USE CASE

RED HAT ENTERPRISE VIRTUALIZATION FOR SERVERS: SERVER CONSOLIDATION

INTRODUCTION

By transitioning workloads from physical servers to virtual machines, datacenter consolidation significantly increases the utilization and agility of computing resources while reducing operational costs with more efficient use of power and space. Capital cost savings in server hardware is the most immediate benefit and can range in a reduction of 40-75 percent. Operations teams also benefit from the reduced requirements for space and power and with the improved on-going management of their servers. For new server hardware, more can be done with less as multiple workloads (running on virtual machines) can more effectively utilize shared physical servers.

This paper will illustrate how the Red Hat Enterprise Virtualization solution provides customers the proven infrastructure to safely and cost effectively virtualize their Windows- and Linux-based workloads and attain these benefits of increased utilization and agility and lower capital and operating costs.

KEY FACTORS DRIVING SERVER CONSOLIDATION

In early 2012, most analysts agree that 40% of all x86 workloads are virtualized and this will be growing to over 75% over the next few years.

The proliferation of client/server and distributed system computing along with the emergence of relatively low cost x86 servers has resulted in a sprawl of underutilized servers in many customer environments. It had become common practice for organizations to add capacity or new capabilities simply by adding another server. Server consolidation reduces the number of physical servers supporting a given set of workloads and increases the effective utilization of server hardware by allowing one physical server to host multiple virtual machine (VM) instances. Many organizations also consolidate as part of the natural refresh cycle of their technology infrastructures. Virtualization offers a proven solution for fast and effective server consolidation, with minimal disruption to existing business processes. There are several factors that are driving customers to consider server consolidation through virtualization, which include:

- Need to reduce costs
- Need to reduce server sprawl that results from client/server and distributed system deployment
- Limited physical space in datacenter
- Desire to capitalize on modern, higher-performing, energy-efficient x86 servers
- Workloads migrating from UNIX- to Linux-based servers
- Requirement to refresh legacy servers with expiring maintenance agreements
- Increased flexibility in order to meet increasingly demanding service level agreements (SLAs)
- Improving return on assets (ROA) of computing resource with increased utilization and agility

In early 2012, most market analysts agree that approximately 40 percent of all x86 workloads are virtualized with this penetration expected to grow to 75 percent over the next few years.

BENEFITS OF VIRTUALIZATION

Virtualizing a data-center for server consolidation extend beyond the immediate savings of reducing server hardware and sprawl and include the benefits listed below:

- Reduction in power and electrical costs as well as necessary floor space due to the ability to consolidate multiple server instances onto a single physical server
- Improved ROA by tapping into a wasted capacity and increasing the utilization of servers, CPUs, memory, disk, and networking resources
- Improved IT staff productivity with an increase in the number of server resources a system administrator can effectively manage
- Improved business continuity with the high availability feature that restarts virtual guests on other servers in the cluster in the event of a server failure
- Ability to respond more quickly to customer demands by provisioning a new server or workload in a matter of minutes rather than days or weeks as required with physical servers

In summary, one of the most significant impacts of virtualization is to enable a larger part of the IT staff to focus more on service levels and the business needs rather than in IT infrastructure management.

PHYSICAL TO VIRTUAL CONSOLIDATION

Virtualization offers a proven solution for fast and effective server consolidation, with minimal disruption to existing business processes. The process of migrating physical server workloads (operating system, application, and data) from a physical to a virtual server to be supported in a virtualization infrastructure is called physical-to-virtual (P2V) migration.

Most P2V projects take a semi-automated approach to consolidation.

P2V migration approaches can be completely manual, automated, or a semi-automated approach that is a combination of the two. Manually configuring and creating the virtual machine with the required operating system, and then copying the data files and finally copying or redeploying the application can be expensive in terms of IT staff hours required. But the manual method can result in the most optimized virtual deployment with each application redeployed in its own virtual machine. To facilitate this migration work and to reduce required IT staff resources, there are P2V tools from several vendors that can help automate this effort. These tools typically image the workload on the source physical server and then restore the image to a virtual server saving time and staff resources. However, the automated approach generally does not deconstruct the physical server workload, separate by application, nor deploy each application on to its own virtual server. By assigning each application to a unique virtual server, computing resources can be easily added or taken away resulting in the most efficient utilization of the cluster computing resources.

In general, most P2V projects take a semi-automated approach to consolidations using a manual approach of the most strategic and resource-intensive server workloads and an automated approach on the less important server workloads requiring fewer resources.

THE FIRST STEPS TOWARD CONSOLIDATION

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

One of the more successful paths to consolidation is to start with a pilot project. This begins with the identification of a group of under-utilized servers to be virtualized. In many cases, servers supporting infrastructure services or internal web portals, or file/print servers are good candidates. Red Hat offers a downloadable evaluation subscription to help customers get started in this way. Once complete, the results of the pilot project can be assessed and promoted within the organization.

To scale this up, the next step involves the assessment of the workloads in the datacenter to better understand resource utilization and to identify underutilized servers. Applications will 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 not only in planning and architecting the new virtualization infrastructure, but also in determining the optimal distribution of workloads across the cluster of hypervisor server hosts. Red Hat Consulting can be engaged to provide a part or all of this service.

RED HAT ENTERPRISE VIRTUALIZATION AND SERVER CONSOLIDATION

Red Hat Enterprise Virtualization offers enterprises the ideal platform on which to base large and small-scale consolidation deployments. The powerful Kernel-based Virtual Machine (KVM) hypervisor has achieved record-setting virtualization benchmark results as well as unmatched consolidation ratios.

The fully featured enterprise management system enables customers to centrally and effectively manage their entire virtual environment – virtual datacenters, clusters, hosts, guest virtual servers, networking, and storage. Red Hat Enterprise Virtualization is fully featured with high availability, live migration, policy-based workload balancing, image management, snapshots, and thin provisioning. With guest operating system support for Red Hat Enterprise Linux guests (32-bit and 64-bit) and for Microsoft Windows guests (32-bit and 64-bit) complete with paravirtualized network and block drivers, Red Hat Enterprise Virtualization has been engineered to support your entire IT infrastructure.

Industry-leading consolidation ratios with high VM density

A key factor in determining the overall cost of a virtualization deployment is the VM density that the hypervisor server host can support. High VM density translates into a greater consolidation ratio and lower capital and operational costs, meaning fewer physical servers are needed to support the same virtualized infrastructure. This translates to fewer licenses for those physical servers, requiring less power and space. It also impacts the cost of virtual server operating system when customers are using unlimited host-based licenses and subscriptions for virtual entitlements, a common practice.

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

Recent results with the industry-standard SPECvirt®[1] virtualization benchmark have validated the Red Hat Enterprise Virtualization customer experience of supporting a very large number of VMs on a single Red Hat Enterprise Virtualization hypervisor host as shown below.

The SPECvirt® 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[1].

In late 2011, 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 December 2011. In addition, the Red Hat solution provided the highest results for each server class for two-socket, four-socket, and eight-socket servers.[1]

Note that the Red Hat Enterprise Virtualization KVM Hypervisor has two supported deployment models. Customers can choose either the RHEV-Hypervisor which is a standalone small footprint hypervisor and included with the RHEV subscription or the Red Hat Enterprise Linux operating system (purchased separately) installed as a hypervisor host. Both utilize the same KVM hypervisor technology.

Some of the Red Hat Enterprise Virtualization technology that helped to achieve this very high VM density included:

- Memory overcommitment allows users to define more RAM in their VMs than what is present in a physical host
- Transparent huge pages allow larger memory pages to be created dynamically for workloads that require it (like databases and high-throughput analysis)
- SRIOV allows bypassing the hypervisor for certain network and disk I/O for near-native speed
- CPU pinning and NUMA support allows the pinning of virtual CPUs and virtual RAM in a VM to physical cores and physical RAM on the server for enhanced performance
- Red Hat Enterprise Virtualization cluster allows for resource pooling across up to 200 hosts

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

Enterprise management that optimizes utilization and agility

Virtualization abstracts workloads away from physical devices and consolidates them onto a cluster of physical machines to optimize utilization of resources. Efficiently utilizing the hardware resources of a cluster requires workload mobility or the management capability for moving data and applications non-disruptively from one physical server to another while continuously being powered-up. This process takes place without any noticeable effect from the point of view of the end user. Both manual execution and policy-based automation of this management capability is required for the efficient management of hardware resources in order to achieve improved utilization through server consolidation.

Red Hat Enterprise Virtualization Manager is a feature-rich server virtualization management system that provides advanced capabilities for hosts and guests, including live migration, policy-based workload balancing, high availability, and storage management.

The live migration functionality provides the ability to move a running virtual machine between physical hosts with no interruption to service. In addition, the Red Hat Enterprise Virtualization system scheduler continually monitors the utilization of host systems and virtual machines, and dynamically manages the placement of virtual machines within the datacenter based on policies defined by the system administrator.

Security

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

Security is a very important consideration in a scenario where several virtual machines are co-hosted on a single physical server. How do you keep separation? Isolation was easy when you knew the applications were hosted on separate physical boxes and then tied into different physical switches, but security becomes more complex when those connections become virtual. And as more business-critical applications are deployed as virtual servers, hypervisor hosts are becoming bigger targets for security threats. If hackers can exploit a hypervisor then chances are good that they can compromise the virtual servers on the hypervisor.

Red Hat Enterprise Virtualization uses the hardened Red Hat Enterprise Linux kernel as its security foundation and it inherits all the security architecture of Red Hat Enterprise Linux. Both leverage kernel-level security (SELinux and sVirt), that was developed in conjunction with the United States Department of Defense and National Security Agency and vendors such as IBM, HP, and MITRE. SELinux ensures isolation between virtual machines and between each machine and the Red Hat Enterprise Virtualization Hypervisor, providing military-grade, unmatched enterprise security for your organization. Rather than having the security be on top of the hypervisor or on top of the base OS image, SELinux adds a security policy inside the kernel itself, effectively placing a wrapper around every process preventing 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. They are usually layers added to the hypervisor and/or operating system. With a layered product, a rogue program can do more harm before it is detected. With SELinux and sVirt working at the kernel level, isolation is ensured between virtual machines and between each machine and the Red Hat Enterprise Virtualization Hypervisor, providing unmatched enterprise security for your organization.

Availability and business continuity

The pressure is on for business and information technology services to produce 100 percent available environments. By concentrating more workloads on fewer servers, it is increasingly important to ensure rapid recovery from outages. Due to the high cost and complexity of application failover and clustering solutions, usually only the most mission-critical applications within an organization are protected.

Three levels of priority allow administrators to ensure that the most important workloads are started first.

With high availability included within Red Hat Enterprise Virtualization, any application deployed within a virtual machine can be protected from hardware and software failures. Red Hat Enterprise Virtualization Manager continually monitors the physical host systems. In the event of a hardware failure, any virtual machine configured to be highly available will be restarted on another host in the cluster. Three levels of priority allow administrators to ensure that the most critical workloads are restarted first. Using Red Hat Enterprise Virtualization, organizations can avoid using multiple, complicated failover and clustering solutions, instead deploying one high availability solution for any application running inside a virtual machine, regardless of the operating system, Red Hat Enterprise Linux or Windows Server.

Pricing and packaging

All Red Hat products are sold on a subscription basis. There is no upfront software license followed by annual support fees. Instead, Red Hat offers an annual subscription that is the same cost each year and includes product access, updates, patches, support, and the certified ecosystem.

Red Hat Enterprise Virtualization is sold on a per-hypervisor-server socket basis and includes the Red Hat Enterprise Virtualization Manager and the Red Hat Enterprise Virtualization Hypervisor. Red Hat Enterprise Virtualization Hypervisor is a bare metal, small footprint KVM hypervisor based on the full Red Hat Enterprise Linux kernel. Alternatively, a customer can choose to deploy the full Red Hat Enterprise Linux operating system with KVM on the hypervisor host server to be managed by Red Hat Enterprise Virtualization Manager.

The complete Red Hat Enterprise Virtualization for Servers enterprise feature set is available through a single, simple subscription. Unlike alternative virtualization products on the market, the Red Hat Enterprise Virtualization for Servers functionality is not segmented into multiple editions nor are customers required to buy add-on products for additional functionality. And because Red Hat Enterprise Virtualization is open sourced and is available through a subscription model, Red Hat is able to offer it at a more competitive price point than commercial proprietary solutions.

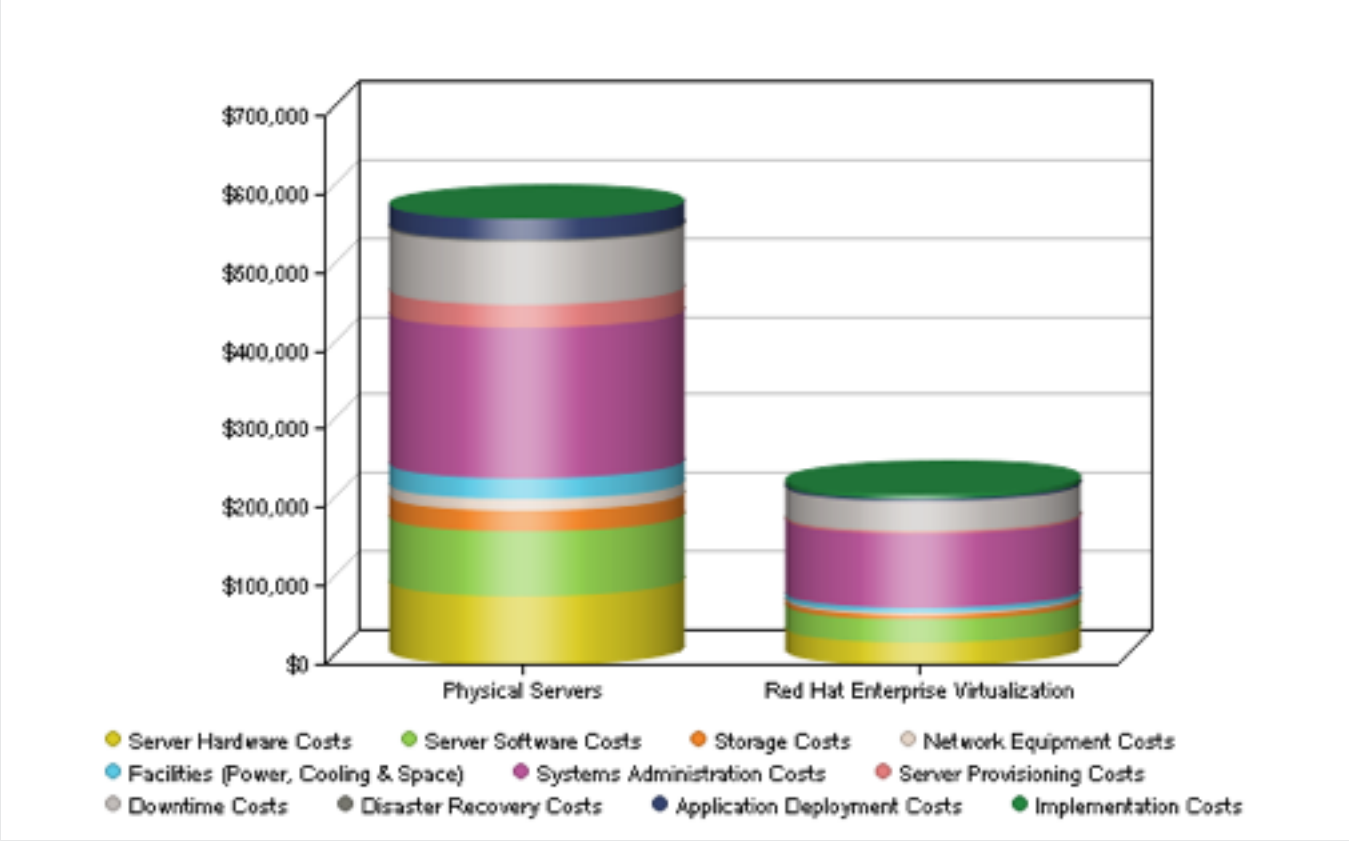
THE TCO AND ROI OF CONSOLIDATION

The Red Hat Enterprise Virtualization for Servers TCO calculator can be used to develop a configuration for virtualizing your x86 servers and to compare the costs of a virtual server-based infrastructure to a physical server infrastructure.

The sample analysis depicted in the chart and table below compares the cost of deploying 20 servers (10 running Windows, 10 running Red Hat Enterprise Linux) as physical servers to a virtual server deployment in a Red Hat Enterprise Virtualization environment. For this comparison, Red Hat Enterprise Virtualization is expected to:

- Require a total investment of $64,132
- Provide total benefits of $387,006 from cost savings and improved service levels
- Yield an ROI of 549 percent with a payback period of less than five months

ROI Results	Values
Initial Investment	$48,643
Total Three Year Investment	$64,132
Total Three Year Savings	$352,105
Return on Investment (ROI)	549%
Implementation Period (months)	3
Payback Period (months)	< 5



Three Year ROI

THREE YEAR ROI

Three Year TCO Analysis	Physical Servers	RHEV	Savings
Physical Servers	20	3	17
Server Hardware Costs	$90,000	$28,800	$61,200
Server Software Costs	$80,235	$29,232	$51,004
Storage Costs	$27,000	$6,750	$20,250
Network Equipment Costs	$16,000	$4,000	$12,000
Facilities	$26,622	$5,184	$21,438
Systems Administration	$191,844	$94,491	$97,354
Server Provisioning Costs	$30,462	$1,524	$28,938
Downtime Costs	$78,840	$39,420	$39,420
Disaster Recovery Costs	$2,400	$720	$1,680
Application Deployment	$27,692	$2,770	$24,923
Implementation Costs	$0	$6,101	($6,101)
Total	$571,096	$218,991	$352,105

The assumptions the model uses with regard to pricing, hardware configurations, etc. is clearly documented and can also be changed to reflect special pricing or lower target utilization rates. When you are satisfied with the results of the analysis, you can click on either "Email a Report" or "Create a Report" to receive a copy of the TCO report.

Access the TCO calculator by clicking on the "Calculate your Savings" banner at **www.redhat.com/rhev/server/cost**.

CUSTOMER EXAMPLE

Compute and memory capability were doubled while capital costs were reduced more than 65%. Power and cooling costs were reduced by 83%.

Despite the global economic downturn, this leading technology company has continued to grow and thrive in recent years. A natural challenge accompanying this growth was the need to evolve the global datacenter infrastructure and to address two major challenges in particular:

1. An increasingly constrained datacenter real estate
2. A tight budget for both capital and operational expenditures, which was under careful scrutiny for waste and inefficiency.

At the same time, the company's installed base of 500 IBM BladeCenter servers had crossed the four-year-old mark, when maintenance contract costs skyrocket. In order to meet these challenges, the company established a new and high-priority goal of moving to a 100 percent virtualized IT architecture worldwide.

Solution

As a user of Red Hat Enterprise Linux for mission-critical workloads for several years, the IT group evaluated and ultimately selected Red Hat Enterprise Virtualization for its virtualization platform due to the solution's performance and enterprise management capability in combination with a low total cost of ownership. In early 2011, the IT group began migrating its installed base of older 500 IBM BladeCenter HS21 and HS22 servers to a new virtualized environment consisting of 84 more modern physical IBM BladeCenter HS22V servers.

Benefits

By consolidating on 84 servers, the server acquisition cost was reduced by more than 65 percent, compute and memory capacity was doubled, and power and cooling costs were reduced by 83 percent. In addition, provisioning virtual machines can now be achieved in minutes, rather than the days it took when provisioning physical machines. In addition, the infrastructure services team was able to configure more than 300 virtual machines in less than three days, which was not feasible under the old architecture. On average, server utilization has improved from 15-20 percent to over 60 percent. And now with a solid virtualization infrastructure in place, the company is adding more internal cloud capability enabling users to self-provision and obtain needed IT resources on demand.

CONCLUSION

Red Hat Enterprise Virtualization offers customers the ideal platform on which to base large- and small-scale consolidation deployments. The fully featured enterprise management system enables customers to centrally manage their entire virtual environments. Based on open source technology, Red Hat Enterprise Virtualization delivers choice and flexibility, industry-leading performance and security, and a low total cost of ownership. With this proven infrastructure, customers can safely and cost effectively consolidate their Windows- and Linux-based workloads and attain the benefits of increased utilization and agility and lower capital and operating costs.

WHAT'S NEXT

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

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.

SALES AND INQUIRIES

NORTH AMERICA
1-888-REDHAT1
www.redhat.com

EUROPE, MIDDLE EAST AND AFRICA
00800 7334 2835
www.europe.redhat.com
europe@redhat.com

ASIA PACIFIC
+65 6490 4200
www.apac.redhat.com
apac@redhat.com

LATIN AMERICA
+54 11 4329 7300
www.latam.redhat.com
info-latam@redhat.com

www.redhat.com
#8953807_0312
DOC74843