

Cyberinfrastructure For Ocean Observatories Leads List Of NSF Information Technology Grants Awarded To UC San Diego

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The National Science Foundation (NSF) today awarded more than \$9 million from its Information Technology Research (ITR) program to create six novel research projects at the University of California, San Diego with broad societal impact. Scientists and engineers will use the funds to develop technologies including cyberinfrastructure to connect land-based researchers to ocean sensors off the west coast of North America; using high-speed wireless networks to get early earthquake warnings from remote areas; techniques to protect the Internet's Domain Name System; and data systems for the operating room to improve the effectiveness of image-guided neurosurgery.

This is the fifth and final year of the ITR program, which committed over \$1 billion to this 'priority area' to encourage innovative, high-payoff research and education. Overall, nearly 120 projects will receive a total of \$130 million, and three of the largest awards in 2004 went to projects led all or in part by UCSD researchers. "The ITR program has dedicated major resources to address the information technology priorities facing the country, including advances in science and engineering, economic prosperity and a vibrant civil society, and homeland security," said Marye Anne Fox, UCSD's new Chancellor. "Given the competitive, merit-reviewed nature of the program, these NSF awards recognize the sustained excellence that characterizes UCSD's research program in information technology and communications."

The largest awards going to UCSD projects this year include:

Laboratory for Ocean Observatory Knowledge Integration Grid (LOOKING). Oceanographers and computer scientists will prototype communications and data-management infrastructure to link research institutions on land with several existing or planned ocean observatories off the west coasts of the United States, Canada and Mexico. Led by University of Washington oceanographer John Delaney, roughly half the \$3.9 million in funding will go to UCSD, where research will be led by Scripps Institution of Oceanography deputy director John Orcutt, and co-PI Larry Smarr, director of the California Institute for Telecommunications and Information Technology [Cal-(IT)²]. Together with other participating institutions, they will collaborate on experimental wireless, optical networks and grid technology required to use and automate undersea sensor networks-both delivery of data from sensors and the control of sensors and networks from land. The cyberinfrastructure will also serve as a prototype for future sensor networks for conducting research in other remote and hostile environments. "Software, hardware and network services developed as part of LOOKING will allow researchers, educators and students to access and analyze ocean and atmospheric data in real time," said Orcutt. "They will also be able to control and interact with ocean-based sensor arrays and robotic platforms from the relative comfort of their labs and classrooms."

Toward Mathematical Rigorous Next-Generation Routing Protocols for Realistic Network Topologies. SDSC networking researcher Kimberly Claffy is leading this effort to monitor and protect the Internet's Domain Name System, a key to maintaining the reliability and stable evolution of the Internet. The \$3.4 million project has three related and clearly defined focus areas: 1) execute the next step on the path toward construction of practically acceptable next-generation routing protocols based on more scalable and mathematically rigorous routing algorithms obtained recently in theoretical computer science; 2) validate the applicability of the above algorithms against several sources of real Internet topology data with the emphasis on scrupulous measurement

of critical statistical and graph-theoretic characteristics of the Internet topology; 3) build and evaluate a model for Internet topology growth, which reflects fundamental laws of evolution of large-scale networks.

Integration and Analysis of Reliable Networking for Remote Science, Education and First Responders.

This project is part of the wide-area High Performance Wireless Research and Education Network (HPWREN) created with NSF funding four years ago. HPWREN created a high-speed wireless network collaboration that includes scientists, educators, first responders, and Native American tribes. "With the network already in place, we will now focus our network research agenda on priority classes for various applications," said Hans-Werner Braun, research scientist at UCSD's San Diego Supercomputer Center (SDSC) and PI on both projects. "This systemic, interdisciplinary and multi-institutional research will address diverse networking predictability needs for remote areas, including strict real-time requirements for earthquake sensor data outrunning a seismic shock wave for advance warning systems, sensors at biological field stations, and rapidly deployable and reliable sensor and human-interface networks for real-life crisis management situations." HPWREN will also expand its education activities, notably on tribal reservations. Braun's co-PI on the project is SIO geophysicist Frank Vernon.

Two other SDSC researchers are PIs on new ITR grants. Kim Baldrige is leading a project to develop "A Novel Grid Architecture Integrating Real-Time Data and Intervention during Image-Guided Therapy." With expected funding of \$750,000 over three years, Baldrige's team will develop and deploy a grid architecture to handle the massive amount of data required to show surgeons exactly what is happening to a patient's brain during image-guided neurosurgery. Separately, SDSC Data and Knowledge Systems co-director Reagan Moore is leading an effort to further develop SDSC's Storage Resource Broker (SRB), production-quality technology for managing, moving, accessing, publishing and preserving today's massive data collections. Called "Constraint-based Knowledge Systems for Grids, Digital Libraries, and Persistent Archives," the project will develop and implement next-generation data management technology in a flexible, "intelligent" system that will support the application of dynamic constraints for controlling access, data placement, and views on data collections. Funding is set at \$737,000 over two years.

UCSD professor Fan Chung Graham—who holds joint appointments in the Department of Mathematics and the Jacobs School's Computer Science and Engineering department—is leading half of a collaborative \$1.3 million project with Princeton to address the theoretical foundation for interactive computing, which concerns information and communication complexity.

Since 1999, the ITR program has funded several large research endeavors led by UCSD scientists from Cal-(IT)², a partnership of UCSD and UC Irvine. In 2002, Cal-(IT)² director Larry Smarr—a professor of computer science and engineering in the Jacobs School—was the principal investigator on the \$12.5 million OptIPuter grid networking project, a partnership led by UCSD and the University of Illinois at Chicago. In 2003, \$12 million went to Project RESCUE (Responding to Crises and Unexpected Events), administered by Cal-(IT)² on both its Irvine and San Diego campuses. RESCUE is developing more robust information systems so emergency response can focus on activities that have the highest potential to save lives and property. Cal-(IT)²'s division director at UCSD—Jacobs School electrical and computer engineering professor Ramesh Rao—is leading the UCSD component of the project. As with LOOKING, these grants were the largest made in those years by the NSF's information-technology program.

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