Abstract
The goal of the Louisiana Optical Network Initiative (LONI) is to create a statewide environment that can integrate and aggregate Louisiana’s many strengths, currently geographically distributed across its universities and industries. This proposal presents the design for the state’s high-speed advanced data network, Louisiana Advanced Regional Network (LARN), that connects the major research centers at LA Tech, ULL, SU-Baton Rouge, LSU-Baton Rouge, UNO, LSUHSC-Shreveport, LSUHSC-NO and Tulane University. LARN will be capable of supporting technological and scientific research, while stimulating economic development across the state. This proposal also recommends new grid technologies connecting LARN sites that will form the LAGrid, enable new collaborations, and provide necessary shared computational resources. LONI, the complete system incorporating both the network (LARN) and grid (LAGrid), is a direct investment in Vision 2020’s major goals for Louisiana to foster learning enterprises and cultural innovation, and to become a top 10 state. The estimated cost of this initiative is $25.5M, with a yearly running cost of $2M.

Introduction
High-speed advanced data networks are revolutionizing not only the way educators, researchers, and businesses work, but they are also changing dramatically the scale and character of the problems they can attack. Computer installations, sensor networks, digital television, animation companies, experimental facilities and many others are increasingly generating unfathomably large amounts of data that must be moved, stored, accessed and processed by people and machines in virtually every walk of life, especially in research and high-tech areas. High-speed networks must be deployed to keep up with the exponentially increasing demands of a data driven society.

The Louisiana Optical Network Initiative (LONI) proposes the deployment of both the Louisiana Advanced Regional Network (LARN) and the LAGrid. High-speed networks, coupled with new application technologies, become “grids”, the fundamental conduit for new models of computation and collaboration across large distances. Grids provide distributed computational facilities, greatly exceeding the capabilities of any one site, while providing tools that can, for example, enable data mining for researchers and businesses to extract information from warehouses full of data.

Regions across the Nation and throughout the world are scrambling to deploy high-speed networks capable of carrying 10’s of Gbits/sec to closely link universities, high-tech industries, research centers and experimental facilities. These networks are typically hundreds to thousands of times faster than the previous generation currently deployed in Louisiana. This capacity, along with the advanced capabilities new networks provide, is required for present and future applications being used and developed today. As detailed below, we propose to deploy a high-speed advanced data network, entitled Louisiana Area Research Network, or LARN, as soon as possible.

This LONI proposal comes at a unique time because optical switching network technology has matured considerably in recent years. LARN will carry the state forward into the next decade, using “lambda” technology (each lambda is capable of carrying 10
Gbits/sec). LARN is easily upgradeable, additional lambdas can be added at relatively little cost. The initial deployment of LARN, is estimated to cost $25.5 M.

One might question why a “multi-lambda” network across the state is necessary, when presently the much lower bandwidth available (typically below 10 Mbits/sec) is not fully saturated. But many problems of importance to industry and academia alike simply cannot be attempted without a very significant upgrade to the existing infrastructure. For example, a single channel of full quality high definition television (HDTV) or video conferencing requires 50Mbits/sec (10x the bandwidth between most campuses). A single interactive remote visualization of a large dataset, needed for medical imaging, requires a network of at least 150Mbits/sec. Such applications are simply not possible on the state’s existing network. Several of Louisiana’s major research centers are already active in developing advanced grid applications, and LSU has recently recruited a team from Europe with unique and world renowned, expertise in grid applications and collaborative technology.

To summarize, the goal of LONI is to create a statewide environment that can integrate and aggregate Louisiana’s many strengths, currently geographically distributed across its universities and industries. Different groups with unique capabilities and expertise are to be found throughout the state, but they are often working in isolation, either unaware of each other, or unable to build on each other’s strengths, hindered by a lack of basic networking infrastructure. Keeping Louisiana’s existing strengths in the state, bringing them together, while attracting new ones in research, education and industry, will require new infrastructure and vision. Our LONI proposal addresses all these issues with a coherent and broadly supported initiative, that includes both the high-speed advanced data networks themselves (LARN) and grid technology deployment (LAGrid). The proposed developments have the potential to significantly raise the level of research, education, and industry across the state. LONI will make Louisiana a prominent player at both national and international levels for attracting not only millions of dollars of research funding, but leading researchers, educators, and high-technology industry as well. These new scientists and businesses will need such facilities for their basic operations.

**Network and Computer Clusters**

The proposed network would connect LA Tech, ULL, SU-Baton Rouge, LSU-Baton Rouge, UNO, LSUHSC-Shreveport, LSUHSC-NO and Tulane University with four lambdas (each lambda is 10Gbit/sec). This would provide dedicated 10 Gigabit connections for commercial internet and Internet2 traffic, research traffic between schools and disruptive network research as well as providing a spare connection for high reliability. The optical network will terminate in redundant routers on each campus making it easy to integrate into the campus LANs. Locating routers on each campus will make it easy for other schools to access the network. The phased in participation of all public and private higher education institutions in Louisiana is important to the state for both research and economic development reasons.

In addition to the network itself, it is crucial to develop Louisiana’s grid computing environment. LARN will seed the further development of these facilities by establishing midsized computing clusters to be located at LA Tech, ULL, SU-Baton Rouge, UNO and Tulane University. Coupled with LSU’s existing 1024 processor “Supermike” cluster, and grid software infrastructure described below, LARN will become a powerful grid computing facility, giving researchers across the state a unique competitive advantage in
their work, and in proposals they will write for federal funding. LARN will also be used extensively for educational purposes statewide.

We note that such facilities are deployed in other states, and significantly at the national and international level. The US “Extended TeraGrid” project is a much larger installation across Pennsylvania, Tennessee, Indiana, Illinois, Texas, and California. In the future, millions of dollars in federal funding are expected to be available to grow this into a much more powerful facility by adding additional sites. Louisiana will be in a position to apply for such funding with an existing infrastructure like LARN.

**Grid**
Grids are the hottest topic in computing since the development of the World Wide Web over a decade ago. Grids aim to harness the power of computers, file servers, handheld devices, and sensors, connected by high-speed networks, by deploying a unifying software infrastructure that aims to make it possible to access them individually or collectively, seamlessly harnessing their collective power and collaborative tools to bring communities, both academic and industrial, together.

Networks alone transmit only data; what makes these networks critical for the state’s future are the applications that exploit them and the people who use them. We stress that LONI is more than a network. It will also create a Grid (LAGrid) with both computing facilities and software infrastructure that makes it possible to deploy the advanced applications needed to catapult the state ahead, putting it in a position to lead in academic research, creating an environment that will support high-tech economic development and attracting new businesses to the state. *It is this comprehensive model, coupled with unique expertise in grid applications, that gives Louisiana a competitive advantage.*

**Mission and Governance**
*Mission:* The Louisiana Advanced Regional Network (LARN) is being built and maintained to provide high-speed networks that connect universities, industries and government sites in Louisiana. By providing a multi-lambda fiber-optic network throughout the State, LARN will foster research and transform economic development opportunities, and serve as the platform for applications development partnerships for universities, industries, and government at regional, national and international levels.

*Governance:* We recommend the establishment of a committee to explore and report best practices in providing governance model for LARN to achieve its intended research, education and economic development outcomes. We further recommend this governance model provide a neutral operating forum for stakeholders from universities, industry and government to (1) design, build, operate, and maintain LARN, (2) employ and train cluster staff, and manage the LAGrid facility and software infrastructure, (3) support academic research and industrial use of Grid applications, and (4) provide a flexible administrative infrastructure to harbor collaborations and partnerships for research and development between universities, industries and government.

**Types of Applications**
Applications drive the need for such a network. This is the area where the state has a unique opportunity to leapfrog other efforts, becoming a world leader in short period of time. Louisiana has the applications that can use grids, and the research expertise to truly enable scenarios such as the following:
Mississippi River Basin: A suite of application codes modeling every aspect of the basin such as floods, coastal erosion, tidal surges, hypoxia, climate and hurricanes are closely coupled together with remote sensing and experimental data to provide a complete modeling environment, accessible through a web-based portal.

Petroleum Engineering: Drilling platform sensors trigger real-time oil reservoir simulations which feedback to the handheld devices of engineers to steer drills to economically drill oil (UCoMS).

Astrophysics: Terabytes of data from the LIGO detectors are searched for gravitational wave signals by farming data to idle workstations around the State, providing new insights into black holes and the origins of the universe.

Coastal Ocean Observing: A network of sensors spanning the eastern and southern coasts send real time data to large data servers which is analyzed by integrated observing systems providing reliable, accurate and timely information to help guide effective coastal stewardship, plan for extreme events, facilitate safe maritime operations, and support coastal security (SCOOP).

Bioinformatics, Biomedical, Biotechnology and Life Sciences: Using large computers connected across the state by LAGrid, highly detailed simulations of patient’s eye are remotely displayed in full 3D to doctors in New Orleans to determine the optimal surgical procedure to save the patient’s sight.

Applications Development Focus: Applications development can be focused on the state’s industry clusters and serve high technology companies already in place, as well as leverage relationships at the national and international levels. Opportunities to enhance the Louisiana’s competitiveness exist in all of the targeted clusters:

- Oil & Gas and Energy
- Information Technology
- Transportation/Logistics
- Durable Goods
- Entertainment
- Advanced Materials
- Biotech
- Agriculture/Food Technology
- Petroleum and Environmental

Comparisons with Other States and Countries
While Louisiana currently ranks near the bottom in the US in terms of network connectivity, the deployment of LARN and LAGrid will catapult Louisiana in a lead position both nationally and internationally. More than 20 states have already either deployed networks of the type proposed here, or have announced a commitment to do so. Typically these networks are based on the needs of the major academic institutes in these states, but economic development is understood to be a major outcome from such investment. All of these states recognize the necessity to connect their higher education research institutions to Internet 2, the National Lambda Rail, and the Extended TeraGrid to be competitive in serving the research, education and economic development needs of their state. It is critical that Louisiana act immediately with a bold plan to address this issue.

Many other countries, even small and/or poor ones, have already deployed networks of this caliber. The Netherlands has quickly become a central site for high-speed networking, and leads Europe in this area. Its research and industrial base have
responded by rapidly deploying advanced applications to exploit them. Philips and Shell have become among the largest industrial users of the “Netherlight” facility. Poland has just deployed a very extensive network at a cost of nearly $100M, and chose to invest in this network even as a higher priority than highways (which it does not yet have).

Scattered about the state are pockets of great strength in both academic and industrial research and development, but these must be integrated in order to harness their potential. We stress again that with the recent influx of researchers with world leading expertise in high performance network applications and collaborative technologies, Louisiana’s comprehensive LONI stands poised to leapfrog other efforts that have only the networks themselves. By acting now, and acting boldly, Louisiana has an opportunity not only to be competitive with other states in attracting and retaining high-tech research and industry activity, but to surpass them due to its exceptionally strong application base and grid computing expertise.

**Economic Impact**

Information technology is the pervasive platform for world-wide economic advancement. California is projecting a $376 billion increase in its annual gross state product by 2010 through the implementation of its Gigabit broadband network. North Carolina has just published an economic impact study stating that by increasing its high performance cluster and grid computing capacity, IT will mean $10.1 billion in annual gross state product and a net increase of 24,000 jobs by 2010.

For Louisiana, the case for economic impact is much stronger than what is provided by traditional academic arguments. LONI, with its LARN network, and LAGrid, will create an environment that makes it possible for companies to flourish in the modern, data driven age, as well as for university researchers to develop applications on national grids on a multi-institutional basis. Most importantly, Louisiana has assembled and is growing an applications development and research team that is regarded as the best both nationally and internationally. This provides Louisiana high-technology employers, manufacturers, and defense contractors a pre-eminent competitive advantage. The objective is to position Louisiana as a leader in facilitating collaborations between universities, industries, and government, focused on creating and deploying new technologies, new jobs and new companies.

The presence of an advanced environment for research and development is in itself a crucial factor in the state’s ability to support and further develop the intellectual environment needed to foster economic development, as evidenced by the well known successes of Silicon Valley, Boston/Cambridge, North Carolina’s Triangle Park, and Austin, to name just a few. The establishment of a stronger research base in the state’s universities will be critical in our effort to attract not only other strong faculty and students, but also business and industry. These faculty, in partnership with businesses, will in turn attract much larger federal dollars in funding their programs. These are fundamental reasons for the state’s investment in the Vision 2020 IT Initiative.
Appendix: Network Connectivity

Fig. 1. The geographic distribution of the LARN network is shown linking Ruston, Shreveport, Lafayette, Baton Rouge, and New Orleans with for 10-Gbit/sec lambdas. LARN makes it possible to link the five Vision 2020 campuses, two medical centers, and Tulane University. The actual "star" network topology will emanate from Baton Rouge.