

## LEARN Research Wave: Synergies That Scale



### THE PROJECT

LEARN's high-performance optical network supports scientists who participate in a wide range of national and global data-intensive research that often has life-changing impacts for humankind. Texas-based scientists collaborate globally with counterparts who research genomics, neuroscience, infectious diseases, weather/climate—and the high energy physics research that contributed to the Nobel Prize-winning discovery of the Higgs Boson particle in 2012. LEARN also supports the scientists of tomorrow by enabling next-generation education applications for Texas-based K-12 schools such as: virtual field trips and face-to-face videoconferencing interactions with world-class experts. To enhance the work of all of its education and research constituents throughout Texas, **LEARN needed a technology partner who could provide a flexible and cost-effective strategy for expanding its network capacity.**



LEARN turned to Internet2 and its [Research Wave Program](#) when it began planning the expansion of its high-performance optical network and underlying infrastructure. **The Research Wave Program allows research organizations to tap into the Internet2 Network at no—or low—cost**, in support of

research projects for a defined time period. Under the Research Wave Program agreement, Internet2 provided a dark optical network channel between San Antonio and El Paso populated with equipment provided by LEARN—funded as part of a \$2,992,000 Academic Research Initiative (ARI) grant from the National Science Foundation (NSF)—also funded as part of the American Recovery and Reinvestment Act of 2009. The NSF grant is awarded and managed by the University of New Mexico, Gil Gonzales, principal investigator. Through its membership in the Internet2 community and the confluence of resources LEARN secured, 40 gigabits of network capacity was deployed along this network segment instead of just the 10 gigabits called for in the grant itself.

### SOLUTION SUMMARY

The Lonestar Education and Research Network (LEARN) provides a high-performance optical network throughout Texas, interconnecting scientific researchers, educators and students at 680 organizations to national and international collaborators via the 100G Internet2 Network. LEARN is actively creating synergies at national and global scale for its constituents through a new project that delivered entirely new capabilities deep into the places today's Texas-based innovators are at work: university-based research facilities and institutes. And the places tomorrow's are at work: K-12 schools. The new capabilities stem from LEARN's leadership and vision to add 40 gigabits of new capacity to its backbone network. Demonstrating resourceful leadership, LEARN kept costs low by combining national resources that support advanced networking to enable innovation and discovery: the National Science Foundation's (NSF) Academic Research Initiative (ARI) and Internet2's Research Wave Program—a progressive program that allows research organizations to tap into Internet2 Network resources to enable advanced capabilities for scientific research.

### COLLABORATORS

- LEARN
- University of New Mexico
- National Science Foundation (NSF)

### PRODUCTS & SERVICES

- Internet2 Advanced Layer 1 Service
- perfSONAR Performance Monitoring Tools

### COMMUNITY RESOURCES

- Internet2 Research Support Center
- Internet2 NOC

### FUNDING RESOURCES

- Internet2 Research Wave Program
- NSF Academic Research Initiative (ARI)
- National Telecommunications and Information Administration (NTIA) Broadband Technologies Opportunity Program (BTOP)
- American Recovery and Reinvestment Act (ARRA)

## THE PROBLEM

A robust data network is a critical component of today's collaborative research and next-generation education environments—and organizations planning network expansion need flexible and cost-effective solutions. LEARN envisioned capacity increases to its backbone network that would offer its research and education constituents more abundant bandwidth, better performance and much reduced data exchange times. **LEARN hoped to ramp up capacity quickly so impacts on scientific research collaboration would be felt immediately, and at the same time, wanted to assure members that network enhancements and expanded capabilities would be available for many years to come.** LEARN required a partner that would allow it to focus on procuring and deploying equipment that met funding requirements, as well as providing a cost-effective solution and maximized benefits to users.

## THE SOLUTION

LEARN boosted the capacity of its existing optical infrastructure by taking advantage of the Internet2 Research Wave Program, which allows research organizations to tap into Internet2 Network resources to bolster scientific research. The program provided LEARN greatly enhanced capacity via the national 100G Internet2 Network backbone, as well as the ability to focus on building its own infrastructure and adding even more capacity than was anticipated from initial NSF funding. Because LEARN is able to utilize the Internet2 infrastructure for three years at no cost, planners could quickly implement needed enhancements and design a more-robust-than-expected network, thanks to better focused resources during implementation. To ensure the capacity remains in place beyond the three-year period provided by the Research Wave Program, LEARN and Internet2 entered into an agreement that will ensure the capacity is available for a minimum of eight years.

To enable the solution, a dark channel segment on Internet2's optical network was allocated between El Paso and San Antonio. To prepare for these enhancements, LEARN acquired additional colocation space, power and Juniper MX480 routers. LEARN then purchased Ciena optical transponders, which were deployed by Internet2 on the allocated dark channel segment. Throughout the implementation, Internet2 Network Services worked closely with LEARN to ensure the newly installed network infrastructure conformed to appropriate technical standards. Further, LEARN deployed perfSONAR and other monitoring tools, allowing for the measurement and analysis of performance gains and losses resulting from dynamically changing network configurations—ultimately providing more reliable big data exchange for scientific collaborators, and consistent advanced application capabilities for teachers and students.

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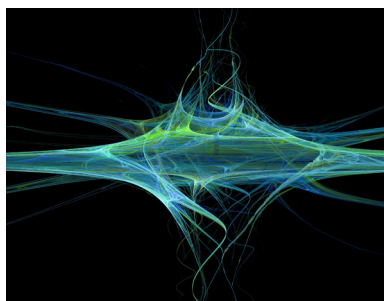
The four 10-gigabit channels were allocated to support:

- **Core Shared Services** – 10G allocated to the network core to support the research requirements of all LEARN members;
- **University of Texas System (UTS)** – 10G allocated to the University of Texas System to support Board of Regents initiatives;
- **Texas Tech University Health Sciences Center – El Paso (TTUHSC-EP)** – 10G allocated to the TTUHSC-EP to support research activities; and
- **Additional bandwidth** was made available to other LEARN members like **Texas K-12 schools**, implementing 1G Layer 1 and Layer 2 services, providing needed bandwidth for advanced educational applications.

## THE RESULT

LEARN has boosted the scientific and educational capabilities of the state of Texas, and provided an important component for economic growth. Because members are able to dynamically draw upon the additional dedicated 40 gigabits of capacity, researchers can more quickly and reliably exchange big data to collaborate on new discoveries—and next-generation learning applications can be enabled in the classroom for the scientists of tomorrow. Through increased network capabilities and performance, the project promises an immediate impact to research collaboration and advanced learning across the network:

- **XSEDE** – Scientists across the country can now access and share distributed computing, data storage and computational science resources. The Texas Advanced Computing Center at the University of Texas at Austin and Rice University are participating in this NSF-funded national project to create a single virtual system that includes supercomputers, high-end visualization and data analysis resources across the country.



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- **Large Hadron Collider (LHC)** – The particle accelerator at CERN in Switzerland, providing a massive facility for physicists around the world to investigate the makeup of the universe and producing the Nobel Prize-winning discover of the Higgs Boson particle in 2012. The world’s largest scientific research project produces roughly 25 petabytes (25 million gigabytes) of data annually for analysis through the Worldwide LHC Computing Grid (WLCG). The University of Texas at Arlington, University of Texas at Dallas, Texas Tech University, Southern Methodist University and Rice University are actively involved in this global project encompassing many sites around the world who receive and analyze the massive data. Physicists from the University of Texas at Arlington are responsible for the operation of the LHC’s Southwest Tier 2 Computing Center and for organizing the computing operations for all Tier 1 and Tier 2 facilities in the United States. Access to advanced networks like LEARN and Internet2 is critical to interconnect the distributed high-performance computing centers that are participating in this important project.
- **Texas K-12 schools** – Acquired 1G of capacity between El Paso and San Antonio as part of a statewide initiative to enable advanced network-based educational content such as virtual field trips and face-to-face videoconferencing interactions with world-class discipline experts.
- **GENI & DYNES** – Exploring next-generation Internet networking infrastructures, researchers in Texas are actively involved in these two projects to develop and deploy software defined networks (SDN) and develop innovative network prototypes that aim to support the advanced applications of tomorrow. The University of Houston has been funded in each of the GENI spirals—the funding rounds in the program—and plays an important role in this national collaboration. Texas is also playing a leadership role in Internet2’s DYNES initiative. Cited as an exemplary national model, LEARN—along with Texas Tech University, University of Texas at Arlington, University of Texas at Dallas, Southern Methodist University, University of Houston, Rice University, and Texas A&M University—has developed a DYNES regional collaboration that has deployed experimental network nodes in Dallas and Houston utilizing software defined dynamic circuit provisioning capability for Texas researchers on these campuses.
- **Texas Tech University Health Sciences Center – El Paso (TTUHSC-EP)** – The only Health Sciences Center on the border between Mexico and the United States, TTUHSC-EP is a research-focused institution operating Centers of Excellence in four key areas: Cancer; Infectious Diseases; Neurosciences; and Diabetes and Obesity.

**Lonestar Education and Research Network (LEARN) is a high performance optical network representing a collaboration of 39 research and educational institutions throughout Texas.** These institutions include private and public institutions of higher education, including research centers, universities and community colleges. LEARN also supports the National Weather Service and K-12 schools in Texas. LEARN was authorized by the Texas state legislature in 2003 in order to stimulate research and educational activities within the state.

For more on LEARN:  
visit [tx-learn.org](http://tx-learn.org)  
or email [info@tx-learn.org](mailto:info@tx-learn.org)

For more on the Internet2 Research Wave Program, visit  
<https://www.internet2.edu/research-solutions/research-support/research-wave-program/>  
or email [rs@internet2.edu](mailto:rs@internet2.edu)

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