BEST PRACTICES 2007

University of California, Santa Cruz Server Virtualization

Implementing a virtual server infrastructure at UCSC has significantly increased the capacity of the campus data center without impacting its power and cooling loads. With a host of benefits for enhanced server management, virtualization can help campuses improve IT services and energy efficiency simultaneously.

Award Category

HVAC Retrofit

System Features

Additional data center capacity created without increasing cooling load

Enables centralization of dispersed servers into secure data center

40 new server purchases avoided

Inefficient servers decommissioned

Increased utilization of servers and storage

Increased reliability and security

Reduced administrative overhead and lower total cost of ownership

Faster deployment of new server requests

Annual Energy Savings

187,000 kWh

20 kW peak demand

$22,000

Cost

$160,000

Completion Date

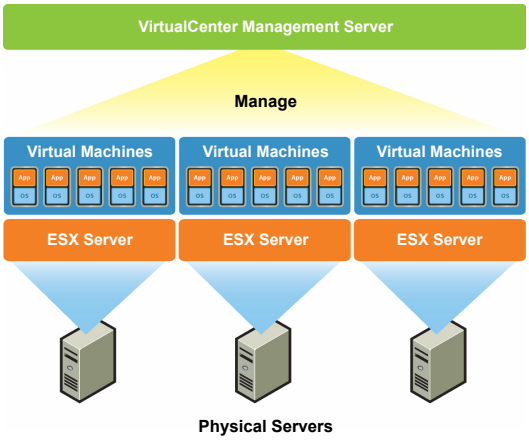
April 2007

Information technology (IT) is a university's lifeblood, providing the computing and communications resources that facilitate everything from research to administrative support. The IT department at UC Santa Cruz previously centralized a majority of the university's servers into a dedicated data center to provide a secure and reliable environment for campus IT operations. After two years of server migrations and the addition of several large research computer clusters, the facility began to near its cooling capacity. At the same time, dozens of smaller servers were still scattered around the campus. The IT department saw an opportunity to remedy both of these problems simultaneously by creating a virtual server infrastructure.

Server virtualization consolidates the operations of many dispersed servers onto fewer physical machines. Virtualization software decouples a server's operating system from its physical hardware to create a "virtual machine". This single software file encapsulates the entire server— its operating system, applications, and virtual hardware. Many virtual machines with heterogeneous operating systems can be run at the same time on the same physical host server, enabling the sharing of hardware resources.

A virtual server requires an average of one-eighth the power and cooling of a stand-alone server.

The ability to run multiple virtual machines on a single physical server has significant implications for the energy required to power campus IT services. Before virtualization UCSC was operating dozens of lightly-loaded servers in isolation. Some of these servers were being utilized at only 1 to 2 percent of their full computing capacity. Power and cooling had to be provided continually to this dispersed and underutilized IT hardware, which operates on a 24/7 basis. Sharing hardware resources and storage space through a virtual environment allows the university to operate fewer physical servers and avoid cooling extra equipment. The resulting energy savings are significant, since a virtual server uses about one-eighth the power and cooling of a stand-alone server.



VMware Infrastructure. *Each physical server hosts several virtual machines, each of which is its own complete server. Image: © VMware, Inc.*

UCSC has achieved a tremendous increase in the number of servers it can host in its data center. Before virtualization the facility was nearly at capacity with 188 physical servers. With the virtual environment in place this number has increased to 240 physical and virtual servers, and additional capacity is available. So far the campus has virtualized 14 existing servers and avoided purchasing 40 new servers by deploying virtual machines instead. These 54 servers are hosted on just 8 physical machines. The project reduces UCSC's peak energy use by 20 kilowatts, and saves $22,000 in energy costs annually.

Changes to the campus server infrastructure will generate both energy and administrative cost savings. These savings are made possible by the increased reliability and flexibility of the server infrastructure, and through opportunities to centralize and streamline IT support

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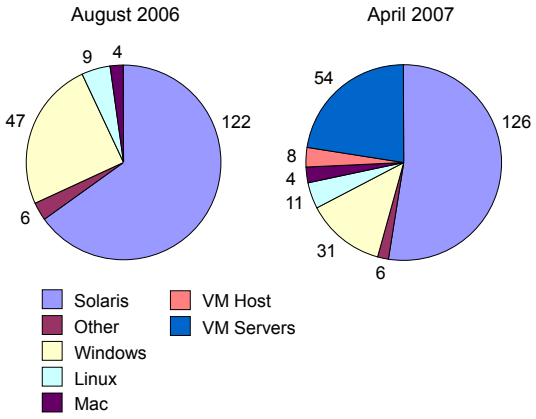
More Information

its.ucsc.edu/core_tech/projects/server_consolidation/index.php

vmware.com

services. Third-party analysis by Gartner Consulting confirms that significant administrative cost savings will emerge when appropriate policies and processes are established.

From the client's perspective, a virtual server environment looks and behaves identically to his original server. Each virtualized server has its own set of virtual hardware upon which the client's familiar operating system and applications are loaded. The familiar interface afforded through virtualization makes transitioning easy for the client, while many opportunities for improved IT support are created behind the scenes.



In 2006 the constrained data center held 188 servers. The facility now holds 240 physical and virtual servers. Image: David Klein.

Staff can respond to IT requests more quickly and effectively due to the higher flexibility of the new server environment. With computer resources easier to configure and deploy, new server requests can be filled promptly, and in as little as 48 hours if necessary. Virtualization will also help the campus transition to a centralized IT support staff, which allows for better leveraging of human resources and expertise than in a decentralized IT model.

The virtual server environment creates opportunities to reduce costs associated with preventing and resolving security breaches. Platform standardization enables better security monitoring and enforcement, and IT staff can execute uniform and regular security and virus patches across virtualized servers.

Servers previously using less than 5% of their full capacity are now at 70% utilization, resulting in better use of the campus's existing hardware.

Disaster recovery is highly expedient in the virtual server environment. If a host server fails, each virtual server is a single, easily portable file that can be copied to any other host server running VMware®, the virtualization software selected by the university. Since redundant backup copies of virtual servers are generated regularly, it can take just minutes to have a failed system running again with no interruption to the client.

Perhaps the most important benefit is the capacity for virtualization to maximize data center space and storage efficiency, delaying the university's need to construct a new facility. Improving the performance of an existing data center is the greenest way to manage a campus's growing IT needs, and UCSC will prolong the life of its facility by continually expanding the virtual server environment.

LESSONS LEARNED

UCSC's IT department warns that gaining permission to virtualize servers may be challenging. Ownership of servers may be unclear, and time spent locating the appropriate parties can delay project deliverables.

The project exemplifies the value of collaboration across departments that do not typically interact. Many synergies exist between the effective deployment of information technology and the pursuit of energy efficiency. Opening a dialogue between staff in campus IT and physical facilities departments can reveal these synergies and foster the development of projects that further both departments' mission.

Best Practices is written and produced by the Green Building Research Center, at the University of California, Berkeley.

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