What is Virtualization?

Virtualization allows multiple operating system instances to run concurrently on a single computer; it is a means of abstracting hardware from a single operating system. All "guest" OSs are managed by a Virtual Machine Monitor (VMM), also known as a hypervisor. Because the virtualization system sits between the guest and the hardware, it can control the guests' use of CPU, memory, and storage, even allowing a guest OS to migrate from one machine to another.

Background

Over the last 10 years, the trend in the data center has been towards decentralization, or horizontal scaling. Centralized servers were seen as too expensive to purchase and maintain. Due to this expense, applications were moved from a large shared server to their own physical machines, often using commodity hardware. Decentralization helped with the ongoing maintenance of each application, since patches and upgrades could be applied without interfering with other running systems. For the same reason, decentralization improves security since a compromised system is isolated from other systems on the network.

However, decentralization's application "appliances" come at the expense of greater power consumption, greater physical space requirements, and a greater management effort which, together, account for up to $10,000 in annual maintenance costs per machine[1]. In addition to this maintenance overhead, decentralization decreases the efficiency of each machine, leaving the average server idle 85% of the time[2]. Together, these inefficiencies often eliminate any potential cost or labor savings promised by decentralization.

Virtualization is a win/win between centralized and decentralized deployments. Instead of purchasing and maintaining an entire computer for one application, each application can partition its own operating system, and all those operating systems can reside on a single piece of hardware. This provides the benefits of decentralization, such as security and stability, while making the most of a machine's resources.

1 http://www.xensource.com/files/xensource_wp2.pdf

2 Ibid.

Why It Matters

As virtualization disentangles the operating system from the hardware, a number of very useful new tools become available. Virtualization allows an operator to control a guest operating system's use of CPU, memory, storage, and other resources, so each guest receives only the resources that it needs. This control eliminates the danger of a single runaway process consuming all available memory or CPU. It also helps IT staff satisfy service level requirements for specific applications by fine tuning resource allocations.

Since the guest is not bound to the hardware, it also becomes possible to dynamically move an operating system from one physical machine to another. As a particular guest OS begins to consume more resources during a peak period, operators can move the offending guest to another server with less demand. This kind of flexibility changes traditional notions of server provisioning and capacity planning. With virtualized deployments, it is possible to treat computing resources -- CPU's, memory, and storage as a cache of resources and applications that can easily relocate to receive the resources they need at that time.

Red Hat Integrated Virtualization with the Xen Hypervisor

With the release of Xen 3.0, virtualization reaches maturity. Xen is the first virtualization solution to support Intel's VT technology enabling each guest OS to run at full processor speed, with only 0.5% to 3.5% overhead incurred by the virtualization process. Guests can migrate from one machine to another in less than 100ms. Through the hypervisor, operators can control the use of CPU, memory, block, and I/O devices dynamically.

Red Hat has incorporated the Xen open source project into its Red Hat Enterprise Linux 5 system. This entailed more than just adding a package. Red Hat improved its management software including provisioning, server management, and storage capabilities and management. Red Hat is also working closely with its ISVs and hardware OEMs to ensure all the features of Red Hat Integrated Virtualization are well integrated and supported by our hardware and software partners.

Xen in Red Hat Enterprise Linux 5 will be capable of running multiple copies of any Red Hat operating system as well as other operating systems such as Microsoft Windows and Sun Solaris.

Possibilities of virtualization

Once Xen's basic virtualization features are understood, many exciting applications become possible. In the same way that virtual LANs allow administrators to ignore the physical layout of their networks, virtualized operating systems allow administrators to ignore their physical installation. The hardware in the data center becomes truly commoditized – hardware upgrades can occur seamlessly, without the OS or application realizing that its host machine has been changed. Downtime can be dramatically reduced.

Administrators no longer have to wait for every application to be certified on a new operating system release before an upgrade. Just migrate the guest OS, and everything works as before. During regression tests, a testbed can be created or copied easily, eliminating the need for dedicated testing hardware or redundant development servers.

In security, virtualization is an elegant solution to many common problems. In environments where security policies now require systems separated by a firewall, those two systems could safely reside on the same physical box. In a development environment, each developer can have their own sandbox, immune from another developer's rogue or runaway code.

If virtualization is tied to a system monitoring solution, or to a provisioning and management tool like Red Hat® Satellite Server, systems could be migrated automatically to better-suited hardware during periods of peak use or maintenance. Imagine a farm of servers which can be re-tasked in seconds, according to workload and time of day.

Xen Adoption and Red Hat

Given the current level of performance and maturity, and the possibilities it provides, Xen is the undisputed leader in open source virtualization. Dozens of corporations and universities are involved in the project, including Red Hat, IBM® , Oracle® , Intel® , AMD® , Cisco® , and Veritas® . Red Hat has been an early adopter of Xen, an active contributor, and has already incorporated the code into its Fedora distribution. Xen is also a crucial component of Red Hat Enterprise Linux® 5. Red Hat has already released early beta code of Red Hat Enterprise Linux 5 and many key partners and customers are planning to adopt this release soon after it is introduced this winter.

Virtualization is only one part of Red Hat's larger strategy to commoditize each major computing component, and make it simple for administrators to bring computing resources to the application that needs them. With the advent of the Global File System, storage is easily allocated and still delivers a high level of performance. Red Hat Network allows administrators to treat systems as generic resources that can be easily installed, upgraded, retasked, and reallocated. Together, GFS, RHN and virtualization free an application from the technical and logistic constraints that are so familiar to the data center, realizing Red Hat's vision for scalable, flexible, reliable, and manageable enterprise computing.

Related Articles, Sites of Interest

Red Hat Virtualization Center: www.openvirtualization.com
Fedora and Xen Kickstart: http://www.fedoraproject.org/wiki/FedoraXenQuickstart
Red Hat Virtualization videos: http://www.redhat.com/virtualization/multimedia/
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