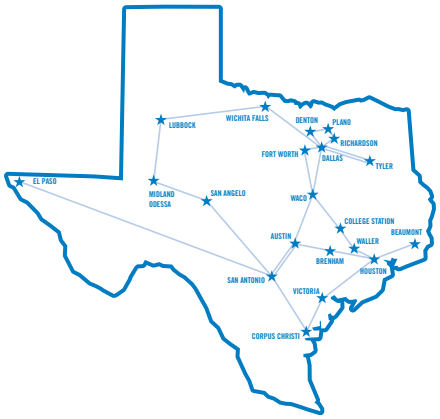
ANNUAL REPORT 2016

LEARN

LONESTAR EDUCATION AND RESEARCH NETWORK



On the Cover

Our cover image reflects the growth of connectivity globally. The Cisco Visual Networking Index (VNI) forecasts that, in the U.S., there will be 4.1 billion networked devices in 2020. That is up from 2.3 billion in 2015. They project that in 2020, the gigabyte equivalent of all movies ever made will cross the Internet every 8 minutes. In 2016, the U.S. had 286,942,362 users; Texas had 17,176,661 users.

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LEARN
LONESTAR EDUCATION AND RESEARCH NETWORK

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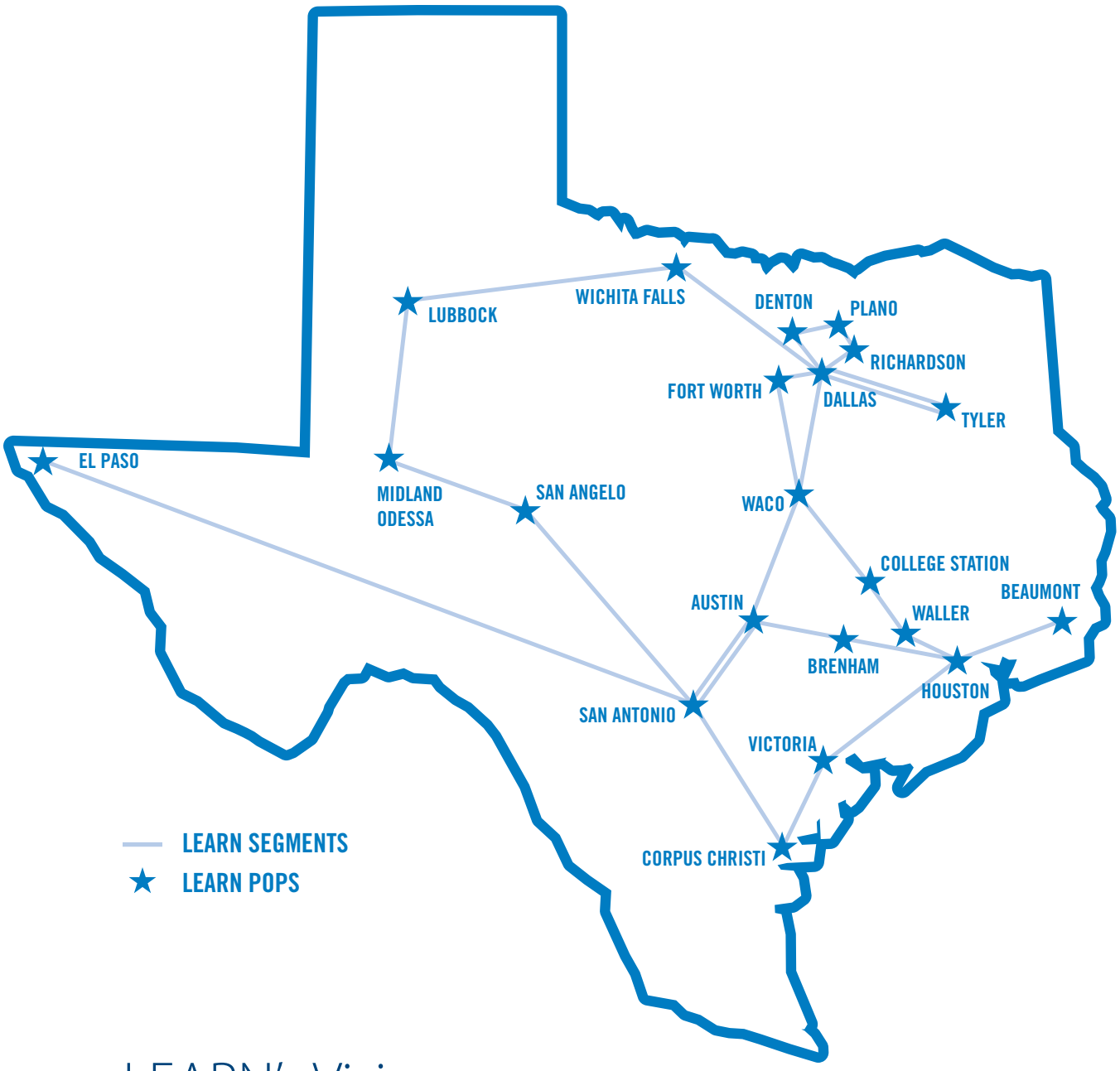
LEARN's Network Topology



LEARN's Vision

To be the premier organization providing advanced network services for research, education, healthcare and economic development throughout Texas. LEARN will be a national model for organizations that serve institutions of higher education. We will provide leadership in creating global networking initiatives.

Letter from the Chair

Terry Tatum

Texas A&M University
– Corpus Christi

Education is one of the noblest pursuits of society. It transforms the future.

As the 2015–2030 Texas Higher Education Plan begins: "Higher education improves the lives of Texans. Our colleges and universities educate our teachers, nurses, and technicians. They find cures for life-threatening diseases and develop technologies that make our lives easier. They inspire, educate, and equip our students to be their best, encouraging them to be more civic-minded, helping them interact in diverse communities, and giving them a passion for lifelong learning. They retrain our adult population, including veterans, helping them find meaningful careers. They enrich us through the arts and new ideas. The impact of higher education is immeasurable."

Individual organizations cannot undertake the grand challenges associated with education and research alone. We must come together through a collaborative community to advance our regions, our State and our Nation. That is the very basis for the Lonestar Education and Research Network — together we accomplish that which we cannot do apart.

The Board was extremely pleased to have Pankaj Shah assume leadership of LEARN as President and CEO in 2016. Pankaj took our organization though a strategic planning process to ensure LEARN is well-positioned to meet the challenges that lay before us and to serve as a resource to Texas and the Nation.

We have a bold vision…

"to be the premier organization providing advanced network services for research, education, healthcare and economic development throughout Texas. LEARN will be a national model for organizations that serve institutions of higher education. We will provide leadership in creating global networking initiatives."

Repeatedly during the planning process, Board Members affirmed the value of LEARN both for its technological infrastructure and as a vehicle for statewide collaboration. I am confident that as LEARN broadens its reach in the State and the Nation, we will set the standard for regional networks and provide a collaborative body that brings value to its members.

Letter from the President & CEO

Pankaj Shah
LEARN

While managing the administration, performing oversight of operations and introducing the strategic planning activity at LEARN, 2016 has primarily been an on-boarding year for me. I have learned a lot at LEARN and in Texas, while "drinking from the broadband hose". While the majority of my time has been invested in the strategic planning process along with our stakeholders, LEARN has continued to have a very successful year. I would also like to share a few highlights from 2016:

- Demand for network transport services increased by 4.3%.
- We streamlined the use of Commodity Internet Service and peering & caching usage, LEARN was able to reduce the expenditure for 88% of the participating members and affiliates by approximately $212,000 in 2017.
- LEARN was successful in winning a 100G RFP put forth by the University of Texas on behalf of UT System and TAMU.
- The expansion of our collaboration with Texas Educational Telecommunications Network (TETN) has resulted in LEARN helping simplify the K–12 architecture and managing WAN traffic for Education Service Centers.
- During 2016, a new 100G direct peering relationship was established with the Energy Science Network (ESnet), at the LEARN Houston Hardy POP, to facilitate a direct path for data flows between Texas scientists and government labs and high performance centers connected to the ESnet International backbone.

As a proud member of the LEARN team, I believe that many of our successes are because of receptiveness to new ideas, process streamlining, staff restructuring and new hiring. All of the activities and accomplishments cited in this year's report are a result of the tireless efforts of the staff, the leadership of the Board and special contributions from the Executive Committee. I must also single-out the help and guidance Terry Tatum has provided to me in spite of his many commitments at TAMU. LEARN staff, Mike Phillips and Joe Gargiulo have also played a vital role in the on-boarding process while pro-actively briefing me on issues, making both operational and strategic decisions easier for me.

With your continued support and guidance, I am looking forward to co-creating a new business model and services strategy for LEARN in 2017. The emerging model should not only keep LEARN sustainable for many years, but also provide necessary growth and national prominence.

Executive Committee

Chair:
Terry Tatum
Texas A&M University – Corpus Christi

Chair Elect:
Kay Rhodes
Texas Tech University System

Past Chair:
Joe Gargiulo
Southern Methodist University

Secretary:
Jeffrey Graham
University of Texas Rio Grande Valley

Treasurer & Chair, Finance Committee:
Klara Jelinkova
Rice University

Chair, Operations & Services Committee:
William Green
University of Texas at Austin

Chair, Governance & Participation Committee:
Ken Pierce
Texas State University

President & CEO:
Pankaj Shah
LEARN

Member Organizations

Angelo State University

Baylor College of Medicine

Baylor University

Lamar University

National Weather Service

Northeast Texas Consortium of Colleges & Universities (NETnet)

Prairie View A&M University

Rice University

Sam Houston State University

Southern Methodist University

Stephen F. Austin State University

Texas A&M Health Science Center

Texas A&M University

Texas A&M University – Corpus Christi

Texas A&M University System

Texas Association of Community Colleges

Texas Christian University

Texas Education Telecommunications Network (TETN)

Texas State University

Texas Tech University

Texas Tech University Health Sciences Center

Texas Tech University Health Sciences Center at El Paso

Texas Tech University System

Texas Woman's University

University of Houston System

University of North Texas System

University of Texas at Arlington

University of Texas at Austin

University of Texas at Dallas

University of Texas at El Paso

University of Texas at San Antonio

University of Texas Health Science Center at Houston

University of Texas Health Science Center at San Antonio

University of Texas Health Science Center at Tyler

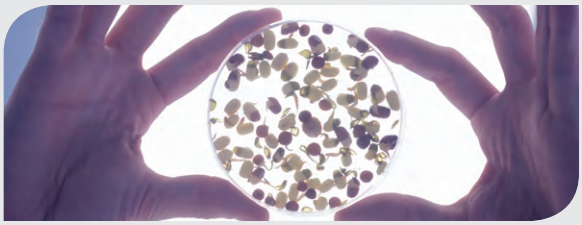
University of Texas MD Anderson Cancer Center

University of Texas Medical Branch at Galveston

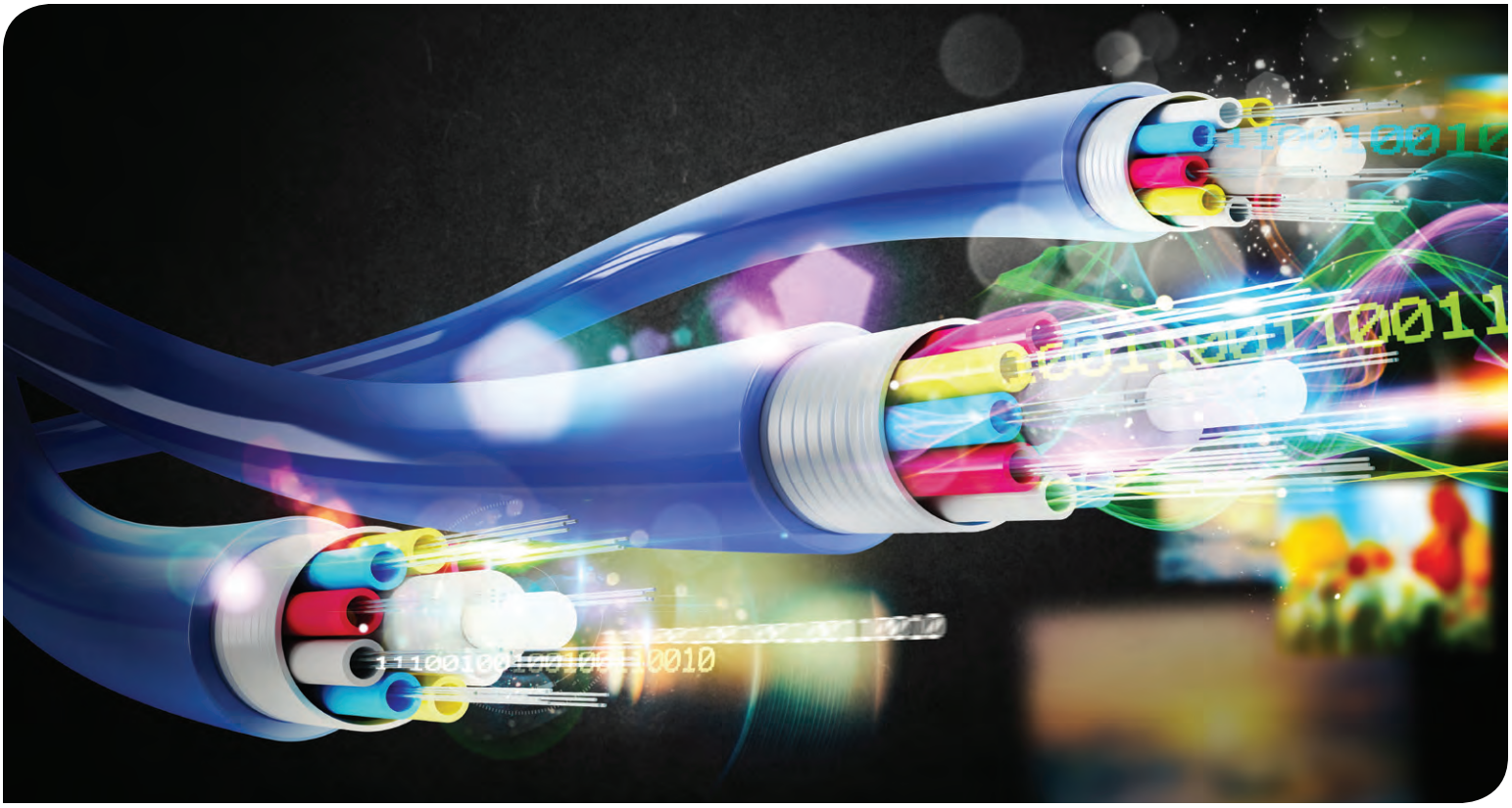
University of Texas Rio Grande Valley

University of Texas Southwestern Medical Center at Dallas

University of Texas System



Overview & History



Optical fiber cable

Who Is LEARN?

The Lonestar Education And Research Network (LEARN) is a consortium of 39 organizations throughout Texas that includes public and private institutions of higher education, community colleges, the National Weather Service, and K–12 public schools. The consortium, organized 13 years ago as a 501(c)(3) non-profit organization, connects its members and over 500 affiliated organizations through high performance optical and IP network services to support their research, education, healthcare and public service missions. LEARN is also a leading member of a national community of advance research networks, providing Texas connectivity to national and international research and education networks, enabling cutting-edge research that is increasingly dependent upon sharing large volumes of electronic data.

A Brief History of LEARN

In 2003, a series of meetings of research universities and health science centers in Texas were held to forge a shared vision of creating a unifying high performance optical network for higher education that would partner with an emerging national network dedicated to research. Overcoming the legacy of competition among the attendees and the fiscal and organizational challenges that lay ahead, the universities and health science centers soon reached a consensus that it was strategically important to create an organization dedicated to high performance networking in Texas and to participate in the emerging national network.

In the fall of 2003, the nascent LEARN organization, realizing that it was imperative to have a legal structure around which to center its operations, decided to use the existing Houston-based Texas GigaPoP as the 501(c)(3) structure for the new statewide organization. The following January officers of the new organization were installed at its first Board meeting on the Southern Methodist University campus in Dallas with the new organization being officially named "LEARN: Lonestar Education And

Research Network". Thus LEARN was officially created with a 30-member Board of Directors.

Also in the summer of 2003, the Texas Legislature endorsed the concept of providing an initial investment of $7.5 million dollars to construct the proposed optical network for Texas. That concept was fleshed out in 2004 as LEARN worked with the offices of the Governor, Lieutenant Governor, Speaker of the House and the Department of Information Resources (DIR) to study the merit of authorizing a Texas Enterprise Fund grant for the optical network project. In the fall of that year the elected leadership offices announced that the State of Texas would fund a TEF grant to provide the initial capital funds to acquire dark fiber and equipment or leased wavelengths for a "triangle" backbone connecting Dallas, College Station, Houston, San Antonio and Austin with additional connections to El Paso, Lubbock, Denton, Tyler/Longview, Beaumont, Galveston and Corpus Christi.

On February 28, 2005, the Governor signed the TEF grant agreement to provide $7.28 million in funding for the optical network project. LEARN now had the organizational, political and financial means to begin deploying the optical network for Texas.

Since its founding, LEARN has expanded both its membership and services. It now connects over 800,000 students enrolled in higher education and over 700,000 students in Texas' public schools. Over 500 organizations rely upon LEARN, either directly or indirectly through LEARN partners, for vital connectivity to local, statewide, national, and international network services.

The reach of LEARN and its importance to networking in the state is demonstrated by the following statistics:

Type of Institution	Number of Institutions Served	Percentage of Texas Institutions Served
Public Higher Education[1]	36	97%
Private/Independent Higher Education[2]	5	13%
Health Science Centers[3]	13	100%
Public Community College Districts[4]	19	36%
K–12 Education Service Centers[5]	17	85%
Independent School Districts[6]	451	37%
Libraries, Counties, & Other Community Anchor Institutions	33	n/a

[1]Source: Texas Higher Education Coordinating Board: Texas Higher Education Data – Public Universities www.txhighereddata.org/Interactive/Institutionsshow.cfm?Type=1&Level=1

[2]Source: Texas Higher Education Coordinating Board: Texas Higher Education Data – Independent Universities www.txhighereddata.org/Interactive/Institutionsshow.cfm?Type=2&Level=1

[3]Source: Texas Higher Education Coordinating Board: Texas Higher Education Data – Health Related Institutions http www.txhighereddata.org/Interactive/Institutionsshow.cfm?Type=1&Level=3

[4]Source: Texas Higher Education Coordinating Board: Texas Higher Education Data – Public Community Colleges www.txhighereddata.org/Interactive/Institutionsshow.cfm?Type=1&Level=2

[5]Source: Texas Education Agency: Educational Service Center Map tea.texas.gov/regional_services/esc

[6]Source: Texas Education Agency: AskTED Report Selection tea4avholly.tea.state.tx.us/TEA.AskTED.Web/Forms/ReportSelection.aspx#Criteria

Organization & Governance

LEARN's Board of Directors governs the overall affairs of the corporation with committees advising the Board on specific operational and policy issues. The standing committees of the Board include Finance, Governance and Participation, and Operations and Services. Additionally, an Audit Committee consisting of three elected Board members and an independent advisor monitors the conduct of the annual independent audit. The Board also creates ad hoc committees of the Board as necessary.

Within the authority delegated by the Board, the Executive Committee comprised of the elected officers of the corporation and the Chairs of the three standing committee develops the Board agendas and governs the affairs of LEARN between meetings of the Board. The Executive Committee is composed of the President, Chair, Chair Elect, Past Chair, Treasurer and Secretary. Other than the President, the officers are elected from the members of the Board of Directors.

The day-to-day business of LEARN is managed by the President and CEO of the corporation, who is elected by the Board and serves at their pleasure. The CEO employs and supervises a professional technical and administrative staff to conduct and manage LEARN's operations, including a Chief Technology Officer who is responsible for the health of the network.

The Technical Advisory Group (TAG) is comprised of technical experts from each of the organization's member institutions. TAG representatives are appointed by the LEARN Board member from the institution they represent and they elect the TAG Chair. TAG is an advisory body to the Board, President and LEARN's Chief Technology Officer and serves an important role in helping shape LEARN's architecture, operations and portfolio of services.

Network Infrastructure

LEARN's fiber network spans over 3,200 miles across the state, connecting its 554 direct or affiliated customers east to west from Beaumont to El Paso and north to south from Amarillo to Brownsville. LEARN is built on dense wavelength division multiplexing (DWDM) optical technology, providing the capability to transport multiple high capacity signals over a shared optical fiber by using the different color wavelengths of laser light. DWDM is state-of-the-art technology that is very scalable and permits LEARN to leverage its initial investment in optical fiber by adding additional capacity at marginal costs.

LEARN's network relies on agreements with the private sector that provide the long term use of optical dark fibers and/or long term leases of optical wavelength capacity. When dark fiber is conveyed via an indefeasible right to use (IRU) agreement, LEARN provides the infrastructure to "light" the fiber and can add additional capacity as needed without having to revise a contract with the fiber owner. In wavelength capacity agreements, the service provider provides the infrastructure and bandwidth under the terms and conditions of the agreement.

Deploying LEARN-owned high-performance routers at its 20 strategically-located Points of Presence (POPs) (see the map on page 1), LEARN makes it possible for its members and affiliates to bridge the last mile with their own network connections

Akbar Kara
LEARN, Chief Technology Officer

Bob Hartland
TAG Chair

at minimal costs. In most cases LEARN's network segments are protected through rings that insure continued operation of the network in case of a fiber cut or other disruption to a segment.

Several university systems as well as the Texas Education Telecommunications Network (TETN) operate their own networks which in turn are linked into LEARN's statewide fiber infrastructure at LEARN's POPs. LEARN cooperates closely with those other organizations to ensure that high-performance networking is made available at the lowest cost, best reliability, and highest performance possible.

Membership & Network Services

Members are entitled to appoint an individual to the Board of Directors and to acquire network services from LEARN at member rates. Network services are designed and provisioned based on the needs of individual members through collaboration between those members and the LEARN staff. Network services, which are funded by the members who consume the services at rates which are set by the Board, sustain current and future network requirements including capital refresh at periodic intervals to keep the network state-of-the-art. Network services include:

- Layer 1 Transport Services Between LEARN Points-of-Presence (POPs),
- Switched Layer 2 MPLS Services,
- Routed Layer 3 Services,
- Connection Gateways to the National Research and Education Network (Internet2 and Energy Sciences Network),
- Colocation Services at LEARN POPs,
- Commodity Internet Services (70G burst capacity spread across 4 POPs), and
- Peering and Caching Services.

LEARN has applied for and received a Service Provider Identification Number (SPIN) with the Universal Service Administration Company. Acquiring a SPIN number permits LEARN's school, library, and rural health customers to receive significant discounts through the Universal Services Fund.

The Board and the staff are committed to ensuring LEARN remains the trusted and preferred means by which its members obtain network services in Texas. There is a broad consensus among LEARN's members that the organization has a unique role to play in the state in providing highly reliable, cost effective network services to the higher education, K–12, and not-for-profit communities. LEARN is a trusted partner and convener in these communities.

Infrastructure Performance

LEARN has deployed and operates a sophisticated state-of-the-art fiber-based optical and IP network throughout the large state of Texas. That "carrier grade" optical and switching technology is highly reliable and capable of provisioning high-speed bandwidth between LEARN's customers in Texas cities and smaller communities throughout the state. While bandwidth capacity is important, LEARN recognizes that the reliability of the network is just as important to the daily operation of its customers who depend upon the network for most of their service functions.

To ensure that LEARN's network operates at "five nines" or greater reliability, LEARN operates a Network Operations Center (NOC) under an agreement with the Texas A&M University System, 24 hours a day, 7 days a week, 365 days a year. The NOC serves as the central point for monitoring and managing the overall health and performance of the network. LEARN engineers have a suite of network management tools at their disposal as well as the training they need to manage the configuration of the network, monitor the performance of the network segments and their components, diagnose and isolate the cause of performance issues, and manage incidents until they are resolved. LEARN's staff works closely with its members to align the network management practices and performance with their needs.

A critical component of LEARN's network reliability toolset is a comprehensive database of hardware assets, network configuration, circuits and other

strategically important data that are essential to LEARN's overall strategy of continuously improving the operational performance and efficiency of its growing network. At the end of 2016, that database had 4,400 entries with information such as the acquisition date, service records, contract expiration dates, projected replacement cycle, etc.

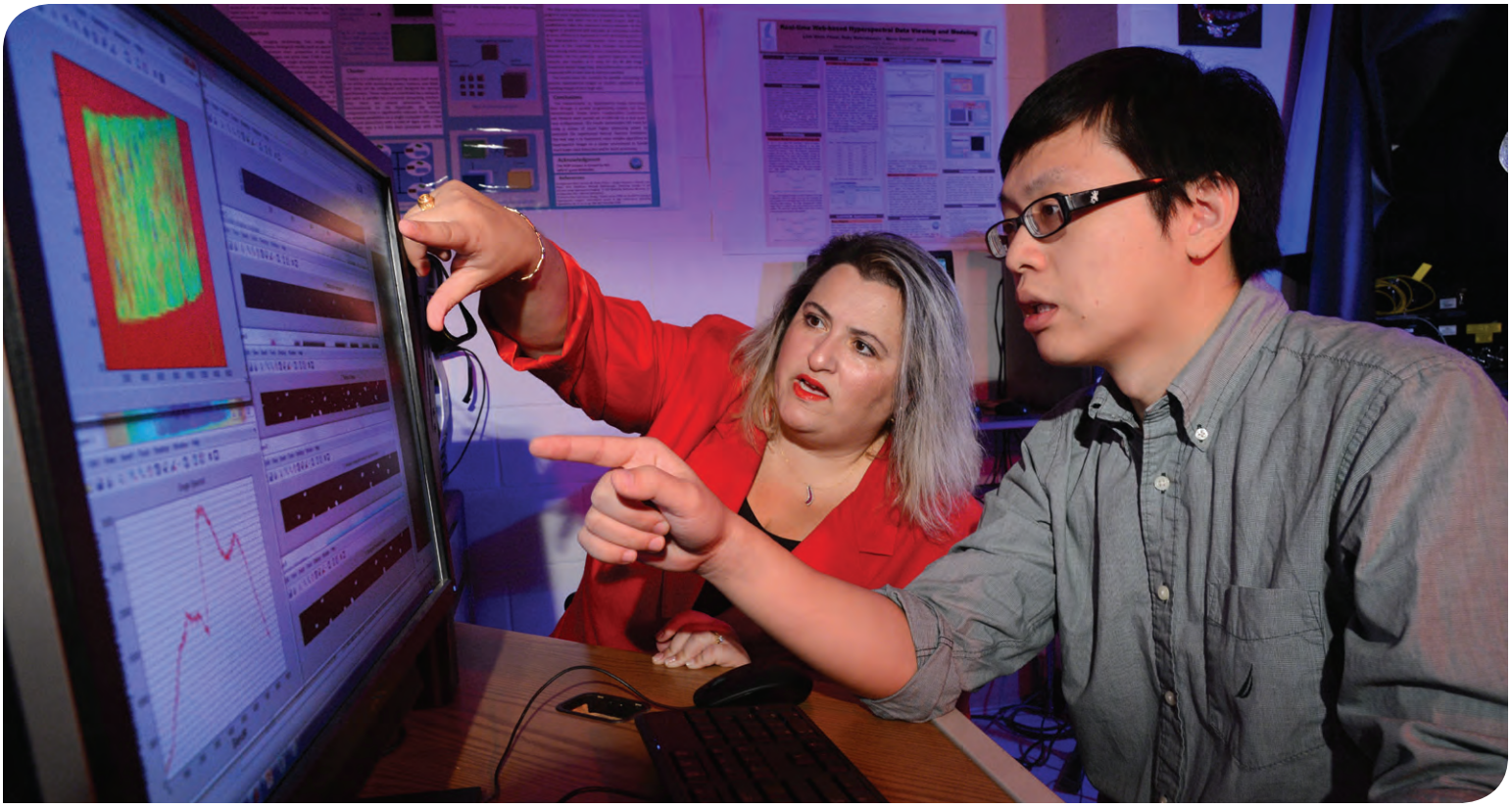
The vast majority of LEARN's network topology is designed to provide network rings which serve as protected paths for customers in the event of a failure in the network infrastructure. If one leg of the ring suffers a fiber cut or equipment failure, the network automatically reconfigures itself to use the other leg of the ring to maintain connectivity. This design redundancy is a key element of the network's performance but despite the network design, failures of a network segment do occasionally occur. In order to reduce the time required to get the segment back into operation, LEARN has acquired and strategically deployed critical infrastructure spares throughout the network. Additionally, LEARN maintains maintenance and support agreements for its critical infrastructure with the vendors of both the fiber paths and the network gear.

The results of LEARN's efforts to provide a highly reliable network to its customers in 2016 were as follows:

- WaveNet Layer 1 services on LEARN's backbone **100% uptime**
- FrameNet or Layer 2 services **99.999% uptime**
- Layer 3 services on LEARN's backbone **100% uptime**
- Connection gateways to Internet2 **100% uptime**
- WaveNet services on the Beaumont spur **99.997% uptime**
- Commodity Internet Services **100% uptime**

While these performance levels are very favorable compared with other telecommunications providers, LEARN's goal is to give its customers 100% reliability on all of its services. To that end, LEARN will continue to improve its technology, tools, training of its staff, and cooperation with its customers/partners and network staffs as it has done since the organization's inception.

Activities & Accomplishments



Data sharing between institutions

Science DMZ at Texas Institutions

In 2012, the National Science Foundation ("NSF") solicited proposals for Campus Cyberinfrastructure — Network Infrastructure and Engineering Program (CC-NIE) grants, one component of which was "Science DMZ's" at local campuses. The intent of the program was to support activities at the local level such as:

- Network upgrades within a campus network to support a wide range of science data flows (including large files, distributed data, sensor networks, and real-time data sources),
- Re-architecting a campus network to support large science data flows, for example by designing and building a "science DMZ",
- Campus network upgrades addressing sustainable infrastructure through improvements in energy efficient networking,
- Campus network upgrades addressing the growing needs in mobile networking, and
- Network connection upgrade for the campus connection to a regional optical exchange or point-of-presence that connects to Internet2 or National Lambda Rail.

Several LEARN members applied for and received those grants and have implemented Science DMZ's on their campuses, successfully meeting the goals of the NSF grant program and more importantly, vastly increasing the data transfer capabilities of their campus researchers. Let's look at those institutions.

Texas A&M University – Corpus Christi

Three years ago, Texas A&M University-Corpus Christi (TAMU-CC) received funding from the National Science Foundation (Award number 1341027) to construct a Science Demilitarized Zone (DMZ) network. Science DMZ is a network architecture, set apart from the general campus network, designed for researchers who have a need to send and receive

large data sets without the negative performance impacts caused by firewalls, while also being protected from malicious online activity.

Fast forward to 2016, the Island University is fulfilling its Momentum 2020 vision of becoming an emerging research university by implementing modern cyberinfrastructure through the Science DMZ. The overall goals of the original grant were more than technological and included:

- Increasing on-campus research collaborations,
- Broadening the scope of science research data sharing with external collaborations,
- Extending research capacity of the University in the fields of coastal, marine, atmospheric and geospatial computing sciences, and
- Ensuring secure and reliable science data storage and delivery for the campus science and engineering community and beyond.

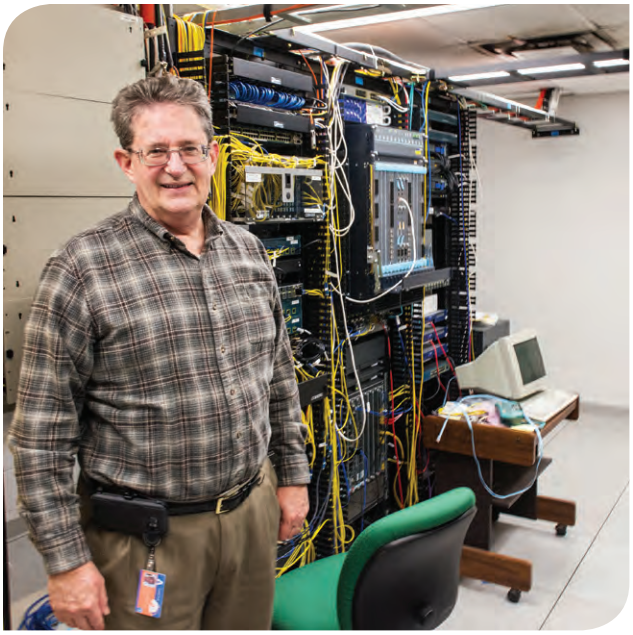
Dr. Dulal Kar, Associate Professor of Computer Science who helped facilitate the project, says the Science DMZ has created a data sharing environment between the Island University and other universities thus accelerating research at TAMU-CC.

"I know some faculty members who deal with a lot of data for their research and have benefitted tremendously from this," said Kar. "The Science DMZ is connected to every building involved in research at TAMU-CC including the Harte Research Institute for Gulf of Mexico Studies (HRI), which is the only marine research institute dedicated solely to advancing the long-term sustainable use and conservation of the world's ninth-largest body of water and the Conrad Blucher Institute, a research institute also at the Island University which conducts innovative research and develops technology solutions relevant to surveying, scientific measurements and to the issues in the Gulf of Mexico region."

The Island University's Division of Information Technology was heavily involved in the construction the Science DMZ. Edward J. Evans, Associate Vice President for Information Technology (IT) and Chief Information Officer for the Island University, stated that the implementation of the Science DMZ was a team effort.

"IT is committed to enhancing research through a modern cyberinfrastructure that allows scientists to focus on their projects rather than maintaining technology," said Evans. "The University as a whole had a cap of about one gigabit per second of bandwidth. When the Science DMZ opened up for researchers in 2014, an increase of 10 gigabits per second was recorded. That means ten times more speed for transferring data."

The Island University plans to continue growing in computational research capabilities with optimal high-availability, fiber-optic data networks, such as the Science DMZ.



Patrick Jordan, UT Arlington

Texas A&M University

Genomics, Math and Computation, and Computer Science researchers, as well as some department-level high performance clusters at Texas A&M University (TAMU), now seamlessly transfer large amounts of data over the Science DMZ network created on the campus as a result of the NSF grant (Award number 1246097). 10Gb or 100Gb connections in several buildings on campus, linked to research labs, tie into a 100Gb port to LEARN's router in Houston, a connection made possible through the expertise and assistance of LEARN network engineers.

Willis Marti, Director and Chief Information Security Officer at TAMU, states that researchers wanted a 100Gb connection to the national network to support their research. With the Science DMZ now in place, they now feel that they have a compelling case to make to NSF about their ability to move large volumes of data in support of their research when applying for grants.

Previously, the campus standard for network connectivity in buildings was 1Gb ports and the Science DMZ provided the impetus to upgrade that standard to 10Gb, with 100Gb to labs being planned for the future. The implementation of the Science DMZ, which bypasses the campus firewall, brought the benefits of high-speed networking, but with the caveat that researchers are now responsible for network security, an issue that TAMU is working through by means of education of faculty members.

Perhaps the greatest impact that the Science DMZ had at TAMU, Marti says, is that it planted the seed for providing the bandwidth that researchers need, demonstrating to researchers that IT would work with and for them to meet their needs. Thus, the overall demand for and capability of the campus network infrastructure has improved significantly. Researchers now feel enabled by the networking available to them.

University of Texas at Arlington

The University of Texas at Arlington (UTA) recently completed the build-out of their Science DMZ (Award umber 1440794) and rolled it out to their researchers, resulting in a doubling of the throughput of data for their researchers (from an average of 7Gbps to 15Gbps). The primary beneficiaries of the Science DMZ implementation were researchers in the Chemistry/Physics Building, which is now connected via a Layer 1 dedicated fiber path to a campus edge router that in turn connects to ESnet, a path implemented with the assistance of UTA, UT System's Office of Telecommunications Services (OTS), and LEARN engineers. A major user of the newly-operational Science DMZ on campus is Dr. Kaushik De in the Physics department, the lead

UT Arlington Engineering Science Building

researcher for UTA's ATLAS Southwest Tier 2 Center (the Large Hadron Collider project). The Earth and Environmental Science, Math and Business School departments will be the next beneficiaries of the high-speed Layer 1 network on the UTA campus

Patrick Jordan, UTA's Science Research Network Coordinator, reports that the establishment of the Science DMZ on his campus demonstrated both the need for and feasibility of upgrading the campus network and its connection to external networks such as ESnet. That helped make the case for a larger campus-wide refresh of the UTA network that is currently in progress. The network refresh equipment and design eliminates many single points of failure of the network on the campus. Without the Science DMZ, it would have been much harder to make the case for that upgrade. When completed the network will fully integrate with the OTS and LEARN networks. And Patrick notes that faculty who need high-speed network performance are now much more trusting in IT's willingness and ability to meet their needs.

Texas State University

Mark Hughes, Texas State University's Associate VP of Technology Resources, reports that his institution's Science DMZ is operational, with the assistance that the $550,000 NSF grant provided (Award number 1440637). Texas State is currently upgrading its HPC cluster, which will significantly increase the computer power available to its researchers and which will benefit greatly from the high-speed networking made possible by the Science DMZ.

Layer 1 dedicated fiber was pulled to campus labs that needed the high bandwidth made possible by the Science DMZ. That dedicated network is being used for point-to-point communications between researchers on campus now. Connectivity to the external national network is via a 10Gbs port made possible by LEARN edge routers in Dallas and San Antonio. Geography, Computer Science (Genomics) and cancer researchers will be the heavy users of the new network on the Texas State campus.

Mark reports that Texas State researchers were excited that the Science DMZ was coming when it was announced on campus and he is convinced that the relationship between Texas State faculty and IT has improved as a result of the hard work that the networking and HPC staff did to make the Science DMZ available on campus.

University of Houston

At the University of Houston (UH), the Science DMZ (Award number 1541368) has been implemented by connecting research lab computers at 10Gbps

with 40Gbps between the labs via a separate dedicated fiber network to five locations on campus. That network connects to the campus' core router: currently traffic on the Science DMZ is between the labs on the UH campus although one researcher is investigating how to collaborate with another facility off campus through the on-campus Science DMZ network. Enabling UH researchers to communicate at state-of-the-art speeds off campus was made possible by a 100Gbps port on the core campus router that connects to the GENI network and other national research networks. That connection was enabled by LEARN's putting a 100Gb port on the Hardy street router in Houston.

The building of the Science DMZ has been an incremental process, says Charles Chambers, the Manager of Network Planning and Development, with the major initial goal being the establishment of a framework for high-speed research connectivity on campus. Because of funding and infrastructure limitations, it was a real challenge to get fiber to the UH labs, which wanted the fast connections. The consolidation of all high-speed connections on campus through a common infrastructure, though, has simplified the work of UH's network staff and will result in better service to all segments of the UH community.

Something that needed to be addressed in building the Science DMZ, one that is echoed in the other campuses with high speed networking needs, was tuning the researcher's systems to be able to transfer data at speeds that could actually take advantage of the enhanced network (previously they were using USB2 thumb drives to move data from one site to another). Working with researchers such as Engineering faculty who use the Science DMZ to transfer high-resolution microscope data across campus, UH networking staff managed to make the faculty's data move at expected speeds.

UH sees two benefits to their implementation of the Science DMZ on their campus: (1) Opening a dialog between IT and the faculty researchers and showing them that IT wants to make them successful and (2) The collaboration with other IT organizations from around the country that occurs when UH networking staff go to NSF meetings and talks to their counterparts about their challenges and successes.

Baylor College of Medicine

Baylor College of Medicine's (BCM) Genomics department is perhaps the largest mover of data over a network in Texas, having sent some 200TB of data at 6+Gbps over a three-day period in the recent past. To help meet their need for fast data transfers, BCM has placed a data transfer node (DTN) on their campus, connected to new state-of-the-art, 100G infrastructure funded by the NSF (Award number 15410750). The DTN will serve as a template for their ultimate full implementation of the DMZ, which BCM expects will foster faster and more effective collaboration for their researchers on campus.

A big challenge in the medical college's environment is the security of protected information as it leaves the campus. Researchers want a frictionless network that removes network security impediments such as firewalls so their transfers can proceed without special configurations or setups. BCM's plans for their Science DMZ include protocols and safeguards to meet those desires as closely as possible without compromising security.

Jeff Early, the NSF grant Principal Investigator (PI) and Director of Communication Technologies at Baylor College of Medicine, has found the discussions he has with CIO's at LEARN Board meetings have been invaluable to him as his teams tackle the technical and policy-related issues of the Science DMZ.

Stephen F. Austin State University

Stephen F. Austin State University (SFASU) built its Science DMZ (Award number 1341010) with a dedicated fiber network on campus, firewalled off from the rest of the university's network. The Science DMZ also connects SFASU's Observatory (the second largest observatory in Texas, located 11 miles off campus) to the main campus. The DMZ connects to the campus' edge router for connectivity to the outside world through a 10Gbps port.

After investigating the cost and feasibility of pulling its own fiber, the University decided that a better approach was to use a local communications provider. Through an agreement with that provider, SFASU was able to obtain a 20-year IRU that gives them the fiber they need at an affordable price.

The physics and computer science departments are the primary user of the Science DMZ and SFASU expects that those departments' research will benefit from the efficient and rapid transfer of data enabling their research.

Texas Woman's University

Two goals of Texas Woman's University's (TWU) IT strategic plan are to (1) Research and deliver classroom technologies to create engaged learning environments and (2) Provide reliable and secure infrastructure for information access and exchange. To help meet those goals, TWU's Office of Information Technology (OIT), headed by Dr. Robert ("Rob") Placido, applied for and was awarded a National Science Foundation (NSF) Science DMZ (Award number 1541440) grant two years ago. According to Rob, the Science DMZ was primarily envisioned as a tool to achieve TWU's instructional and research goals.

Dr. Pierce Cantrell at Texas A&M gave TWU's staff invaluable advice and assistance in designing and implementing the Science DMZ, drawing on his experience at bringing a Science DMZ to TAMU several years earlier. The resulting network at TWU has greatly enhanced the University's ability to conduct teaching, research and public service and Rob is convinced that the improved network will be instrumental in OIT's meeting its goals.

Prior to receiving the NSF Science DMZ grant, TWU's network was limited to 1Gbps at the backbone and 100mbps between buildings. With such limited bandwidth available, the network was underutilized because faculty members found it unusable for their purposes. The NSF grant allowed TWU to pull fiber to buildings where the higher bandwidth was needed on campus and to increase the backbone speed to 10Gbps. New endpoints within the network were installed, the commodity internet was isolated from the research network, and TWU started routing traffic through Internet2, something that they hadn't previously done because of the limitations of their campus backbone. LEARN upgraded TWU's endpoints to 10Gbps to give the University the requisite bandwidth for researchers to collaborate with large datasets around the world.

Placido emphasizes that TWU's partners of Dallas-Ft. Worth universities, community colleges, and public schools were instrumental in his university's ability to improve its own campus network. A multi-institution, multi-year networking project among the partners provided the high-speed fiber connection that takes a circuitous path to the north of Dallas and then south to LEARN's router in Dallas. That fiber is shared by UNT, UT Dallas, SMU, TWU, and the Denton Independent School District and traverses fiber owned in many segments by the collaborating institutions. The new connection gives TWU's network a backup Internet connection and much greater throughput to meets its ever-growing research demand. According to Placido, "the expansion would not have been financially possible without the collaborative efforts of other institutions

Texas Woman's University

and the leadership, creativity, and expertise from partners in the LEARN organization".

TWU's Science DMZ project, now in operation, has enabled significant advances in the University's research and instructional mission. Foremost among those advances are:

- Data from scanning microscopes in TWU's Biology labs can now be transmitted to a central storage facility and shared by other researchers,
- TWU education majors can now count on the quality of service needed to use "Teach Live" virtual classroom to a school in Florida, teaching students at the remote site and simulating behaviors that improve TWU majors' instructional skills,
- Community health informatics, hospital data mining informatics, and business informatics now have the ability gather and store data needed for those program's research,
- TWU's nursing program can now engage in clinical telehealth interactions between nursing students and remote patients (full implementation of this program will require many remote clinics to upgrade their own networks), and
- TWU recently joined the Texas Digital Library's Open Data Repository, something that would not have been feasible without the increased bandwidth provided by the Science DMZ project. TWU will begin transferring data from its local repository to the Open Data Repository and will rely upon it for its future needs to store and share research and other data.

Texas Woman's University's Science DMZ project is meeting the goals of both the NSF, which funded the project and TWU, which put in the hard work of making the new network operational. Dr. Placido is proud of his organization as well as of TWU's research and education community that is now taking advantage of a major advance in the University's data communications capabilities.

Houston Community College Upgrades Its Network

The Houston Community College (HCC), the tenth largest college in the country with 114,288 students, six colleges, and 5,000+ employees, faced the likelihood of significant cost increases in its network connectivity with the demise of Texas' HB2128 several years ago. That bill provided educational institutions in the Texas with much lower rates on telco circuits, including wide area network (WAN) circuits, and the Houston Community College System (HCCS) was concerned that those rates would increase significantly. HCC therefore embarked on a project to find alternative sources of network connectivity as well as to upgrade its network to meet the growing need for bandwidth within the district and to the Internet.

Three years ago, HCC upgraded its membership status in the Southeast Texas GigaPOP (SETG), a local consortium of higher education and public institutions in the region that includes the University of Houston, Rice University, Texas A&M University, Baylor College of Medicine, METRO and others. SETG is the aggregator of Internet2 traffic in the Houston area and is supported by LEARN through a recently-upgraded 100Gbps circuit to Dallas as well as through the professional development activities sponsored by LEARN.

As an active member of SETG, HCC started a dialogue with the GigaPOP to see if there were synergies that could support the network needs of both HCC and SETG states Kyle Cooper, Director of Network and Telecommunications at HCC. They quickly discovered that indeed SETG had network capacity and fiber resources that might be feasible alternatives to the telco lines that they had previously leased. They then began the process of designing a new dark fiber-based network that would represent a significant shift in how they delivered network services district wide.

Bill Carter, Vice Chancellor for Information Technology at HCC, is very appreciative of the SETG members, particularly Rice University and Baylor College of Medicine, who were extremely collaborative with HCC on the design and deployment of the new network. He states that "during the redesign and engineering phases, we realized that we could connect 75% of their current core network connections on an expanded HCC-SETG dark fiber ring and also connect through a carrier-neutral data center/coloction provider, allowing HCC the opportunity for a third-party, high-peformance, fully-redundant business continuity/disaster recovery site and reducing risk." The colocation provider that the HCC chose to route through is serviced by a large number of Internet providers. The new configuration is advantageous to SETG and several of the consortium members who were interested in connecting to additional colocation and peering providers in the region and utilizing it as a key route point for future SETG expansions.

While completing the design of their dark fiber network, HCC was also in the process of converting

from traditional analog PSTN circuits to SIP trunking. The migration to SIP trunking greatly enhanced HCC's telephony infrastructure and fault tolerance, but also put greater importance on its Internet connectivity. The new HCC-SETG fiber ring supports HCC's SIP infrastructure by providing additional last-mile connectivity to backup Internet providers.

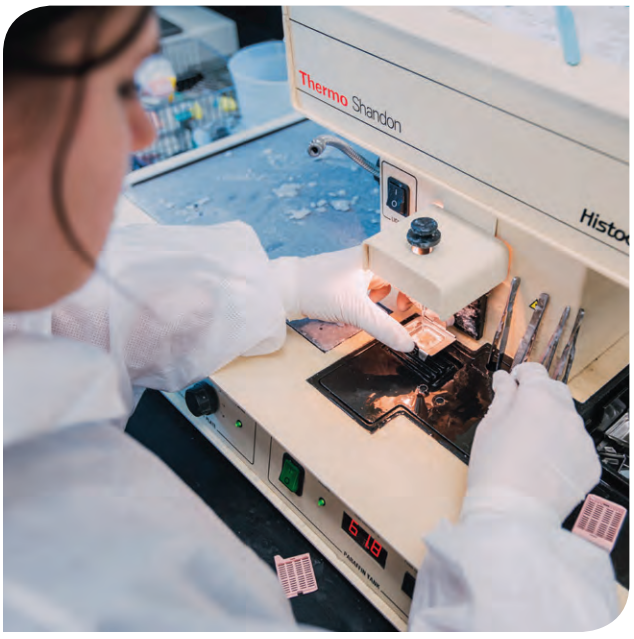
The redesigned WAN ring will be fully implemented by October of this year, with some sites already online. The redesign brings HCC a number of benefits:

- Connections at 8 key campuses were upgraded from 1Gbps to 10Gbps, satisfying students' desire for faster connectivity to the Internet,
- Physically diverse 10Gbps circuits to primary and secondary network hubs have greatly reducing HCC's vulnerability to circuit interruptions,
- Costs of the WAN connectivity were reduced by over $300,000 per year,
- SIP trunking connections which is supported by the fiber network saved $250,000 annually, essentially eliminating long distance toll charges,
- Costs for cooling and power at the primary and secondary data centers will be reduced as systems are moved to the colocation provider,
- Cost savings from the dark fiber network allowed for tertiary backup Opteman circuits to be added to each campus. These savings will fund future expansions to the shared HCC-SETG fiber ring,
- Access to additional shared fiber resources within the RENoH network infrastructure,
- Enhanced peering and caching relationships that SETG has established with large Internet Content providers such as Microsoft, Amazon, Google, and Netflix, reducing their need for additional commodity network capacity. These services are particularly attractive since HCC is a Microsoft Office 365 user, and
- DWDM fiber optic equipment used to power the new HCC-SETG ring is compatible with the existing SETG RENoH ring which will allow HCC to run 100G in the future.

"Our partnership with SETG has been very beneficial to HCC and our goal to provide students with the Ultimate Learning Experience. Currently, over half of all our Internet traffic is offloaded to SETG and LEARN peers, which helps to both increase our aggregate Internet capacity and reduce ISP costs", asserts Kyle Cooper.

Going forward, the Houston Community College is planning to reduce its need for in-campus wiring by providing high density 802.11ac wireless coverage on all of its campuses. HCC currently utilizes NBASE-T and Wave2 wireless technology on some of its campuses and is in the process of surveying all campuses to ascertain the hardware needs and costs of making it available everywhere in order to provide more reliable access to the Internet and satisfy students' growing online educational, social, and entertainment needs. The redesigned and upgraded backbone network supports these needs as well as HCC's future demand for increased bandwidth and need for reliable offsite/out-of region colocation sites for their existing data center.

Houston Community College's new network (HCCNet) represents a significant change in how it provides network services to its students, faculty, and staff. With increased capacity, lower costs, and redundancy, the new HCCNet will serve HCC's needs for many years to come. Bill Carter notes that "working together with our higher education colleagues in the SETG and LEARN consortiums greatly reduced the time required to negotiate contracts, for building out infrastructure, and to navigate the bureaucracy that typically accompanies such a large project as we support our mission of providing high-quality, affordable education for academic advancement, workforce training, career development, and lifelong learning to prepare individuals in our diverse communities for life and work in a global and technological society."



Using Networking to Deliver Mental Health Services at the Texas A&M Health Science Center

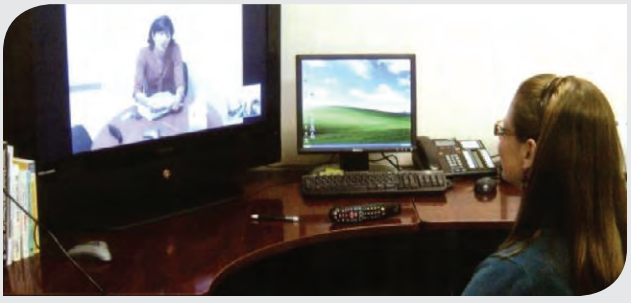
Responding to the needs for mental health services of underserved clients in rural areas of its region, the Texas A&M Health Science Center's (TAMHSC) Telehealth Counseling Clinic (TCC) is providing telehealth counseling to four counties in southeast Texas. Delivered via videoconferencing equipment, mental health counseling is given to patients who would otherwise lack such services.

Doctoral students in TAMHSC's APA-accredited Counseling Psychology program, supervised by doctoral-level staff, provide videoconferencing counseling to individuals at rural clinics. Dan Basile, Executive Director of Finance and Administration at the HSC, reports that students in the program are enthusiastic about the experiences they are getting as they prepare for their careers in health services through the telehealth program and that the students believe that the technology is virtually equivalent to face-to-face counseling in clinic offices.

The technology used in the program connects sites in Leon County, Madison County, Washington County, and Grimes County to two sites on Texas A&M's campus in College Station where doctoral students interact directly with patients over high-quality Tandberg videoconferencing units. Connections between the remote sites and the A&M campus are over high-speed TTVN network circuits that use LEARN's fiber. VPN tunnels between the sites as well as Tandberg encryption insure HIPAA compliance for privacy and security. The system is utilized heavily, with about six hours a day being a typical schedule for the videoconferencing system.

Faculty in the doctoral program say that the experience the students get counseling rural residents can translate well to post-graduation jobs as therapists for other underserved populations, such as veterans and inmates. Students get training and experience with the technology and with different populations—experience that will serve them well when they begin their professional practice. And studies have shown that there are no significant differences between in-person and telehealth counseling sessions. The counties served are also able to reduce the cost of delivering mental health services since their clients don't have to travel miles to obtain the help they need.

The innovative telehealth service that TAMHSC has begun is one more example of how new technological advancements, delivered over state-of-the art fiber networking, can improve our country's health delivery system.



LEARN/TETN Partnership Benefits ESCs & Texas School Children

In support of the K–12 students in Texas, the Texas Education Telecommunications Network (TETN) provides services to enhance the classroom experiences of students in school districts throughout the state that are supported through the 20 Education Service Centers (ESC) throughout Texas. As classroom teachers become ever more dependent on bandwidth to support their needs to deliver quality education, TETN continues to add bandwidth capacity to serve the ESCs, with four more members expanding to 10Gbps connections within the past year. Recognizing that network expansion means that additional management tools will be needed, TETN continues to improve its security and bandwidth management services as well as its video content platforms.

TETN provides a Distributed Denial of Service (DDoS) solution to five of the ESCs to prevent downtime due to attacks. These types of attacks are becoming more prevalent and thus are causing more issues for our school districts. TETN purchased a solution through a third-party vendor and maintains it for those ESCs that choose to participate. DDoS attacks are mitigated with the solution thus preventing ESCs from having long periods of downtime that would impact the districts they service.

As video becomes increasingly in demand in classrooms, TETN's network connects ESCs and districts with the broadband capability needed to expand their video services. Videoconferencing has always been a primary use of the network and as this technology becomes more cloud-based, TETN is utilizing more cloud services to support the ESCs who in turn support the districts. This year TETN purchased cloud services through AWS to provide scalability in their cloud bridging and desktop video platform. Needed bandwidth is available to send large amounts of video for special programs and now the service is available in the cloud to "burst" and scale when needed. In addition to the video cloud service, TETN has also added service for ESCs and district personnel to have a video content portal to upload and distribute videos. Videos available on the portal are used to provide information to students who may have missed class or need additional assistance on homework as well as providing videos produced for projects and training.

As a part of the LEARN community, school districts enjoy the tremendous benefits of the caching services provided through LEARN, with Microsoft and Google being the largest suppliers of cached content to schools. This enables school districts to continue classroom work without interruptions on the days when products from those companies have large software upgrades that can shut down a network.

The Texas Education Telecommunications Network is proud to be included in the membership of LEARN and is particularly gratified that LEARN's services significantly enhance the high quality of service that TETN provides to Educational Service Centers and school districts throughout Texas. TETN truly adds value to LEARN's educational mission.

SMU's ManeFrame

A Path to Prominence: SMU's New High Performance Computing Cluster

Southern Methodist University, the nationally ranked university in downtown Dallas, has taken significant steps to achieve a new level of computational capabilities on its campus of 11,000 students. With strong programs in the humanities and sciences plus seven professional schools, SMU has recognized that the best path forward to advancing its research agenda is computationally-based research, not the traditional wet labs of the past.

After several generations of smaller clusters, SMU received an award from the Department of Defense of a large cluster with 8,800 cores several years ago. SMU held a naming contest for their new powerful machine: the winning name, "ManeFrame", reflected SMU's Mustang mascot and pony heritage. Eventually, that machine's capabilities were stretched by the university's growing computational research community and a new solution was pursued.

A committee composed of Research Community's Center for Scientific Computation representatives and the Office of Information Technology came up with a proposed configuration of worker nodes, high-memory nodes, and graphics process unit nodes all backed by a high speed multi-petabyte storage and 100Gbs internal network. Although the resulting system design would be costly both from an initial purchase standpoint and a continuing maintenance perspective, the University's administration and board supported the purchase, recognizing its importance to SMU's research prominence.

A key to the future success of the new High Performance (HPC) would be the infrastructure needed to house it, and SMU was fortunate at having constructed a new state-of-the-art data center as well as having upgraded its networking with fiber optics connecting all 100 buildings and installing redundant high-speed fiber connections to LEARN, SMU's

SMU Data Center

Joe Gargiulo and Allen Hughes

Internet service provider. With those needs satisfied, SMU proceeded to release an RFP, select vendors, and order the significantly improved High Performance Computing Cluster.

The new HPC cluster will dramatically increase the computational capacity and performance that SMU provides to its researchers. It features state of the art CPUs, accelerators, high speed/low latency network, multi-petabyte parallel file system, larger memory configuration per node, and advanced interactive GPU-accelerated remote desktop experiences. Also, the cluster is much more energy efficient (making it more economical to run) and more environmentally friendly than the previous cluster.

The new ManeFrame II cluster will provide a similar interactive experience for researchers currently using the soon-to-be-replaced cluster. The familiar operating system, resource scheduler, and the Lmod environment module system will be in the new cluster. Additionally, updated, but familiar development tool chains will be available, making the transition to the significantly-improved cluster as easy as possible for SMU's researchers.

The new and more efficient architecture, high core count, and high memory capacities of ManeFrame II nodes will provide significant improvements to existing computationally or memory intensive workflows. The new cluster consists of:

- 176 standard compute nodes with dual Intel Xeon E5-2695v4 2.1 GHz 18-core Broadwell processors, 256GB of memory, and 100Gb/s networking,
- 35 medium-memory compute nodes with the same processors as the standard ones but with 768GB of memory,
- Five high-memory compute nodes with 1,536GB (1.5TB) of DDR4-2400 memory,

HPC Clusters in SMU's New Data Center (old on left & new build-in-progress on right)

- The previous ManeFrame's new four 768GB and six 1,536GB (1.5TB) nodes also will be added to the new cluster,
- 36 accelerator nodes powered with dual Intel Xeon E5-2695v4 2.1 GHz 18-core Broadwell processors, 256GB of DDR4-2400 memory, and one NVIDIA P100 GPU accelerator,
- 36 many-core nodes with Intel Xeon Phi 7230 (also known as Knights Landing or KNL) processors and 385GB of DDR4-2400 memory,
- Five virtual desktop nodes will allow researchers remote desktop access to high-performance compute capability. These nodes can be used for applications that have demanding remote visualization and/or rendering requirements. In addition, these virtual desktops can be configured as either Linux or Windows for a handful of compatible applications,
- The cluster provides high-speed and low-latency EDR InfiniBand networking. Every node is equipped with a Mellanox ConnectX-5 InfiniBand adaptor and all nodes are connected via Mellanox Switch-IB 2 switches, and
- Three new storage systems. The first storage system will be an NFS based storage providing space for home directories, applications, libraries, and compilers, etc. The second storage system will provide the high-performance Lustre parallel file system for calculation scratch space. The third storage system is 110TB of usable disk based archive space that includes off-site backup for disaster recovery.

Southern Methodist University's ManeFrame II HPC Cluster, while still under construction, has generated lots of excitement at the university and demonstrates SMU's commitment to research through High Performance Computing. Joe Gargiulo, CIO of SMU, is convinced that the HPC is on a path to help achieve his university's goal of "World Changers Shaped Here"!

Appendices

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University of Texas System

Financial Statements

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Member of Texas Society of Certified Public Accountants

INDEPENDENT ACCOUNTANT'S COMPILATION REPORT

To the Board of Directors
Lonestar Education and Research Network
Lubbock, TX

Management is responsible for the accompanying financial statements of Lonestar Education and Research Network (a nonprofit organization), which comprise the statement of financial position as of December 31, 2016, and the related statement of activities for the year then ended in accordance with accounting principles generally accepted in the United States of America. I have performed a compilation engagement in accordance with Statements on Standards for Accounting and Review Services promulgated by the Accounting and Review Services Committee of the AICPA. I did not audit or review the financial statements nor was I required to perform any procedures to verify the accuracy or completeness of the information provided by management. Accordingly, I do not express an opinion, a conclusion, nor provide any form of assurance on these financial statements.

Management has elected to omit substantially all of the disclosures and statement of cash flow required by accounting principles generally accepted in the United States of America. If the omitted disclosures and statement of cash flow were included in the financial statements, they might influence the user's conclusion about the Organization's financial position, changes in assets, and cash flow. Accordingly, these financial statements are not designed for those who are not informed about such matters.

February 19, 2017

Certified Public Accountant
Austin, TX

Statement of Financial Position December 31, 2016

	Current Operating Funds		
	Program Fund	Network Fund	Total
Assets			
Current Assets			
Cash & cash equivalents	996,359	15,569,024	16,565,383
Accounts receivable: Network services	-	592,082	592,082
Prepaid expenses	-	21,204	21,204
Funds held by others	1,900	-	1,900
Total Current Assets	998,259	16,182,310	17,180,569
Property & Equipment			
Network equipment	-	8,997,074	8,997,074
Furniture & equipment	52,371	-	52,371
	52,371	8,997,074	9,049,445
Less accumulated depreciation	(47,787)	(7,206,911)	(7,254,698)
Property & Equipment - net	4,584	1,790,163	1,794,747
Other Assets			
Network & IRU access rights	-	9,835,897	9,835,897
Less accumulated amortization	-	(5,319,682)	(5,319,682)
Total Other Assets	-	4,516,215	4,516,215
Total Assets	$ 1,002,843	$ 22,488,688	$ 23,491,531
Liabilities & Net Assets			
Current Liabilities			
Deferred revenue	-	262,863	262,863
Accounts payable	85,955	180,522	266,477
Credit cards payable	23,657	7,552	31,209
Capital leases payable - current portion	-	15,000	15,000
Total Current Liabilities	109,612	465,937	575,549
Long Term Liabilities			
Capital leases net of current portion	-	37,056	37,056
Total Liabilities	109,612	502,993	612,605
Net Assets			
Unrestricted net assets	893,231	11,987,539	12,880,770
Unrestricted board designated net assets	-	-	-
Life cycle replacement	-	9,916,087	9,916,087
Member balances	-	82,069	82,069
Total Net Assets	893,231	21,985,695	22,878,926
Total Liabilities & Net Assets	**$ 1,002,843**	**$ 22,488,688**	**$ 23,491,531**

Statement of Activities for the Year Ended December 31, 2016

	Current Operating Funds		
	Unrestricted		
	Program Fund	Network Fund	Total
Revenues & Other Support			
Network services	-	7,630,218	7,630,218
Membership dues	780,000	-	780,000
Investment income	4,628	83,005	87,633
Credit Card Rebates	-	7,600	7,600
Loss on disposal of assets	(4,584)	-	(4,584)
Net Assets Released from Restrictions			
Fund transfers	(4,681)	4,681	-
Total Revenues & Other Support	$ 775,363	$ 7,725,504	$ 8,500,867
Expenses Program Services			
Connections & fibers	-	2,961,598	2,961,598
Installation	-	50,290	50,290
Network parts & supplies	-	31,033	31,033
Amortization	-	603,013	603,013
Depreciation	-	681,329	681,329
Total Program Expenses	-	4,327,263	4,327,263
Supporting Services			
Professional fees			
Administration	388,796	546,532	935,328
Consulting	4,034	34,047	38,081
Auditing	19,750	-	19,750
Legal	11,569	-	11,569
Accounting	9,368	-	9,368
Salaries & wages	12,748	363,012	375,760
Travel	55,547	56,885	112,432
Sponsored meetings	78,867	-	78,867
Insurance	50,871	-	50,871
Payroll taxes	1,018	22,097	23,115
Office rent	21,382	-	21,382
Membership dues	20,020	-	20,020
Telephone	10,765	240	11,005
Office expenses	7,561	3,833	11,394
Postage & delivery	1,005	4,655	5,660
Books & subscriptions	1,838	3,415	5,253
Office utilities & maintenance	4,791	-	4,791
Computer & software supplies	3,386	1,048	4,434
Marketing, education & awards	4,354	47	4,401
Depreciation	2,454	-	2,454
Total Supporting Services	710,124	1,035,811	1,745,935
Total Expenses	$ 710,124	$ 5,363,074	$ 6,073,198
Changes in Net Assets	65,239	2,362,430	2,427,669
Net Assets			
Beginning balance at January 1, 2016	827,992	19,638,460	20,466,452
Prior period adjustment	-	(15,195)	(15,195)
Beginning balance at January 1, 2016 as restated	827,992	19,623,265	20,451,257
Ending balance at December 31, 2016	$ 893,231	$ 21,985,695	$ 22,878,926

Affiliated Organizations

Colleges

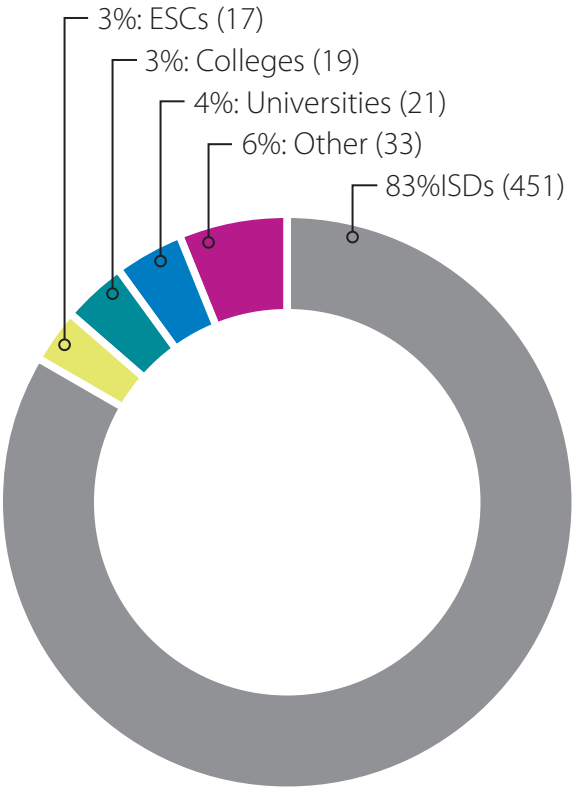
Angelina College
Austin Community College
Blinn College
Brazosport College
Del Mar College
Galveston College
Houston Community College
Lamar Institute of Technology
Lamar State College – Orange
Lamar State College – Port Arthur
Midland College
Navarro College
Northeast Texas Community College
Panola College
Paris Junior College
Texarkana College
Trinity Valley Community College
Tyler Junior College
Victoria College

Education Service Centers

Education Service Center – Region 1
Education Service Center – Region 2
Education Service Center – Region 3
Education Service Center – Region 4
Education Service Center – Region 5
Education Service Center – Region 6
Education Service Center – Region 7
Education Service Center – Region 9
Education Service Center – Region 11
Education Service Center – Region 13
Education Service Center – Region 14
Education Service Center – Region 15
Education Service Center – Region 16
Education Service Center – Region 17
Education Service Center – Region 18
Education Service Center – Region 19
Education Service Center – Region 20

ISDs

Abernathy ISD
Adrian ISD
Albany ISD
Alief ISD
Alpine ISD
Alto ISD
Amherst ISD
Anderson-Shiro CISD
Andrews ISD
Angleton ISD
Anson ISD
Anton ISD
Apple Springs ISD
Archer City ISD
Aspermont ISD
Aubrey ISD
Austin ISD
Austwell-Tivoli ISD
Baird ISD
Balmorhea ISD
Bangs ISD
Banquete ISD
Bartlett ISD
Bellevue ISD
Ben Bolt-Palito Blanco ISD
Benavides ISD
Benjamin ISD
Big Sandy ISD
Birdville ISD
Blackwell CISD
Blanco ISD
Blanket ISD
Bluff Dale ISD
Bob Hope Charter School
Boling ISD
Booker ISD
Borden County ISD
Borger ISD
Bovina ISD
Bowie ISD
Boys Ranch ISD
Brackett ISD
Brady ISD



Affiliated Organizations (continued)

Brazos ISD
Brazos School for Inquiry & Creativity
Breckenridge ISD
Brenham ISD
Broaddus ISD
Brock ISD
Bronte ISD
Brookeland ISD
Brooks County ISD
Brooksmith ISD
Brownfield ISD
Brownwood ISD
Bryson ISD
Buckholts ISD
Buena Vista ISD
Buna ISD
Burkburnett ISD
Burkeville ISD
Burnet CISD
Burton ISD
Caldwell ISD
Calhoun County ISD
Calvert ISD
Canadian ISD
Canyon ISD
Castleberry ISD
Cayuga ISD
Centerville ISD
Channing ISD
Chester ISD
Childress ISD
Chillicothe ISD
Christoval ISD
Cisco ISD
City View ISD
Clarendon ISD
Claude ISD
Clint ISD
Clyde CISD
Coahoma ISD
Coldspring-Oakhurst CISD
Coleman ISD
Colmesneil ISD
Colorado ISD
Comal ISD
Comanche ISD
Comfort ISD
Comstock ISD
Cotton Center ISD
Coupland ISD
Crane ISD
Crockett County Consolidated CSD
Crockett ISD
Crosbyton CISD
Cross Plains ISD
Cross Roads ISD
Crowell ISD
Culberson County ISD
Damon ISD
Danbury ISD
Darrouzett ISD
Dawson ISD
De Leon ISD
Denton ISD
Deweyville ISD
D'Hanis ISD
Dime Box ISD
Dimmitt ISD
Doss Consolidated CSD
Douglass ISD
Early ISD
East Central ISD
East Fort Worth Montessori Academy
Eastland ISD
Eden ISD
Ehrhart School
Electra ISD
Era ISD
Erath Excels Academy, Inc.
Etoile ISD
Eula ISD
Evadale ISD
Excelsior ISD
Fayetteville ISD
Flatonia ISD
Floydada ISD
Follett ISD
Forestburg ISD
Forsan ISD
Fort Davis ISD
Fort Elliott CISD
Fort Sam Houston ISD
Fort Stockton ISD
Frankston ISD
Fredericksburg ISD
Gause ISD
George West ISD
Giddings ISD
Glasscock County ISD
Godley ISD
Gold Burg ISD
Gonzales ISD
Good Shephard Network
Goodrich ISD
Gordon ISD
Gorman ISD
Grady ISD
Graford ISD
Grandfalls-Royalty ISD
Grandview-Hopkins ISD
Granger ISD
Grape Creek ISD
Grapeland ISD
Greenwood ISD
Groom ISD
Groveton ISD
Gruver ISD
Gustine ISD
Hale Center ISD
Hamlin ISD

Happy ISD
Hardin-Jefferson ISD
Harlingen CISD
Harper ISD
Harrold ISD
Hart ISD
Hartley ISD
Haskell CISD
Hawley ISD
Hedley ISD
Hemphill ISD
Henrietta ISD
Hermleigh ISD
Hidalgo ISD
Higgins ISD
High Island ISD
Highland ISD
Highland Park ISD
Holliday ISD
Holy Cross
Huckabay ISD
Idalou ISD
Industrial ISD
Iowa Park CISD
Ira ISD
Iraan-Sheffield ISD
Irion County ISD
Jacksboro ISD
Jarrell ISD
Jim Ned CISD
Johnson City ISD
Joshua ISD
Karnes City ISD
Kelton ISD
Kenedy ISD
Kennard ISD
Kennedale ISD
Kermit ISD
Kinkaid School
Kirbyville CISD
Klondike ISD
Knox City-O'Brien CISD
Kountze ISD
Kress ISD
La Gloria ISD
La Grange ISD
Lackland ISD
Lake Travis ISD
Lake Worth ISD
Laneville ISD
Lapoynor ISD
Latexo ISD
Lefors ISD
Leggett ISD
Leon ISD
Leveretts Chapel ISD
Liberty Hill ISD
Lindsay ISD
Lingleville ISD
Lipan ISD
Little Cypress-Mauriceville CISD
Littlefield ISD
Lockhart ISD
Lockney ISD
Loop ISD
Loraine ISD
Lorenzo ISD
Lovelady ISD
Lueders-Avoca ISD
Luling ISD
Lumberton ISD
Lyford ISD
Lytle ISD
Madisonville CISD
Malakoff ISD
Mansfield ISD
Marfa ISD
Martins Mill ISD
Mason ISD
Matagorda ISD
May ISD
McCamey ISD
McDade ISD
McLean ISD
McMullen County ISD
Meadow ISD
Medina Valley ISD
Memphis ISD
Menard ISD
Merkel ISD
Meyersville ISD
Miami ISD
Midland Academy Charter
Milano ISD
Miles ISD
Mission CISD
Monahans-Wickett-Pyote ISD
Monsignor Kelly Catholic High School
Montague ISD
Moran ISD
Morgan Mill ISD
Morton ISD
Moulton ISD
Mount Enterprise ISD
Muenster ISD
Mumford ISD
Munday CISD
Murchison ISD
Natalia ISD
Navarro ISD
Navasota ISD
Nazareth ISD
Neches ISD
New Braunfels ISD
New Deal ISD
New Home ISD
Newcastle ISD
Newton ISD
Nixon-Smiley CISD
Nocona ISD

Affiliated Organizations (continued)

Normangee ISD
Northside ISD
Nueces Canyon ISD
Nursery ISD
Oakwood ISD
O'Donnell ISD
Olfen ISD
Olney ISD
Onalaska ISD
Orange Grove ISD
Orangefield ISD
Overton ISD
Paint Creek ISD
Paint Rock ISD
Palacios ISD
Palo Pinto ISD
Pampa ISD
Panhandle ISD
Panther Creek ISD
Pearland ISD
Peaster ISD
Pecos-Barstow ISD
Perrin-Whitt CISD
Perryton ISD
Petersburg ISD
Petrolia ISD
Pilot Point ISD
Pine Tree ISD
Plains ISD
Plemons-Stinnett-Phillips CISD
Ponder ISD
Poolville ISD
Port Aransas ISD
Port Arthur ISD
Post ISD
Prairie Lea ISD
Prairie Valley ISD
Presidio ISD
Pringle-Morse CISD
Quanah ISD
Ralls ISD
Ranger ISD
Raven School
Reagan County ISD
Richards ISD
Richland Springs ISD
Rio Vista ISD
Rising Star ISD
River Road ISD
Robert Lee ISD
Roby CISD
Rochelle ISD
Rocksprings ISD
Roma ISD
Roosevelt ISD
Roscoe ISD
Rotan ISD
Round Top-Carmine ISD
Rule ISD
Runge ISD
Sabinal ISD
Sabine ISD
Sabine Pass ISD
Saint Jo ISD
San Isidro ISD
San Saba ISD
San Vincente ISD
Sands CISD
Sanford-Fritch ISD
Santa Anna ISD
Santa Maria ISD
Santa Rosa ISD
Schertz-Cibolo-Universal City ISD
Schleicher ISD
Schulenburg ISD
Seagraves ISD
Seashore Charter Schools
Seymour ISD
Shallowater ISD
Shamrock ISD
Shelbyville ISD
Shepherd ISD
Shiner ISD
Sidney ISD
Silverton ISD
Sivells Bend ISD
Slaton ISD
Slidell ISD
Slocum ISD
Smyer ISD
Snyder ISD
Somerville ISD
Sonora ISD
Southland ISD
Spearman ISD
Spring Creek ISD
Spring Hill ISD
Spurger ISD
St. Francis de Sales School
Stamford ISD
Stanton ISD
Sterling City ISD
Stockdale ISD
Strake Jesuit College Prepatory
Stratford ISD
Strawn ISD
Sundown ISD
Sunray ISD
Sweet Home ISD
Sweetwater ISD
Taft ISD
Tahoka ISD
Tenaha ISD
Terlingua ISD
Terrell County ISD
Texas School for the Blind & Visually Impaired
Texhoma ISD
Texline ISD
Thorndale ISD

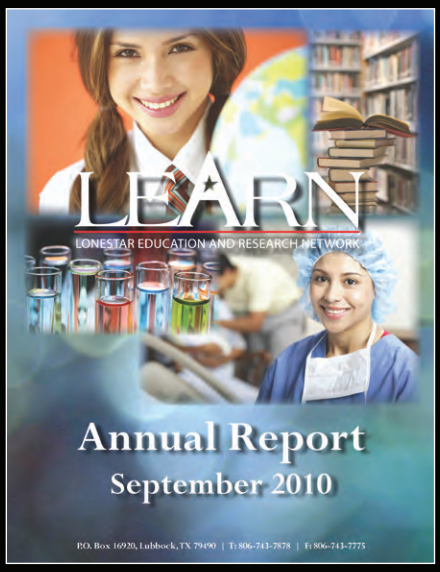
Thrall ISD
Three Rivers ISD
Three Way ISD
Throckmorton ISD
TLC Academy
Tolar ISD
Trent ISD
Trinidad ISD
Tulia ISD
Valentine ISD
Valley View ISD
Vega ISD
Veribest ISD
Vernon ISD
Victoria ISD
Vidor ISD
Vysehrad ISD
Waelder ISD
Walcott ISD
Wall ISD
Walnut Bend ISD
Warren ISD
Water Valley ISD
Webb CISD
Wellington ISD
Wellman-Union CISD
Wells ISD
West Orange-Cove CISD
West Rusk ISD
West Sabine ISD
Westbrook ISD
Westhoff ISD
Wharton ISD
Wheeler ISD
White Deer ISD
Whitharral ISD
Wichita Falls ISD
Wildorado ISD
Wilson ISD
Wimberley ISD
Windthorst ISD
Wink-Loving ISD
Winters ISD
Woden ISD
Woodson ISD
Woodville ISD
Wylie ISD
Yoakum ISD
Yorktown ISD
Zavalla ISD
Zephyr ISD

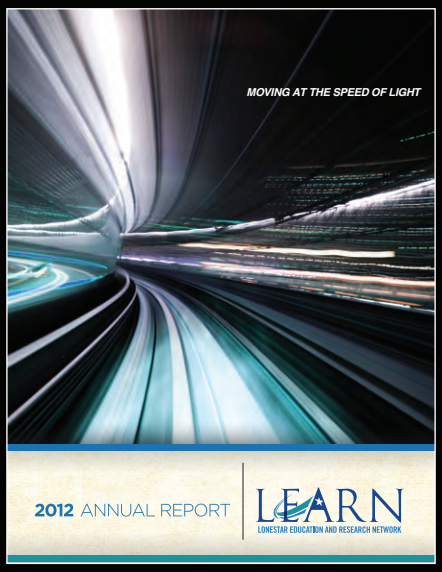
Universities

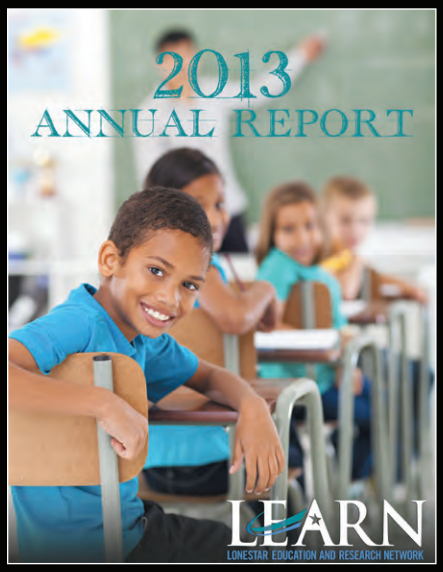
Southwestern Adventist University – C.S. Dept.
Sul Ross State University
Sul Ross State University Rio Grande College
Tarleton State University
Texas A&M International University
Texas A&M University – Central Texas
Texas A&M University – Commerce
Texas A&M University – Kingsville
Texas A&M University – San Antonio
Texas A&M University – Texarkana
Texas A&M University at Galveston
Texas Southern University
University of Houston – Clear Lake
University of Houston – Downtown
University of Houston – Victoria
University of North Texas at Dallas
University of North Texas Health Science Center
University of Texas – Permian Basin
University of Texas at Tyler
University of the Incarnate Word of San Antonio
West Texas A&M University

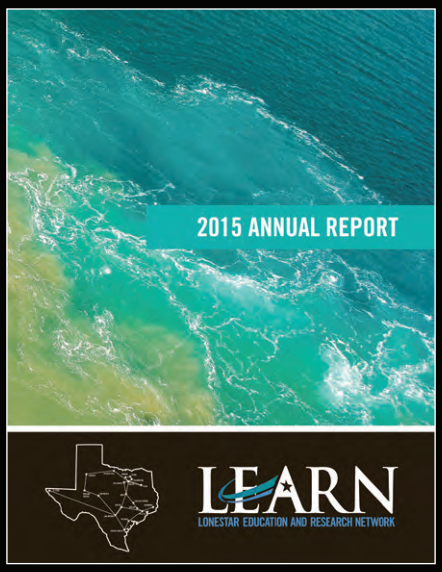
Other

Alamo Area Council Of Governments
Brazos Valley Affordable Housing
Brazos Valley Council of Governments (BVCOG)
Brazos Valley Council on Alcohol & Substance Abuse
Brazos Valley Small Business Development Council
Bryan/College Station Chamber of Commerce
Citizen's Medical Center – Victoria
City of Austin Information Services
Duncanville Public Library
Fort Worth Public Library
Grimes County Clerk's Office
Guadalupe Valley Hospital
Houston Metro
Internet2
Lower Colorado River Authority
Mesquite Public Library
Mission Hospital
Newton County Library
NOAA
Orange County
Parkland Memorial Hospital
Project Unity
Texas AgriLife Extension Service
Texas AgriLife Research
Texas Engineering Experiment Station
Texas Engineering Extension Service
Texas Forest Service
Texas Transportation Institute
Texas Veterinary Medical Diagnostic Lab
The Houston Museum of Natural Science
Travis County
Washington County
Wharton County Library









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