finding by IDG in 2011 found that over 70 percent of customers surveyed are either already deploying a dual virtualization vendor strategy, or have concrete plans to do so[1]. With the maturation of the virtualization market and the emergence of alternative virtualization platforms, VMware customers are recognizing the advantages of deploying Red Hat Enterprise Virtualization either as a second virtualization platform to coexist with VMware vSphere or as complete replacement. Many customers begin this deployment by moving some or all of their Red Hat Enterprise Linux virtual servers into the Red Hat Enterprise Virtualization environment and then evaluate their virtual servers running Windows.

To assist enterprises in deploying and migrating to Red Hat Enterprise Virtualization, there are a number of proven tools available from Red Hat and third-party vendors that automate the virtual-to-virtual migration of virtual machines (VMs) from VMware to Red Hat Enterprise Virtualization. And since Red Hat Enterprise Virtualization offers most of the enterprise management features with a similar look and feel as vCenter, system administrators who are experienced with VMware find the transition to Red Hat Enterprise Virtualization to be straightforward.

In all cases, customers are realizing the Red Hat Enterprise Virtualization benefits of greater choice through open source, better performance and security, improved workload density, and lower cost of ownership. This paper summarizes benefits and provides an overview of the steps required to move your Linux and Windows VMs from VMware to Red Hat Enterprise Virtualization.

1 2011 IDG Research study for Red Hat based on 78 qualified CIO Peer2Peer Research Panel members

BENEFITS

There are several benefits associated with adding Red Hat Enterprise Virtualization as a virtualization platform in your environment:

Open source enables the selection of best in breed solutions.

Open source offers a strategic alternative

Customers today often choose a single vendor to manage the complete virtual infrastructure. If they choose a proprietary, closed-source hypervisor and management solution, they are totally dependent on one vendor. By offering a complete, open source virtualization infrastructure stack, Red Hat Enterprise Virtualization is a true strategic alternative as it provides customers with choice and flexibility and enables them to avoid vendor lock-in.

In a business context, software flexibility is about being able to choose solutions suitable for the needs of the users. As requirements in the business change, solutions and other infrastructure components should not be unreasonably constrained by software. Other proprietary vendors, including VMware, Oracle, and Microsoft, are not strategic alternatives as they do not lead to greater choice and flexibility but rather to increasing dependence on closed proprietary software. Open source software tends to be free of dependency on specific products allowing buyers to choose the solution to meet their requirements, knowing that the value of their investments will be preserved and not locked into a single vendor solution. Being open source, Red Hat Enterprise Virtualization does not limit customers to what one company believes they need, but rather allows best-of-breed solutions to be selected for particular components within an architecture.

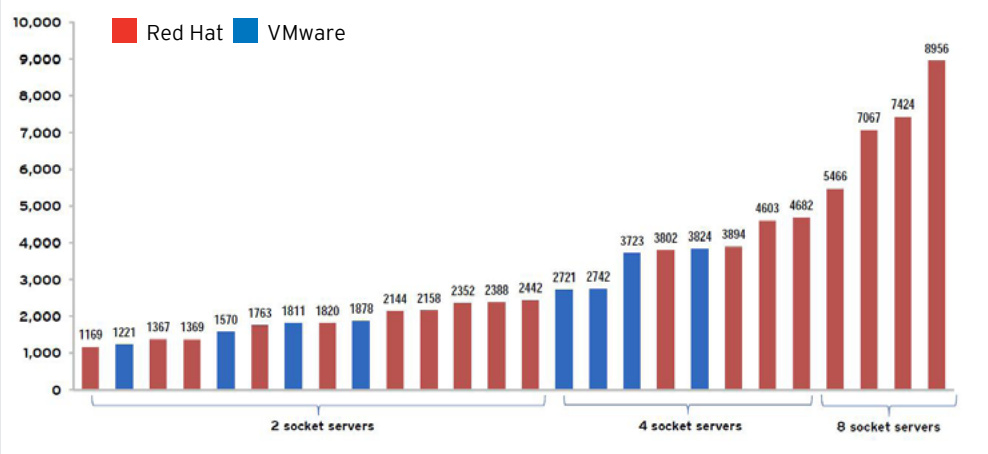
Performance and scalability

The Red Hat Enterprise Virtualization Kernel-based Virtual Machine (KVM)-based hypervisor has proven to be the industry leader for performance and scalability among virtualization platforms. Recent results by industry-standard SPECvirt_sc2010[2] virtualization benchmarks have validated the Red Hat Enterprise Virtualization customer experience of excellent performance and scalability capable of supporting a very large number of VMs on a single Red Hat Enterprise Virtualization Hypervisor host.

The SPECvirt_sc2010[2] benchmark results for Red Hat Enterprise Linux with KVM are shown in red below and are published at **www.spec.org** as of October 1, 2012. The metric along the vertical axis is the SPECvirt_sc2010 result[2].

2 SPEC®, SPECvirt_sc® and the benchmark name SPECvirt™ are trademarks or registered tradmarks of the Standard Performance Evaluation Corporation. For more information about SPECvirt_sc2010, see www.spec.org/virt_sc2010/

INDUSTRY LEADING VIRTUALIZATION PERFORMANCE



SPECvirt_sc2010: As of October 1, 2012, RHEV claims top 7 results and the only 8-socket server October scores

As of October 1, 2012 Red Hat Enterprise Virtualization has attained the seven highest virtualization benchmark results.

As indicated in the graphic above, the KVM-based hypervisor that is included in Red Hat Enterprise Linux not only achieved the highest performance result, but also attained the seven highest results to date. In addition, the KVM-based hypervisor had the highest result for each server class for two-socket, four-socket, and eight-socket servers.

The SPECvirt_sc2010[2] virtualization benchmark measures the ability of a system to host VMs that are running a set of typical server applications and is modeled to look like a customer's real environment. The SPECvirt_sc2010 metric is derived from a combination of the performance of the virtualized applications, noting the number of VMs used in the test and a Quality of Service (QoS) requirement. Red Hat Enterprise Linux 6.1 and its integrated KVM

hypervisor established new leading results—8956@552VMs and 92 tiles—setting the best virtual performance mark and highest number of tiles, or set of six VMs running an application, of any published SPECvirt result as of October 1, 2012[2].

"VMware is no longer the only game in town."

Enterprise functionality

"VMware is no longer the only game in town, choosing an alternative certainly involves tradeoffs... Red Hat Enterprise Virtualization comes closest to VMware in having all the ingredients to support a scalable environment." InfoWorld April 2011[3]

RED HAT vs VMWARE

ENTITLEMENTS PER LICENSE OR SUBSCRIPTION	RED HAT ENTERPRISE VIRTUALIZATION 3.1	VMWARE VSPHERE 5.1 ENTERPRISE EDITION
Max vCPUs per VM	160 vCPU/VM	32 vCPUs/VM (64 with Enterprise Plus)
MANAGEMENT FEATURES		
Single-view for centralized control	Y	Y
High availability	Y	Y
VM live migration	Y	Y
Storage live migration	Y	Y
System scheduler: Cluster policies to automatically distribute workload evenly across cluster host servers	Y	Y
Power saver: During off-peak hours, concentrates VMs on fewer hosts	Y	Y
Thin provisioning	Y	Y
Templates: VMs can be deployed from master installations	Y	Y
Import/Export of VMs in the standard OVF format	Y	Y
Self-service user portal: Provides administrative access to users for creating/running VMs and managing environments	Y	N
API: Programmatic access to all management commands	Y	Y
Customizable reporting engine: Reporting of historic usage, trending, and QoS	Y	N, Requires VMware Operations Manager Standard Edition

3 Infoworld.com: "Virtualization shoot-out: Citrix, Microsoft, Red Hat, and VMware" 13, April, 2011 <http://www.infoworld.com/d/virtualization/virtualization-shoot-out-citrix-microsoft-red-hat-and-vmware-666>

Red Hat Enterprise Virtualization offers a feature-rich server virtualization management system that provides advanced capabilities for hosts and guests, including high availability, live migration, storage management, system scheduler, and more. Unlike at the beginning of the x86 virtualization technology, VMware is no longer the only leader in the virtualization market.

In just over three years since its initial release, Red Hat Enterprise Virtualization 3.1 today delivers a comprehensive enterprise management system that compares very favorably with VMware vSphere 5.1 Enterprise Edition, a product that has been on the market for over ten years. The ability to deliver this robust feature set in a short period of time demonstrates the remarkable feature velocity that the open source development model provides to Red Hat Enterprise Virtualization and its customers.

SELinux with sVirt provides kernel-level military grade security for unmatched enterprise security.

Security

Red Hat Enterprise Virtualization uses the hardened Red Hat Enterprise Linux kernel as its security foundation, inheriting all of the security architecture of Red Hat Enterprise Linux. Both leverage kernel-level security (such as with SELinux and sVirt), which was developed in conjunction with the United States Department of Defense, National Security Agency, and vendors such as IBM, HP, and MITRE. SELinux ensures isolation between VMs and between each machine and the Red Hat Enterprise Virtualization Hypervisor, providing military grade, unmatched enterprise security for your organization.

Rather than layering the security on top of the hypervisor or the base operating system image, SELinux adds a security policy inside the kernel itself. This placement effectively places a wrapper around every process and prevents a compromised VM from breaking out and attacking the hosts or other VMs.

Competitive virtualization products are not engineered with the same level of security baked into the kernel; instead, they include layers that are added to the hypervisor and/or operating system. And with a layered product, a rogue program can do more harm before it is detected. With SELinux and sVirt working within the kernel level, isolation is ensured between VMs and between each machine and the Red Hat Enterprise Virtualization Hypervisor, providing unmatched enterprise security.

Cost Advantage

Because Red Hat Enterprise Virtualization is based on open source and is offered through a subscription model, it is available at a better price point than commercial, proprietary solutions. Its simple and easy-to-understand subscription model is priced on a per-hypervisor-socket basis. As the example below reveals, the Red Hat Enterprise Virtualization for Servers solution can cost 60–80 percent less than the VMware vSphere 5.1 solution. To focus on a true cost comparison, this analysis only considered the virtualization solution consisting of the hypervisor host and enterprise management system when factoring in licensing and support costs. Server hardware costs and virtual server operating system costs are not included, because they would be identical for both solutions.

The following table has the comparison of costs for Red Hat Enterprise Virtualization for Servers and VMware vSphere 5.1 Enterprise Edition. In this scenario 100 virtual machines are configured to support workloads ranging from IT and web infrastructure services to business applications.

Three year TCO analysis	Red Hat Enterprise Virtualization	VMware vSphere Enterprise Edition
Number of servers	10	10
Number of sockets	20	20
License costs (one-time)	$0	$62,495
Annual support/ subscription cost	$14,980	$15,629
Total first year costs	**$14,980**	**$78,124**
For the first year, VMware VSphere Enterprise is over 5x more expensive than RHEV.		
Total three year costs	**$44,940**	**$109,382**

The following is a breakout of the above costs:

First year costs	Qty	Price	Total price
RHEV for Servers Premium (24x7) (per socket)	20	$749	$14,980
VMware vSphere Enterprise (per socket)	20	$2,875	$57,500
VMware vSphere Enterprise SnS 24x7 (per socket)	20	$719	$14,380
VMware vCenter Server Standard	1	$4,995	$4,995
VMware vCenter Server SnS 24x7	1	$1,249	$1,249
Total VMware vSphere 5.1 first year cost			**$78,124**

MIGRATING FROM VMWARE TO RED HAT ENTERPRISE VIRTUALIZATION

Red Hat offers a downloadable evaluation subscription to help customers get started.

Migration Overview

The process of migrating virtual server workloads (operating system, application, and data) from one virtualization platform to another is called a virtual-to-virtual (V2V) migration. Each virtualization hypervisor (e.g., Red Hat Enterprise Virtualization Hypervisor and VMware ESX/ESXi) uses a different file format for the VM and there are two methods for V2V migration:

1. Manually recreate the new VMs from scratch
2. Migrate the VMs using V2V migration tools

Virtualization customers typically use the second method, V2V tools, because 1) they have already invested the time installing a guest operating system, and 2) there are excellent tools available to accomplish V2V migrations. But manually recreating the VMs in the new environment provides the opportunity to optimize the configuration for the workload and to separate applications into separate virtual servers if necessary. In general, most V2V projects include a flexible approach using automation when possible and a manual or semi-automated approach for the most strategic and resource-intensive server workloads. In almost all cases, these projects consist of assessment, preparation, evaluation, execution, and testing phases.

Project considerations

V2V migrations are generally less complicated than virtualizing physical servers (or physical-to-virtual (P2V) migrations). Unlike physical servers, virtual servers are not configured with a wide range of hardware devices; therefore, there are fewer problematic hardware dependencies.

It is important to understand the performance requirements of the VM prior to the migration. A resource assessment of the source VMs is an important step in the process to ensure project success. Understanding requirements (e.g., RAM, disk, network connection, CPU capacity, etc.) up front will save time and effort later.

One of the more successful paths to a V2V migration is to start with a pilot project. This begins with the identification of a group of virtual servers to be moved into the Red Hat Enterprise Virtualization environment. Many customers with Red Hat Enterprise Linux as a guest operat-ing system in their VMware clusters choose to start with a subset of these virtual servers.
VMs supporting infrastructure services, internal web portals, or file/print servers are also good candidates. Red Hat offers a downloadable evaluation subscription to help customers get started in this way. Once complete, the results of the project can be assessed and promoted within the organization.

The next step involves the identification and assessment of all virtual servers to be migrated. The targeted VMs need to be monitored and analyzed for their use of CPU, memory, disk, and networking resources. Both the average and peak levels of utilization should be measured and tracked. The results of this analysis will be used in architecting the new Red Hat Enterprise Virtualization infrastructure and in determining the optimal distribution of VMs across the cluster of hypervisor server hosts. If necessary, Red Hat Consulting can provide a part or all of this service.

There are V2V tools available to convert a VMware ESX/ESXi virtual machine into a Red Hat Enterprise Virtualization virtual machine.

VM portability

One would think that since hardware abstraction and independence was one of the first and foremost benefits of virtualization, VMs would be portable across different hypervisor platforms. Unfortunately, each hypervisor uses its own proprietary format. All VM formats consist of VM configuration data (CPUs, memory, operating system, etc.) and the binary virtual disk image. V2V tools are available to convert a VMware ESX or ESXi VM into a Red Hat Enterprise Virtualization VM. And since these tools support automation, the effort to migrate VMs from the VMware format to the Red Hat Enterprise Virtualization format is a straightforward and manageable process.

In order to facilitate the migration of VMs between environments, there are industry efforts underway to develop standards such as the Open Virtualization Format (OVF). OVF allows for packaging of one or more VMs into a single file for distribution and is supported by many vendors, including Red Hat, VMware, and Citrix. Red Hat Enterprise Virtualization uses OVF internally for storing VMs. However, OVF implementations from different vendors vary by format and content of the virtual disk, because OVF does not mandate the virtual disk format or the contents of the virtual disk. VMware vSphere uses a disk format called VMDK (virtual hard disk), Microsoft Hyper-V uses a disk format called VHD (virtual hard disk), and Red Hat Enterprise Virtualization uses the RAW format for pre-allocated virtual files and the QCOW format for thin-provisioned virtual disk.

To migrate the VM between hypervisors, the virtual disk image needs to be converted into the native virtual disk image supported by the target hypervisor. In addition, the VMDK virtual disk image includes content such as VMware tools and drivers that are not portable and work only with a VMware hypervisor. These tools and drivers must be removed and replaced with device drivers that are native to the Red Hat Enterprise Virtualization environment. For example, if a Windows VM was configured in the VMware environment, it was likely installed with VMware tools, a number of paravirtualized drivers, and perhaps sound card emulation. These VMware device drivers are not portable and must be removed and replaced with Red Hat Enterprise Virtualization virtualized drivers.

Converting VMs

Because of the lack of standardization for the virtual disk format and content, there is no true portability for VMs across different hypervisor hosts. VMs must be converted into the native format of the target hypervisor during the V2V migration. In general, the process of performing a V2V migration between virtualization platforms consists of the following steps:

1. Read the VMs configuration file and create a VM with the same configuration on the target hypervisor platform.
2. Copy the VMs virtual disk (VMDK) and convert it to Red Hat Enterprise Virtualization hypervisor virtual disk format (RAW or QCOW).
3. Replace the VMware tools and virtualized drivers in the guest operating system (inside the virtual disk) with the Red Hat Enterprise Virtualization tools and virtual device drivers.

Red Hat Enterprise Virtualization provides an open source V2V migration tool that enables customers to automatically convert and import VMs created on other systems, including VMware ESX/ESXi version 3.5 and 4.0. This tool is available on Red Hat Network (in the "Red Hat Enterprise Virt V2V Tool (v5 for x86_64)" channel and converts VMs from a foreign hypervisor to run on Red Hat Enterprise Virtualization 2.2 and later. It automatically packages the VMs as OVF files and uploads them to a Red Hat Enterprise Virtualization export storage domain. The supported guest operating systems include Red Hat Enterprise Linux (version 3 and later), Fedora, Windows 2003, 2003R2, 2008, 2008R2, XP, Vista, and Windows 7.

The Red Hat Enterprise Virtualization V2V tool automatically handles the migration of the VMware VM into Red Hat Enterprise Virtualization. This automated process includes:

- Pulling in the VM configuration
- Changing the format of the disk to be appropriate to the Red Hat Enterprise Virtualization hypervisor
- Making any guest changes (e.g., pulling out the VMware drivers)
- Changing the registry
- Installing paravirtualized drivers for optimal disk and network performance
- Importing the VM into Red Hat Enterprise Virtualization

And because it is a command line tool, the Red Hat Enterprise Virtualization V2V tool can easily run on a large scale, automating a 100 or 200 VM migration with very simple scripting. Note that the V2V tool operates on a copy of the original guest image; therefore, images that are greater than 10 GB will take longer. However, once the copy is completed, the conversion takes place in less than a minute. The tool then creates the OVF file on the Red Hat Enterprise Virtualization export domain, and the VM will appear in the Red Hat Enterprise Virtualization Manager console as an available VM in the export domain.

Red Hat Virtualization Services

Red Hat Consulting offers a range of migration services—from foundation and quick start offerings to on-site migration planning, project scoping, and project execution support. In addition, Red Hat Training and Certification offers online, classroom, and on-site training, as well as a certification program that ensures that your staff members and consultants have advanced Red Hat Enterprise Virtualization knowledge in addition to a basic virtualization skillset.

Third-party migration tools

One of the nation's leading heathcare institutions recently migrated its virtualization environment from VMware vSphere and Oracle Virtual Iron to Red Hat Enterprise Virtualization with the help of the Acronis Backup & Recovery Virtual Edition software. The software, which is certified for Red Hat Enterprise Virtualization and includes P2V, V2V, and V2P (virtual-to-physical) migration capabilities, was critical to the migration because Red Hat does not support migrations from the older vSphere 3.1. The Acronis Backup & Recovery Virtual Edition solution is platform independent and took the worry out of the platform-specific issues that the IT team had previously encountered. After the fast and successful migration,

the customer has realized the benefits of reduced datacenter costs, improved application responsiveness and performance, and significantly increased the stability, reliability, and security of its virtualized infrastructure.

WHAT'S NEXT

For more information, visit **www.redhat.com/virtualization** or contact your local Red Hat Enterprise Virtualization reseller.

REFERENCE

VMware vSphere Pricing 2012, **www.vmware.com/products/datacenter-virtualization/vsphere/pricing.html**. (September 7, 2012)

ABOUT RED HAT

Red Hat was founded in 1993 and is headquartered in Raleigh, NC. Today, with more than 70 offices around the world, Red Hat is the largest publicly traded technology company fully committed to open source. That commitment has paid off over time, for us and our customers, proving the value of open source software and establishing a viable business model built around the open source way.

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