



## HRG Insight: Virtualization

Virtualization? Everyone has heard about it but even the term conjures up a hazy, intangible image. It is one of those technology topics many CIOs and IT decision-makers would rather avoid. However, they avoid it at their own peril. This HRG Insight discusses what virtualization is, why it's fundamentally important to your business and how Red Hat is addressing it.

### What problems are being solved with virtualization ?

Before reviewing how virtualization is defined and why it may not be as “new” as some think, it's important to understand the current market landscape. What challenges are keeping you up at night?

First, today's business environment is a continual challenge to do more with less – flat or declining IT budgets, less human and capital assets available, constrained power resources in a world becoming far more energy efficient. However, the market is demanding more – more services and applications, higher levels of application availability and improvements in quality of service. At the same time, IT resources are often operating at significant inefficiencies. Capacity in the organization is often fragmented, underutilized and duplicated. As more and more applications and operations are being pushed out to the edge, IT organizations are looking more like disconnected “silos of inefficiencies” with a proliferation of everything from physical servers, storage and networking gear to poorly managed, less integrated applications. The net result of this environment has been a significant, often hidden cost of doing business. Besides the obvious direct acquisition cost of underutilized hardware and applications, there are the more indirect expenses of managing the real life-cycle of application support and associated physical costs of cooling, space management, power consumption and other environmental factors. More assets, including software, are depreciating without efficient use of these assets.

Let's look more closely at the application costs. As IT managers are aware but often business decision-makers are not, acquisition costs of applications are only the tip of the iceberg. They need to be installed, configured and tuned to the current environment, managed and administered by often unique and expensive expertise and supported throughout the application lifecycle by upgrades and fixes. Additionally, there may be specific development costs associated with the application including debugging, setting up test scripts, running beta tests and the like – all additional costs beyond the acquisition.

*Virtualization is a critical topic for today's CIO and IT decision-makers. How can enterprises do more with less? How can enterprises optimize IT resources, reduce application life-cycle costs beyond simply consolidating servers? Red Hat's approach builds on open software standards and a common set of management tools to help enterprises adopt virtualization as a solution for the future*

The flip answer to these significant business issues is to talk about “server consolidation”, reducing the overall number of physical servers to increase overall IT efficiencies. But simply reducing the footprint and putting more applications on fewer servers is not enough. That’s where virtualization comes in and at the same time addresses other significant business drivers.

Beyond actual costs, there are the very real issues of how to treat different computing environments based on differing business needs. You may not want to run routine “legacy” and transactional “mission critical” environments in the same computing environment for purposes of security, optimization or the sheer impossibility of running older systems in a specific environment. You, as well as clients (internal end-users, customer, partners), may require some form of service provisioning.

Finally, your business may also require a secure environment both for the obvious running of the application but also for doing R/D, “sandboxing”, testing, product development, specific fault isolation and personnel training. There are simply certain needs which require separate, effectively stand-alone environments. You may want to isolate untrusted applications, create system environments with specific resource limitations or boundaries. Any type of software development may require the equivalent of several separate systems particularly separating the testing and debugging from coding. This is especially true for large complex data base and Web services applications. Complex SAP or SOA deployments often require separating test from code from production environments. In addition, any major upgrade to a new version of operating system often requires significant testing and qualification work resulting in costly downtime and sometimes unplanned outages to the production environment. Virtualization can be a major benefit in these situations.

In summary, in order to run today’s complex businesses to meet “just-in-time” business needs efficiently and economically, a computing environment needs to be more flexible, easier to administer and secure. Virtualization can be a major solution.

## What is Virtualization?

So suppose you could reap the benefits of a consolidation of resources but be able to also ensure you could run separate application computing environments essentially creating unique images, virtual images on the same machine? You could reap the benefits of increased IT efficiencies with the need for differentiated and separate environments when required. That’s where virtualization comes in.

There are as many definitions of “virtualization” as there are stars in the sky. And it’s not a new concept. The term can be applied to everything from servers, storage, and networking to memory management and addressing. Let’s stick to the concept of hardware or platform virtualization.

Basically, virtualization in this definition is a technology that allows a single server or platform to run multiple operating system images at once. It means you have a single operating system (host) running multiple images of the same or multi-vendor operating systems and applications (guests). It’s an “abstraction” of computing resources making a single server or platform appear to function as multiple resources including unique, virtual operating systems, applications and services. Rather than running a single or a few applications on a dedicated server requiring dedicated administrative and management resources, an enterprise can run several applications on the same server utilizing virtual operating system images. This clearly saves hardware, management, power, cooling and other fixed costs.

Interestingly, virtualization is an old concept going all the way back to the early 70s when IBM’s VM (virtual machine) operating system offered the similar ability to run multiple operating system images on a mainframe. This ability paid a price however since the hardware itself was specialized in order to run virtual images.

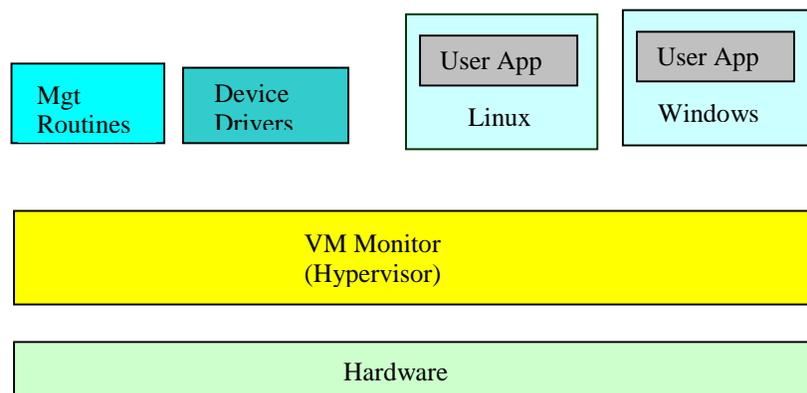
Virtualization rests upon the concept of “abstraction”. Abstraction means the entire hardware/OS platform required to run the application is, in effect, reduced to a single image not dependent on a specific set of

hardware/software/peripheral/networking combinations. It masks the actual physical components of the resources, hiding the technical “details”, from the application or end-user. The resulting “virtual image” is “encapsulated” and becomes a portable, executable data file ready to be run on a single server independent of other, similarly “encapsulated” virtual images. Thus the same server could be running one instance of a BI (business intelligence) application running on Red Hat Linux Enterprise at the same time independently testing and debugging a Windows Vista environment.

During the past decade, virtualization has become a major issue for CIOs due in part to its natural affinity to the computing environment of the 21<sup>st</sup> century – open, distributed, web and standards-based, utilizing commodity-priced servers and desktops. Initially promoted by EMC subsidiary VMware Inc and later, Microsoft, virtualization has increasingly been supported by the open source community. This is due in part to a desire to avoid “locking-in” with vendors promoting proprietary virtualization software. In fact, using open-source software can be a most economical balance between cost and overall server performance, an issue with initial proprietary virtualization implementations which limited them to sandboxing, testing and development applications.

There are several methods to “do” virtualization ranging from requiring specialized hardware (such as the IBM VM) to emulating hardware to software implementations such as “full virtualization” or “para-virtualization” where the guest operating system is modified to run with a mediator called a “hypervisor” which can “talk to” the host operating system and ultimately the hardware instruction set. With full virtualization, the VM monitor must create and maintain data structures for virtual components. This management of resources negatively affects the performance of the system.

In contrast, paravirtualization requires modifications to the guest operating system which eliminates much of the overhead in maintaining resource structures. This allows for near native performance. Figure 1 illustrates the logical architecture that is common in a paravirtualization environment. User applications continue to execute with their respective operating systems. Management routines are provided that manage and control the various virtual machines. Special device drivers can also provide near native performance.



The paravirtualization approach is used by the open source software, Xen, developed by the technology company XenSource, started as a research project at the University of Cambridge and recently bought by Citrix. Xen’s paravirtualization software uses a hypervisor to run modified guest operating systems providing shared access to the hardware. It offers high performance in a more cost-effective environment.

Paravirtualization  
Figure 1.

As virtualization matures as a concept, open standards will increasingly be the major driver just as they have been in the adoption of PCs, operating systems, TCP/IP, and most recently Web Services. Application life-cycle costs are greatly magnified in disparate, non-integrated environments each using different technologies. The management and administrative costs alone, not to mention reducing environmental costs through consolidation, demand CIOs look at virtualization seriously.

## Red Hat and Virtualization

One vendor who has been leading the charge in using open source software to tackle the virtualization challenge is Red Hat. Red Hat has built its reputation on exploiting open source software and providing a robust support environment. It has coupled its Red Hat Enterprise Linux with the Xen source virtualization technology. Red Hat goes beyond simply integrating its operating system with Xen to offer a range of virtualization management tools, installation and software management - a complete platform approach called "Red Hat Enterprise Linux Advanced Platform". The platform offers fully integrated server and storage virtualization. In addition, Red Hat's Global File System and Red Hat Cluster Suite products offer high availability clustering. The platform supports servers of any size and an unlimited number of virtualized guest environments. With this approach, Red Hat is offering a true commercial-grade virtualization solution expanding the opportunities for real enterprise advantages beyond the more limited use of virtualization in debugging, testing and sandboxing applications. In addition, it makes it easier for an enterprise to implement and manage a virtualization approach while reducing costs through planned server consolidation projects. Red Hat's platform partners such as Intel and AMD have also continued to enhance their hardware for virtualization. Due to its leadership in the accelerating pace of open software development, Red Hat has been able to take advantage of these platform vendors' enhancements.

Red Hat offers both full and para-virtualization for guest operating systems. Para-virtualized mode offers high, near-native performance requiring the guest operating system be modified with Xen. Full virtualization allows the unmodified guest operating systems to run but does require some specific hardware (Intel-VT or AMD-V) as the host platform. The platform offers an unlimited number of guests, multiple operating systems and versions and performance and security settings running on the same server regardless of vendor. It also allows shared logical storage volumes. Most important for commercial environments, it offers high availability clustering and failover for both the application and guest operating system. The Global File System and Cluster Logical Volume Manager insures that application data will be securely accessed and shared by any running virtual application.

Clearly virtualization can offer an enterprise some powerful benefits. Some are more obvious:

- The potential reduction in the overall cost of computing
- The ability to cost-effectively segregate computing environments while using the same server
- The opportunity to provide a sandbox test, development, and debug environment without requiring dedicated servers in order to test complex operating system and application changes or insert fault testing
- The ability to provide training which might otherwise require a complete infrastructure.

Red Hat's approach to virtualization offers additional benefits. Because their approach doesn't stop at the operating system level but also focuses on the application, enterprises can continue to run mission-critical applications as guests in a virtual machine while hardware upgrades and new version to operating system upgrades can be performed at the system administrator's discretion. Unplanned software upgrades are eliminated. In addition, virtualization isolates each guest application making any one application less susceptible to unwanted data or application sharing, sometimes an issue in Web Services deployments. Red Hat's SELinux and Identity Management software provide both user and data isolation.

Sometimes, applications can be over-utilized even on a virtualized server. Either soft or transient errors or temperature fluctuations may require an application be “moved” forcing a “live migration”. Also, heavy financial transactions, batch processing or other intensive applications may require the equivalent of “load balancing”. In these cases, Red Hat’s approach to virtualization allows a “live guest migration” to be initiated over a physical network to another virtual server when necessary.

Finally, Red Hat also believes virtualization doesn’t stop at the operating system level nor is it a panacea. There are several other technology issues CIO’s are grappling with – Cloud Computing, Web Services, appliance-based solutions and multiple vendors to choose from. Red Hat’s “Linux Automation Suite” provides a standard set package of operating system, application and management tool software which is focused on helping businesses easily implement and administer these complex environments. Virtualization is a central component of this strategy. Just as virtualization is a concept to “hide” the physical elements of the technology and “abstract” them into a virtual image, Linux Automation is Red Hat’s strategy to “isolate” the complexities of these technologies so an enterprise can take advantage of the accrued benefits and extend their open environment investments. The Linux Automation Suite solves the key challenges of reducing overall application lifecycle costs and ensuring that server consolidation can take advantage of virtualized applications without degradation of performance. The suite enables a Red Hat Linux-certified application to be run as a software appliance, certified once, deployed many times, “anytime, anywhere”. It simplifies the application development for Red Hat’s Linux software partners and extends the general benefits of virtualization for end users by offering even greater flexibility in using increasingly scarce computing resources.

## Summary

Virtualization as a concept is not new. In fact, operating systems as well as hardware systems vendors are making modifications to their products to more fully integrate and take advantage of virtualization. CIOs and IT decision-makers need to embrace virtualization in the future. Its benefits of overall cost reduction, flexibility in using computing resources and segregating applications cost-effectively are only enhanced by utilizing open software standards. Red Hat is one company that gets it.

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