Rebuilding a research powerhouse

Tulane University deploys new high-performance computing cluster to analyze big data, enable new scientific research and attract top talent

“There’s a federally funded national initiative to map the human brain. What a terrific computational challenge that is. It’s going to be wonderful, and I want Tulane to be a part of it. We have that opportunity now.”

*Dr. Laura Levy, Vice President of Research, Tulane University*
New Orleans’ Tulane University prides itself on being a cutting edge research institution. Designated by the Carnegie Foundation as a research university with “very high research activity,” the school was recently ranked by the Ford Foundation as one of the top 15 research institutions in the United States, and the major International Studies research university in the South.

But the school’s reputation—in fact, its very existence—was jeopardized in 2005, when Hurricane Katrina devastated the campus, along with the entire city of New Orleans. “After Hurricane Katrina, it’s difficult to describe how close to death both Tulane University and the city of New Orleans were,” says Dr. Laura Levy, the university’s vice president of research. The storm’s floodwaters had such a devastating impact that the school was actually forced to shutter entire departments. “The university had to make some very tough decisions about what to retain and what to continue to invest in, and computer science regrettably was one of those majors that was eliminated,” states Dr. Nicholas Altiero, the school’s dean of science and engineering.

Researchers need high-performance computing capabilities

Another casualty of Katrina was the university’s high-performance computing (HPC) infrastructure. “I think it’s clear that scientists depend now, more than ever, on computational modeling and simulation to accelerate discovery. It’s data-intensive. It requires high-performance computing,” Levy says. However, the hurricane put the university well behind in its efforts to rebuild its HPC capabilities, which are essential to power big data analysis and new scientific research. “We found ourselves struggling to put the components in place that were necessary for a major research university,” says Charlie McMahon.

Tulane’s CTO and vice president of IT. For example, the school has numerous oncology research projects that involve statistical analysis of large data sets. “These projects involve modeling incredibly complex biological systems, so the ability to manipulate large data sets is critically important,” says Altiero. Tulane also has a large number of scientists and engineers studying nanotechnology, the manipulation of matter at the molecular level. “As you can imagine, when you’re dealing with anything at the molecular level, you have a large amount of data to deal with, and so high-performance computing is essential to doing anything in that field,” Altiero adds.

“The Cypress cluster, based on Dell technology, is going to bring to us a whole new level of infrastructure that will make our current faculty members want to stay here. It will also help us to attract new faculty members.”

Dr. Nicholas Altiero, Dean of Science and Engineering, Tulane University
For Tulane, rebuilding its HPC infrastructure was paramount to attracting top researchers to the university. “If researchers don’t perceive that they have an IT environment that supports their careers, they’re going to have a career somewhere else,” says McMahon.

Tulane works with Dell to deploy Cypress, a new HPC cluster

Tulane initially worked with Dell to simplify the university’s IT environment and standardize on Dell PowerEdge servers, Dell PowerConnect switches, and Dell EqualLogic storage arrays. But the school still needed to create a new HPC cluster. The journey toward that cluster started when McMahon attended the annual Dell World conference, where Dell executives introduced him to the high-density, low-latency Dell Networking Z9500 switch, powered by Intel® Xeon® processors. The Z9500 switch has the highest density per RU in the networking industry, with 132 40GbE ports in just 3RU.

Intrigued, McMahon then learned from a Dell representative that the switch’s latency is 600 nanoseconds. “Now, when he said that, that got my attention,” says McMahon. “This is Ethernet that performs like InfiniBand.” Excited by the features in the Z9500, McMahon and his colleagues decided to work with Dell to make the Z9500 the backbone of a new HPC cluster dubbed Cypress. Cypress consists of 124 Dell PowerEdge C8220X server nodes, connected through the Z9500 switch. The cluster features 2,480 Ivy Bridge cores and more than 15,000 Intel® Xeon Phi™ processor cores, providing a total computational theoretical peak performance of more than 350 teraflops.

A supercomputer that is powering big data analysis and supporting new research

Tulane now has a supercomputing architecture that is helping power the analysis of big data and support scientific research. “As Tulane was looking at how to build an architecture, Dell became clearly the leading partner for us to figure this out,” says McMahon. “Dell leveraged their relationship with Intel, who in turn leveraged their relationship with Cloudera. For one of the first times ever in production, we are going to have an environment that takes a high-performance file system, Lustre, layers Hadoop on top of that, and allows us to do big data analytics using Hadoop in an HPC environment. That’s what makes the approach that Tulane is taking so unique, so leading edge.”

The university also partnered with Dell to create the Tulane Science DMZ (demilitarized zone) perimeter network, which includes Dell Networking Z9000 and S4810 switches that connect directly to researchers’ desktop computers and laboratories to improve security. Tulane also chose Dell Networking N3000 Series switches as the edge switches for the distribution network in the school’s new football stadium. “All communications technologies in the stadium, from scanning tickets to cash registers to vending machines to VoIP, rely on Dell Networking,” says McMahon.

Enabling new scientific research

The university is using Cypress to enable new scientific research in fields such as epigenetics, the study of the mechanisms that regulate gene activity. “We’re really trying to integrate a lot of different data sources, and the high-throughput computing environment enables that kind of research in ways that were not possible before,” says Michelle Lacey, Ph.D., associate professor of mathematics at Tulane.

Tulane is also relying on Cypress to get more accurate information on flow cytometry, the measurements of the existence of certain subsets of cells within a kind of tissue in the human body. “In the old days, you could stain cells so you could see a certain property being stained or not stained...
in a microscope, and the samples were about one hundred cells on a slide,” says Calvin Lanclos, a medical research specialist studying flow cytometry at the school. “These days, you can sample half a million cells. And with this kind of equipment, one of the things we hope to achieve at some point is the discovery of a vaccine for some disease that’s plaguing mankind.”

Accelerating discoveries based on primate research
Researchers at Tulane are also using Cypress in conjunction with the Tulane National Primate Research Center, where they continue to analyze 40 years’ worth of data including tissue samples and DNA/RNA sequencing. As a result, the researchers can do modeling and experimentation via high-performance computing, reducing the amount of experimentation on animal colonies. “We have huge amounts of data that have been generated from these animals, and to handle that data you need an instrument like the supercomputer that we have,” says Dr. Andrew Lackner, director and chief academic officer of the Tulane National Primate Research Center. “It allows us to use all the resources we currently have on the animals much more efficiently and to get more data faster, and anything you can do to accelerate the rate of discovery will have roll-on effects toward human health.”

Making sports safer
Tulane University is also using Cypress to gather and analyze big data surrounding sports-related concussion research. The university also uses Cypress to determine the impact of sports injuries on young athletes. “A really great opportunity here is the use of our new supercomputer Cypress to be able to collect an incredible amount of data, to be able to determine the risks in playing sports, not only football but all collision or contact sports,” states Gabriel Feldman, director of sports law and co-director, Center for Sport at Tulane University. “That could give us the ability to change the way that not only are the sports played but also how these injuries are treated, the way they’re prevented, and how we educate everyone involved in sports to make it a safer experience for everyone.”

Transferring data up to 40 times faster
The school’s researchers are now experiencing much faster data transfer rates with the Dell-based HPC cluster and the new Tulane Science DMZ, based on Dell Networking switches. “We can give users 10-times faster data transfer rates with the new high-speed network, based on Dell Networking technologies, and some of them can have 40-times faster rates if they have equipment that can accept 40-gigabit connections,” says Lieu Tran, assistant vice president for IT Infrastructure and deputy chief technology officer, Tulane University. This means that researchers can more rapidly transfer data to entities such as the National Institute of Health.

Additionally, Tulane researchers can get research results faster than before. “Having high-speed transfer of terabytes of data is really mission-critical. It would have taken people months or years to get results that can now happen in a matter of days,” says Lacey. “It’s really changed the kinds of questions that scientists can ask and investigate.”

Helping interdisciplinary teams model complex systems
The university has established co-localized interdisciplinary research clusters, consisting of scientists, engineers and energy policy analysts, who have been able to use Cypress to model and analyze complex data related to community resiliency. “This is a good example of a project that requires high-performance computing,” says Levy. Now, with Cypress, these research teams have the performance required to collect and study big data on power-distribution grids, water supply systems, transportation and other infrastructure elements.

“Having high-speed transfer of terabytes of data is really mission-critical. It would have taken people months or years to get results that can now happen in a matter of days.”

Michelle Lacey, Ph.D., Associate Professor of Mathematics, Tulane University
Giving birth to a new computer science department
Tulane has also been able to use its new technology infrastructure to resurrect its computer science department. “We had the opportunity to basically start from scratch, and identify what it was we wanted to see in a computer science department, and to build it,” says Altiero. “So we have begun to do that. We have five faculty members now, and we intend to double that in the next couple of years.” The university sees computer science as an essential degree. “There’s enormous interest in computer science from the new generation of students who are interested in seeing what digital platforms and software can do,” says Dr. Michael Bernstein, senior vice president for academic affairs and provost at Tulane. “And computer science cuts across all the fields here, whether it’s music, chemistry, medicine, law or architecture. The ability to write code or develop new digital platforms is instrumental to success in all those fields.”

Keeping existing faculty and attracting new researchers
The new HPC cluster is also expected to enhance recruiting efforts for Tulane. “The Cypress cluster, based on Dell technology, is going to bring to us a whole new level of infrastructure that will make our current faculty members want to stay here,” says Altiero. “It will also help us to attract new faculty members. This puts us on a new level, and it is a huge recruiting tool for us, as you can imagine.”

Tulane is also excited to be able to play a role in important future research initiatives. “There’s a federally funded national initiative to map the human brain,” says Levy. “What a terrific computational challenge that is. It’s going to be wonderful, and I want Tulane to be a part of it. We have that opportunity now.”

“A really great opportunity here is the use of our new supercomputer Cypress to be able to collect an incredible amount of data, to be able to determine the risks in playing sports, not only football but all collision or contact sports.”

Gabriel Feldman, Director of Sports Law and Co-director, Center for Sport, Tulane University

For more information go to www.DellHPCSolutions.com

View all Dell case studies at Dell.com/CustomerStories