NC State makes a breakthrough in improving access to academic computing resources.

Overview

- ***Business Challenge***
  Growing demand for academic computing resources at NC State made it increasingly difficult to deliver the service level that its key user populations – students, instructors, researchers and administrators – required. NC State needed to fundamentally change the way it managed these resources.
- ***Solution***
  In collaboration with IBM, NC State looked to the domain of high-performance computing to create a new "cloud computing" model for provisioning technology that offers a quantum improvement in access, efficiency and convenience over the traditional computer labs it had relied on.
- ***Key Benefits***
  - *Projected savings in software licensing costs of up to 75 percent*
  - *150 percent increase in students served per application license*
  - *Increased flexibility to shift computing capacity between instructional, research and administrative needs*
  - *Ability to meet significant growth in enrollment without building additional computer labs*

Based in Raleigh, NC, North Carolina State University is a comprehensive university known for its leadership in education and research, and globally recognized for its science, technology, engineering and mathematics leadership. NC State has more than 31,000 students and nearly 8,000 faculty and staff.

As a look into virtually any college or university will tell you, academic computing has grown steadily more integral to the way institutions of higher education fulfill their multi-faceted missions. While the ubiquity of personal technology devices on campus may be its most familiar sign, the effect of this trend on the overall educational experience runs deep and broad. In the classroom, it is basically reshaping the way instructors and students interact, while giving students greater exposure to the technology tools they will be dependent on in the "real" world.

> *"Our goal was to rethink the way we met the academic computing needs of students, instructors and the other populations we serve. By collaborating with IBM, we are now better able to deliver on that mission."*
>
> – Mladen Vouk, head of the Department of Computer Science, North Carolina State University

Business Benefits

- Projected savings in software licensing costs of up to 75 percent
- 150 percent increase in students served per application license
- Higher student satisfaction through more convenient access
- Improved access to most recent software releases for instructors
- Increased flexibility to shift computing capacity between instructional, research and administrative needs
- Ability to meet significant growth in enrollment without building additional computer labs
- Overall improvement in server utilization levels

The infusion of technology is also raising the bar for academics to find more innovative ways to engage students, while at the same time providing them with a growing pool of computational power to push the boundaries of academic research. Perhaps most importantly, the growth of academic computing is helping colleges and universities meet what is arguably their paramount goal of improving access.

But as technology has become more pervasive on campuses – and enrollment continues to grow – institutions striving to keep pace with ever-growing resource requirements are coming under increasing strain. The need for increased raw computing capacity to support a continually growing user base is just one dimension of this. The bigger and more complex challenge for schools is to provide a level of service that meets the diverse needs of their "customers," the students, instructors, researchers and administrators whose everyday lives have become deeply dependent on technology. North Carolina State University (www.ncsu.edu) is one institution that – with the help of the IBM Research Triangle Park Center for Advanced Studies (CAS) – took a decidedly unique approach in addressing this challenge. As with most universities, NC State's campus-based computer labs represent an important conduit through which its students access (and instructors deliver) curriculum-related applications, especially those that are more costly or require intensive processing, such as engineering programs. When a new application or release comes out, instructors typically approach the IT organization with a request to update the back-end system, where applications are embedded into a series of application clusters or "images" – each of which are accessed by specific classes in specific labs.

> *"Deploying a new software application in our student labs on a timely basis had become a major challenge due to the sheer volume of software utilized in our engineering programs. A more scalable approach was clearly needed."*
>
> – Thomas K. Miller III, vice provost for Distance Education and Learning-Technology Applications, North Carolina State University

Hampered by complexity

For NC State, it became increasingly difficult to fulfill these requests. The reason was complexity. For NC State's IT staff, one of the biggest challenges to preparing an image was in making sure all the applications within it interacted smoothly. Because it took so long to perform the necessary integration and testing, IT was forced to impose a deadline on the porting of new applications months before classes were due to start. As a result, instructors wishing to add the latest applications or releases had to wait as long as a year to get them in the hands of students. To fill that gap, NC State envisioned a more flexible, user-driven provisioning framework that would enable fundamental change – in the way the university's internal customers access academic computing resources and, more broadly, in the way these resources are managed. While its physical computer labs would continue to play a key function, NC State sought to move beyond them for the benefit of all key university stakeholders.

In moving from conception to design, NC State established two basic requirements. The first was a modular yet integrated pool of computing resources; the second was a platform to efficiently and centrally manage it. The university chose to deploy the IBM BladeCenter® platform in various places across the university to run high-performance computing applications. While the BladeCenter's native management capabilities for functions like remote deployment provided a solid foundation, NC State's proposed solution would also require advanced scheduling capabilities to enable automated provisioning.

To address this need, NC State worked with local IBM BladeCenter development and CAS, the latter an outreach organization within IBM designed to foster information exchange with university researchers. As an outgrowth of this collaboration, NC State decided to employ an IBM open-source management tool known as Extreme Cluster Administration Toolkit (xCAT) – which had been used principally for workload scheduling in high-performance computing environments – and import that functionality into an academic computing environment. Using these building blocks, NC State built a first-of-a-kind provisioning and scheduling system – known as the Virtual Computing Lab (http://vcl.ncsu.edu/) – that has completely redefined the way students, faculty and researchers interact with NC State's IT resources, and has enabled the university to reach a new level of resource optimization. Distinct from a grid computing solution, and operational now for almost five years, VCL was, in effect, the first true "cloud computing" solution developed for education – long before the term became popularized.

In designing VCL, NC State put a premium on simplicity and convenience, qualities that are perhaps most evident at the user interface level. Perhaps the most basic difference is that users can access VCL from anywhere they want, enabling them to trade the inconvenience of a late night at the lab for the convenience of their own dorm room, office or home. Based on their access privileges, users can select a granular application image (consisting of the operating system and a suite of applications) either for current use or future use, at a set time and for a set duration. Instructors can create block reservations for an entire class, reserve clusters of servers and even add new applications – all without the assistance of NC State's IT staff. Some of VCL's most noteworthy properties are enabled by the system's intelligent provisioning architecture, which automatically allocates blade computing capacity in accordance with each user's needs. Once a scheduled session is over, that user's "virtual space" – which had been running on one or more blades – is wiped clean, enabling the blades to be put back in the resource pool, where they can be re-provisioned by other users as needed.

Solution Components

Software

- IBM Extreme Cluster Administration Toolkit (xCAT)

Servers

- IBM BladeCenter

Services

- IBM Research Triangle Park Center for Advanced Studies (Raleigh, NC)

Smarter Education

With demand for academic computing resources skyrocketing, NC State took a flexible and intelligent provisioning system originally developed for high-performance computing and adapted it to meet the university's broader technology needs. By introducing virtualization into academic computing, NC State has changed its basic formula for managing its resources, enabling it to deliver more resource support across the university at lower cost.

While its decision to fundamentally change application provisioning was driven by the need for better service, NC State also saw the benefits of such a change spilling into other critical areas. For instance, under its more fixed, location-based application model, NC State was essentially forced to "over-provision" to ensure that a certain number of lab-based machines were equipped to deliver specific applications. With its new self-provisioning model, NC State can now follow a more efficient licensing strategy based on real utilization, reducing its future licensing costs by up to 75 percent. What's more, the model's greater flexibility of access has enabled the university to increase the average number of students served per license by more than 150 percent. The net result – fewer application licenses serving more students at a lower cost – epitomizes resource optimization through flexibility.

University-wide benefits

NC State's intelligent provisioning system also improves its ability to flexibly allocate resources between instructional, administrative and research activities, each of which has its own peaks and valleys of resource requirements. A key example is the near complete drop-off of student computing activity that is typical during breaks between semesters. The new system gives NC State the ability to quickly and easily switch the bulk of its roughly 1,000 IBM BladeCenter server blades to the computationally intense requirements of researchers – such as running complex models and simulations – and in the process leveraging what would have been idle server capacity to advance the goals of the university's researchers. The same capability would enable NC State to shift capacity to administrative functions like class registration that produce a surge in processing activity before each academic semester.

All of these benefits point to how intelligent provisioning and similar "cloud" initiatives effect the more granular optimization of computing resources, which enables NC State to handle the academic computing requirements of a growing student population while minimizing the growth of its infrastructure. Mladen Vouk, head of the Department of Computer Science at NC State and one of the project's key visionaries, believes that the new solution heralds a shift in the way universities address the challenges of academic computing in a time of tight resources, growing enrollment and rising expectations. "Our goal was to rethink the way we met the academic computing needs of students, instructors and the other populations we serve," says Vouk. "By collaborating with IBM, we are now better able to deliver on that mission."

For more information

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