

SOLUTIONS

- HPC



BUILDING A FOUNTAIN OF KNOWLEDGE

Texas Tech University attracts \$4 million per year in research funds and speeds research results by 4x to 16x with Dell cluster



CUSTOMER PROFILE

COUNTRY: United States

INDUSTRY: Education

FOUNDED: 1923

NUMBER OF STUDENTS: 30,000

WEB ADDRESS: www.ttu.edu

CHALLENGE

Texas Tech needed to build a new high performance computing (HPC) cluster to attract top-name researchers, accelerate research efforts with the fastest technology, and help fulfill its mission to be in the top tier of Texas research universities.

SOLUTION

The university deployed an HPC solution with Dell™ PowerEdge™ servers running Rocks Cluster Distribution software on CentOS Linux operating system with InfiniBand high-speed interconnects. Dell ProManage Services deployed and installed the cluster in only three weeks.

BENEFITS

GET IT FASTER

- 3-week installation of cluster with Dell ProManage Services
- Leveraged existing Dell Strategic Partnership to order and receive equipment expeditiously

RUN IT BETTER

- 4x to 16x faster research results compared to previous cluster
- 20 teraflops of computing power
- Up to 100% utilization

GROW IT SMARTER

- Ability to attract top name researchers and \$4 million annually in research grants

The Dell logo, consisting of the word 'DELL' in a stylized, white font with a red outline, set against a black circular background.

Grendel, the beloved antagonist of the Old English epic Beowulf, has spawned mountains of research performed by graduate students and scholars of English literature. However, in the monster's latest incarnation as a high performance computing (HPC) cluster at Texas Tech University, Grendel is a veritable fountain of new knowledge. Grendel is helping scientific researchers to complete their work in fields ranging from computational chemistry to high-energy physics. Some of this work has already won praise as outstanding research in fields from chemistry to chemical engineering, and Texas Tech University anticipates more accolades going forward.

“THE NEW DELL CLUSTER WILL HELP US RECRUIT NEW RESEARCHERS. A NUMBER OF OUR MODELS ARE RUNNING FROM 4 TO 16 TIMES FASTER.”

Sam Segran, CIO, Texas Tech University

With an enrollment of more than 30,000 students, Texas Tech University is dedicated to attaining two major initiatives. “One, it continues to be a major initiative for the university to attain tier one research university status in Texas,” says Sam Segran, CIO of Texas Tech. “Two, we are constrained by budget and space, so a lot of our decisions are based on maximizing our resources by using them efficiently. Those are the driving factors for us to do the right thing for Texas Tech.”

ATTRACTING RESEARCHERS—AND GRANTS

To attract outstanding researchers, as well as Federal, State, and private grant funding, the university has to provide facilities in high performance computing—the biggest and best it can afford. A few years ago, the Texas Tech High Performance Computing Center (HPCC) decided to migrate from a proprietary mainframe supercomputer for its high performance computing facilities to a high-performance computing cluster—a group of commercial, off-the-shelf computers interlinked with high-speed interconnects to create a robust,

high-speed computing resource that rivals the performance of traditional mainframe supercomputers at a fraction of the cost.

The cluster, named Hrothgar (also after a character in Beowulf), consisted of 128 Dell PowerEdge servers with Intel Xeon processors, and was successful in attracting the attention of high-caliber researchers. Among the researchers attracted to Texas Tech in part due to Hrothgar was Dr. William L. Hase, whose groundbreaking work on roundabout mechanisms challenges the cherished models of reaction mechanisms in organic chemistry. “I had an interview with Dr. Hase when he was considering Texas Tech, and he understood that we would be able to support his computing needs,” says Dr. Philip Smith, director, High Performance Computing Center, Texas Tech University.

20 TERAFLUPS OF COMPUTE POWER

Time, speed and space expectations change quickly in the world of HPCCs. Today's high performance is dwarfed quickly by new generations

HOW IT WORKS

HARDWARE

- Dell™ PowerEdge™ 1950 servers with Intel® Xeon® E5450 processors
- Dell PowerEdge 2950 servers with Intel Xeon 5430 processors
- Dell PowerConnect™ 6248 switches
- QLogic 12300 36-port 40Gbps InfiniBand switches
- QDR InfiBand

SOFTWARE

- Rocks Cluster Distribution cluster management software
- CentOS Linux operating system
- Lustre File System

SERVICES

- Dell ProManage Services (Deployment and Installation Services)

“THE NEW DELL SUPERCOMPUTING CLUSTER WILL ACCELERATE CURRENT TEXAS TECH RESEARCH PROJECTS THAT COLLECTIVELY GENERATE APPROXIMATELY \$4 MILLION IN RESEARCH FUNDS EACH YEAR.”

Dr. Philip Smith, director, High Performance Computing Center, Texas Tech University

of processors which drastically change price performance ratios. Researchers always want faster performance, and Intel's quad-core processors have drastically improved the performance of x86-based hardware. Texas Tech University's newest cluster, Grendel, has 210 Dell PowerEdge servers with Intel Xeon E5450 processors for a total of 1,680 cores. At its peak, Grendel puts out around 20 teraflops, or 20 trillion floating point operations per second. The university plans to double the number of server nodes in the near future, bringing Grendel to 3,360 cores.

Grendel uses QLogic 12300 36-port 40Gbps InfiniBand switches to get maximum performance from quad-data rate (QDR) InfiniBand and to conserve space and dollars. “On Hrothgar, we were interested in buying a large machine with a high-performance interconnect, and Dell proposed the system with InfiniBand,” says Dr. James Abbott, associate director, High Performance Computing Center, Texas Tech University. “We went with it, and we're happy we did decide to use InfiniBand for Grendel.”

Rocks Cluster Distribution cluster management software with CentOS Linux operating system provides the platform for the cluster. Eight Dell PowerEdge 1950 nodes combined with Lustre File System provide high bandwidth access to 100 terabytes of DataDirect Network storage over a Fibre Channel network. One Dell PowerEdge 2950 server with Intel Xeon E5430 processors functions as a management node for the cluster. The system is managed using Dell

PowerConnect 6248 switches with stacking modules to provide a single virtual switch network.

Dell ProManage Services installed the cluster in just three weeks. “We are very happy with Dell's performance,” says Abbott. “The Dell deployment and installation services were fast and efficient.”

OUTSTANDING SUPPORT AND PARTNERSHIP

Texas Tech University evaluated three other vendors along with Dell. Clearly price per flops was the key criterion, but Dell was the distinct leader on several fronts. “Dell has been our primary partner for our servers, desktops and laptops for a number of years,” says Segran. “And our experience with Dell has been exceedingly good, from Dell's administrative side to the account executives who oversee our account. Throughout our strategic partnership history, Dell professionals have always been great people to work with and have always been with us whenever we have needed them, and the technical support and expertise they bring to the table is just outstanding.”

That support includes standard warranty support on the cluster nodes with 24-hour replacement of parts. “We've been very happy with Dell's support,” says Abbott.

\$4 MILLION IN RESEARCH FUNDS PER YEAR

The Texas Tech University IT team consulted with researchers to help them determine what they needed to

know to meet the increasing demand for a higher density computing environment. “The new Dell cluster will accelerate current research projects and help us recruit new researchers,” says Segran. “A number of our models are running from 4 to 16 times faster on Grendel than on Hrothgar.”

For one graduate student, the difference has been key to completing his research. Casey Richardson is a research assistant working on his master's degree, funded by the National Institutes of Health. He created an algorithm to search for MicroRNAs—genes that are made from DNA but differ from other genes in that they do not encode proteins. The discovery of MicroRNAs in the 1990s opened the field of RNA interference, and was the subject of the 2006 Nobel Prize in Medicine and Physiology. By discovering new MicroRNAs and elucidating the mechanisms of how they turn off other genes, for example, a cancer gene could be made to de-activate.

“I was stalled in my research with the old system, as it just was not powerful enough to run the computations. I was able to run only about one percent of my work,” Richardson says. “With Grendel, I finished a project in a week that had been stalled for about three months. The staff of the High Performance Computing Center helped me refine the algorithms I was using to take full advantage of Grendel's scalability.”

“The new Dell supercomputing cluster will accelerate current Texas Tech research projects in high energy

physics, molecular dynamics, computational chemistry, fluid flow modeling and other areas that collectively generate approximately \$4 million in research funds each year. The new facility also provides room for on-site support staff and additional computing capacity as the need arises," says Smith.

Dr. Sukanta Basu's group at Texas Tech University utilizes a new generation numerical weather prediction model (the Weather Research and Forecasting - WRF model) and an in-house MatlabMPI-based large-eddy simulation (LES) model to perform multi-scale, multi-physics simulations of the Earth's atmosphere. "These simulations generate very high-resolution four-dimensional atmospheric flow fields that help probe and better understand several complex atmospheric phenomena," says Basu. "They are also invaluable in tackling practical problems like wind energy generation and air pollutant dispersion. The new Dell cluster has enabled us to significantly improve the grid-resolution of our simulations, and in turn this has enhanced quality and reliability."

UP TO 100% UTILIZATION

At first researchers were expecting that it would take weeks to run their projects and were surprised when they ran in a few days. "It's taken us a while to get up to speed on usage, because researchers were used to much slower speeds," says Smith. "But now we're seeing utilization rates of 80 to 100 percent. When all the researchers are here on campus, we'll see full utilization."

Both Grendel and Hrothgar were configured so that departments in the university can purchase their own compute nodes that can be added to these clusters. This program is called the community cluster initiative. Each department is guaranteed the use of 100 percent of its

own nodes plus idle resources available at the time of their job processing. "The whole idea behind a community cluster is to get maximum utilization without building clusters all over the university when just one will do," says Segran. "Obviously we're saving space, power and cooling with this concept and providing administrative services so that faculty members don't have to be data center managers."

High performance computing is a mission-critical service delivery point for Texas Tech University. "We have to deliver these services to our researchers in order to fulfill our mission, which means that this is one of the points where IT has the ability to negatively or positively impact our institutional mission delivery," says Dr. Katherine Austin, assistant vice president, Texas Tech University. "It was crucial to have a strategic partnership and alliance with a reputable, dependable, responsible and capable partner, and that is just what Dell is for Texas Tech University."

Darrell Bateman, assistant vice president, Office of the Chief Information Officer, Information Technology Division, Texas Tech University, agrees. "Dell changed the performance game for us when they began competing in the HPC space," he concludes. "Dell's product lines and expertise are a natural fit for high performance computing, as evidenced by the rapidly growing number of Dell-based clusters found on the TOP500 Supercomputer Sites list."

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