Problem
The objective is to provide a high performance and high throughput computing environment to support various multidisciplinary research projects for faculty and researchers in the university, and to provide curriculum services to students of computer science and other disciplines in the university.

Solution
The BJUT Cloud Initiative, hosted at the College of Computer Science, consists of high performance hardware infrastructure and various software services. The hardware infrastructure is IBM systems-based.

Goals
- Accomplish an agile on-demand deployment of the diverse high performance computing and high throughput environments
- Provide dynamic computing resource provisioning to serve a variety of application jobs
- Create a highly effective learning environment and a state-of-the-art experimental platform for students to gain real-world cloud computing experiences and to evaluate and test research results in a large and scalable system

Results
- A virtual parallel computing environment, the scale of which ranges from eight to 100 virtual nodes
- Up to 32 virtual computing environments concurrently managed
- A 30-minute average in time elapsed for environment deployment
- Savings of 35-50 percent in physical resources cost using virtualized technology

Beijing University of Technology
Founded in 1960, Beijing University of Technology (BJUT) is the flagship university under the administration of the Beijing municipal government. It is a leading university for sciences and engineering in the country, which has been named as one of the 100 national universities for the 21st century in China (a member of China’s elite 211-University group).

BJUT offers a set of rich, comprehensive programs in education and research in major fields of science and engineering. It offers strong business and technology management programs at undergraduate and graduate levels. The university has recently started several programs in the fields of social sciences and liberal arts. The student enrollment of the university includes about 13,000 undergraduate students and 5,000 graduate student students in its 43 B.S. programs, 98 M.S/ M.E programs and 45 Ph.D. programs. BUJT has about 1,500 full time faculty members in its more than 20 academic colleges and research institutes.

The BJUT Cloud Initiative is hosted at the College of Computer Science, which has a long history and excellent tradition of experimental computer systems research. In the 1980s, the faculty and researchers of computer science and engineering at BJUT played a key national leadership role in developing single-board computer systems with intensive research. The systems in both hardware and software had been widely used in various industrial and business applications as well as in college education and research in China. Several computer science graduates of BJUT have distinguished themselves and play strong leadership roles in both academia and industries in the country and worldwide, including Dr. Xiaodong Zhang, IEEE Fellow, Distinguished Professor and Chair of Computer Science and Engineering Department at the Ohio State University in the U.S., and Dr. Songnian Zhou, Member of the Canadian Academy of Engineering and CEO of Platform Corporation.

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The challenge

The ultimate goal of the BJUT cloud initiative is to provide a high performance and high throughput computing environment to many researchers and students in the university for their computing and multidisciplinary research and education activities.

High performance computing and fast data accesses have been a basic requirement for both research and education activities in any science and engineering fields. BJUT is facing a common challenge today: Each discipline is trying to grow its own computing service for research and education in an isolated way. This will significantly increase the costs for power consumption, physical space, human support for system maintenance, and redundant hardware infrastructure and software services. In such an isolated and individual environment, computing and storage utilization is normally very low.

A centrally managed cloud computing environment at BJUT would fundamentally address this long-term and difficult challenge. The cloud computing platform at BJUT will provide different users with different services by its hardware infrastructure, by its software for various applications, and by its computing platforms for various execution demands.

The solution

The cloud solution at BJUT consists of both high performance hardware infrastructure and various software services.

On the BJUT Campus Cloud Platform, the hardware infrastructure (the physical node pool) is IBM systems-based. There are a total of 84 computing nodes interconnected to form a cluster-based computing pool. Each computing node is an IBM BladeCenter® HS21 server with 2 4-core CPUs, 16GB memory and 146GB hard disk. All nodes are interconnected with a 1-Gb Ethernet.
In this cluster, we also provide software support called the computing pool, where the IBM Blue Cloud™ software is installed. IBM Blue Cloud virtualizes the computing pool and provides users computing resources based upon their demand. Beyond the node-level provision, we are also able to provide the core-level computing resource provision (a core is a unit for a virtual node). Eight virtual machines can crowd on a physical computing node while owning the isolated physical resource consuming. With the feature of software automatic deployment in Blue Cloud, users can customize their computing environments, covering from the operating system (for example, Microsoft Windows, Red Hat Enterprise Linux), to the parallel library (MPICH2, Open IMP, and Hadoop). This is how agile, on-demand deployment of the diverse parallel computing environments can be achieved.

This system has been successfully used in the Second Parallel Programming Competition with Cloud Technology hosted by BJUT in 2010. This competition consisted of a total of 29 teams from eight universities. The parallel computing environments required by the teams are very different, ranging from Windows+MPI, Linux+Open MPI, Linux+Hadoop, and others.

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