The Link

NEWS FROM Information and Telecommunication Technology Center

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Polar Ice Research Gets Multi-million Dollar Grant

ITTC received a new grant from the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA) to help determine why sea levels have been rising for the past century. The project's total funding equals $8.7 million—ITTC's largest to date.

Prasad Gogineni, Ackers distinguished professor

The project will develop and deploy mobile radar sensors in the polar regions to collect and analyze real-time data about interactions between ice sheets, oceans, and the atmosphere.

ITTC received the award as part of NSF's Information Technology Research program, which spurs fundamental research and innovative uses of information technology in science and engineering. NSF awarded 309 grants, only eight of which exceeded $5 million, from more than 2,000 competitive proposals. KU's proposal by **Prasad Gogineni**, Deane E. Ackers distinguished professor of electrical engineering

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Four Partnerships Result in NSF Grant Awards

ITTC-affiliated faculty members have received four new grants from the National Science Foundation (NSF), for a total of ten active, NSF-funded projects at the Center.

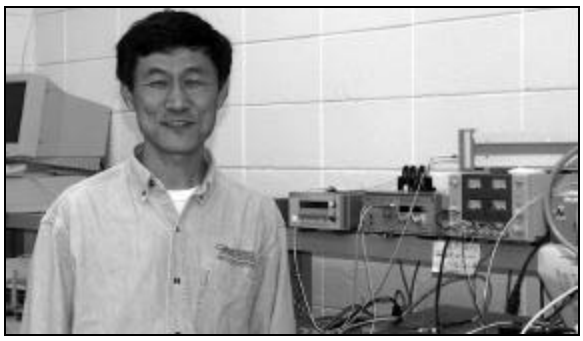
Researcher Finds Material at KSU

Ron Hui needed III-Nitrides for his work with optical communications. The highly stable material combines any two elements from the third row of the periodic table with nitride. Hui thought the material would be ideal for his optical packet switch, but the University of Kansas could not produce III-Nitrides. The assistant professor of electrical engineering and computer science (EECS) found what he needed just down the road at Kansas State University.

Hui teamed with physicists at KSU to develop "III-Nitride Wide Band Gap Semiconductors for Optical Communications." And NSF awarded the researchers a three-year, $400,000 grant to pursue the project. Hui said he'd use III-Nitrides to maximize the efficiency of the network and to speed up communications.

"We know the applications, and they know the physics of the material," Hui said of KSU. "I knew this device could improve optical system performance but didn't know how to make it. They knew the fundamentals of the material but didn't know how to use it."

Lin Jingyu, associate professor of physics at KSU, said the partnership was a perfect match. The project puts together experts from different fields to improve communications, Jingyu said. III-Nitrides have previously been used in full-color displays, traffic signal lights, and energy-saving lights, but Hui's work will break new ground.



Ron Hui will develop a new optical switch using III-Nitrides.

"As far as we know, this is the first project to utilize III-Nitride semiconductors for optical communication devices," he said.

The III-Nitrides compound would allow an optical switch to redirect messages without converting them to electronic signals. The conversion causes messages to be delayed and shrunk because of electronic limitations, Hui said.

The optical packet switch would redistribute the data through an open network. Transferring the information to another network and then on to the receiver takes a nanosecond—one-billionth of a second.

Hui said the III-Nitrides worked in the optical switch because of the material's controllable nature. It would allow for percentage changes of each compound

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Director's News

This fall ITTC celebrates some significant accomplishments, those big and those not quite as big. On the very big side of that scale, ITTC received $8.7 million of funding for **Prasad Gogineni's** project. Winning the prestigious NSF award puts us in the ranks of research programs at Carnegie Mellon, MIT, and Johns Hopkins. Prasad's outstanding vision and leadership led the team to this success. I'm sure they will find more successes as they enter the execution stage of the plan. A more complete story about the grant is on the front page.

Director Victor Frost

NSF is the judge in a very competitive field. And yet, ITTC has recently received more awards from NSF then ever before. Along with Prasad, affiliated faculty members **Chris Allen**, **Ron Hui**, **Victor Wallace**, and **Susan Gauch** have each received an NSF award in the past few months. Time and again, ITTC's researchers have proven that they are nationally competitive by working hard on significant problems.

ITTC participated in two significant events this fall that helped to increase ITTC's visibility in the community and the region. We're very pleased with our successful participation in the KU Whirlwind Tour and Open House. This was the inaugural year for both events, and the first year is always the hardest. But ITTC received good attendance and positive feedback on both.

In September, journalists from all across Kansas attended the KU Whirlwind Tour. This behind-the-scenes press tour gave Kansas' editors and publishers an opportunity to learn about the University. The group visited ITTC for an afternoon to learn about its research endeavors. The tour helped provide contacts and ideas for future news coverage of KU and ITTC.

In October, ITTC participated in a campus-wide Open House. For this Saturday event, attendees could enjoy personal tours through the labs, a poster display, computer-based project presentations, and refreshments. One special attraction during the Open House was **Dan Depardo's** demonstration of high definition television (HDTV). We're proud to have given many people their first glimpse at this new technology.

Those who attended the Open House ranged from high school students thinking about college to industry professionals wanting to partner with the Center. I'd like to thank all the staff members who helped make both these events possible by putting in extra time both during and after hours.

But you don't have to wait for a special event to come visit the Center. Please stop by anytime. ■

Staff Announcements: ITTC Welcomes New Employees

This fall, ITTC welcomes three new employees. **Matt Schlesener** joins ITTC as he begins work on his master's degree. He can return to school thanks to the Sprint Technology Services Advanced Technical Degree Sabbatical Program. The program covers the cost of tuition and books and provides a stipend. Schlesener's area of focus is networking and network architecture design.

Matt Schlesener

Working at ITTC will allow him hands-on experience, using the latest networking equipment, he said. After he completes his degree, Schlesener plans to return to Sprint where he hopes to join the technical management division.

This fall **Renxiang Huang** becomes ITTC's newest research engineer. But Huang is not new to ITTC. He began working in the Lightwave Communication Systems Lab in 1998 as a graduate research assistant. During that time he developed a model to simulate multiple wavelengths. In May 2001, Huang received his master's degree in electrical engineering. Now he continues his work in the lightwave lab as a full-time research engineer.

Renxiang Huang

In his new position, Huang will conduct research and support projects such as polarization-mode dispersion compensation and sub-carrier multiplexing.

Enguang Dai

Enguang Dai, a new post-doc associate, comes to ITTC from China's Peking University. He was a postdoctoral fellow there for two years, then stayed to research photonics and fiber optic communication and to teach graduate students. At ITTC, Dai will continue his research in the Lightwave Communication Systems Lab. His research interests include polarization-mode dispersion compensation and wavelength routing.

ITTC must say goodbye to two employees, who are beginning new careers in teaching. **Leen-Kiat Soh** joined ITTC in 1998 as a research scientist after completing his Ph.D. at KU. He worked in the Intelligent Systems and Information Management Lab on a variety of projects. Soh left ITTC in August to fulfill a long-time dream to teach at a university. He took a teaching and research position with the University of Nebraska, Lincoln.

Tim Buller joined ITTC in 2000 as a network specialist. He was responsible for network design and installation. Buller left ITTC in October to return his alma mater—Bethel College, in Newton, Kans. There he will teach system administration in the Department of Mathematical Sciences. ■

NSF Grant Helps Find Why Sea Level is Rising

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and computer science (EECS), was the only large grant awarded in Kansas. Other large awards went to universities such as Carnegie Mellon, Johns Hopkins, and MIT.

"This grant demonstrates clearly that Prasad and his group's work is internationally recognized for its excellence. It proves once again that KU faculty are competitive winners on a world stage," KU Chancellor Robert Hemenway said.

Gogineni will lead an international team of researchers to measure ice thickness and basal conditions, as well as near-surface and deep internal layers, over selected areas. Gogineni works within ITTC's Radar Systems and Remote Sensing Laboratory (RSL), which has been involved with polar ice research since the late 1980s.

"The results from this project will help us refine our understanding of the Antarctic ice sheet and how it responds to changes in the climate. Dr. Gogineni's project will add to the data and modeling efforts of many scientists who have an interest in developing a better understanding of this unique part of the world," said Julie Palais, program manager of the Antarctic Glaciology Program at NSF's Office of Polar Programs.

Outlet glaciers and ice streams control the discharge of ice into surrounding seas, and consequently the contribution of ice sheets to the rise of sea level, said Waleed Abdalati, manager of the Polar Program at NASA headquarters. Understanding the characteristics of these areas is essential to understanding how the ice sheets currently affect sea level, and how they are likely to do so in the future, Abdalati said.

"A major program objective at NASA is understanding changes in the mass of the Earth's ice cover and their potential effects on sea level rise," Abdalati said. "Since the Greenland and Antarctic Ice sheets represent a major reservoir of ice (equivalent to about 70 m of sea level), these areas are of particular interest. The system of radars will go a long way toward helping us understand the processes that control the discharge of ice to the surrounding seas."

Sea level has risen about 15 cm over the past century, and climate change is likely to accelerate this increase, with serious consequences for some of the 60 percent of the world's population living in coastal regions. Although about half of the recent sea-level rise was probably caused by net losses from the polar ice sheets (future contributions could be far larger), researchers still lack accurate estimates of the present ice-sheet mass balance (the net gain or loss of ice). Predictions of future behavior are little better than guesses.

The sensor web will collect, process, and analyze data from the ice. Vehicles will be equipped with ice-penetrating radars for mapping bed conditions, evaluating ice thickness, looking at different layers of the ice sheet to understand past ice dynamics, and examining recent snowfalls. They will work cooperatively as a single distributed system to select and create optimal sensor configurations.

Gogineni and the team of researchers will deploy the mobile sensor web in the next few years. The team's efforts enable researchers to study ice-sheet conditions at the bed by modeling present and future behavior of the ice sheets. The sensor web will give scientists new and accurate data, while reducing future operational costs and risks associated with polar research.

Palais said that researcher safety and reducing the human impact through the use of robotics and intelligent sensors were among NSF's considerations in selecting this project. While sensors and autonomous vehicles can never completely replace the need to send scientists to the Antarctic, this project is a step in the right direction.

"In the U.S. Antarctic Program, we have been striving in recent years to reduce our 'footprint' in Antarctica," Palais said. "New innovative technologies of this kind will help us to collect data without having to send as many personnel and field parties into this remote scientific laboratory and will in the end reduce costs and minimize the human impact on one of Earth's last pristine environments."

KU is leading a multi-institutional, multi-disciplinary team on the Mobile Sensor Web project. KU team members are: Arvin Agah, assistant professor of EECS; Chris Allen, associate professor of EECS; David Braaten, associate professor of physics and astronomy; Victor Frost, Ackers distinguished professor of EECS; Glenn Prescott, professor of EECS; and Costas Tsatsoulis, professor of EECS.

Other participants include the University of Alaska-Fairbanks, NASA's Jet Propulsion Laboratory, Ohio State University, the U.S. Army Cold Regions Research and Engineering Laboratory, the University of Chicago, the University of Copenhagen, the Alfred Wegener Institute (Germany), the University of Bristol, the Australian Antarctic Division, and the Phoang Institute of Technology (Korea). ■

"The NSF-ITR award is truly significant, not just due to the millions of federal research dollars coming to Kansas, but also because ITTC was so successful in the face of national competition."

—Beth Brough
KTEC's vice president of academic programs and legislative affairs

Four New NSF Grants Added to ITTC's Project Listing

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within the different layers of the material. By changing the amounts of each compound, Hui can control the refractive index, which determines the amount of light or information that passes through the optical switch.

Labs Work Together for Equipment Grant

Two of ITTC's research labs will reap the benefits of a $225,000 equipment grant from NSF. The Radar Systems and Remote Sensing Laboratory (RSL) and the Lightwave Communications Systems Laboratory (LCS) will purchase equipment needed to continue their cutting-edge research, said **Chris Allen**, director of RSL and co-director of LCS.

The two labs worked together on the proposal because of their overlapping research agendas. Researchers in the labs draw on common resources and skill sets, making them highly complementary.

"This equipment grant will allow us to continue doing cutting-edge research in both lightwave communications and remote sensing in the years to come," Allen said.

LCS will improve its testbeds, while RSL will purchase equipment to help further its understanding of the environments on Earth and in space.

LCS will get a surge of signaling power when it upgrades its test beds from 10 Gb/s to 40 Gb/s, providing a four-fold increase to fiber optic capabilities, Allen said. Researchers will use the extra fiber capacity to explore new ways of moving larger packets even faster. The powerful, new testbeds will have the greatest impact on Internet research, Allen said.

Chris Allen secured $225,000 from NSF for new equipment in two labs.

RSL will build and test three new radars with the grant. The first will be used on Greenland's ice sheet to see if the ice is frozen to the bedrock below or if a layer of water exists between the two. A water layer would increase the mobility of the ice, thus increasing melt. The second, a pulse compression laser radar, would allow radio signals to ride an optical carrier much like audio signals ride on radio waves in AM radio. This technology would allow scientists to gather information on a specific area with much greater precision, Allen said. The third radar would travel into space and search the subsurface of Mars, looking for water. Allen said that some craters and cracking patterns indicate that water may be present.

UMKC, KU Team to Clear Network Traffic

As more users connect to the information superhighway, congestion begins and a traffic jam ensues. Those cruising the Internet may hit a "hot spot," which is a random area that gets overloaded with information. The information may be lost or dramatically slowed down, leaving people stuck.

Victor Wallace, professor of EECS, said these hot spots received too much information too quickly. They arise most commonly from multimedia, high-speed network traffic.

Victor Wallace works with two colleagues from to UMKC improve network design using LAQT.

Wallace and two colleagues— professors Appie van de Liefvoort and Ken Mitchell, from the University of Missouri, Kansas City—have developed a possible solution to the roadblock. They received a $300,000 NSF grant to research "Scalable Performance Models for Large Scale Networks with Correlated Traffic." The investigators will use a technique called Linear Algebraic Queuing Theory (LAQT) to develop new network designs. Wallace created LAQT in the 1960s; in the following years, other researchers like van de Liefvoort and Mitchell refined and developed the theory.

"The combination of LAQT and the theory of nearly decomposable Markov chains gives a powerful new way to model the long-term correlations exhibited in these networks, while still exhibiting detail of the network design and its traffic," Wallace said. "This gives us the power to examine ways in which things like hot spots are affected by network design."

The use of algebraic queuing models to explain correlation effects is unusual, especially when those correlations involve very different time scales. Other researchers use models like fractals and diffusion analogs, but those have only a weak connection to the actual design elements of the network and the protocols that control the traffic.

"Using our models, we can try out many hypothetical situations and gain insight into how a design could be more effective, or how limits on performance are influenced by external factors," Wallace said.

The team hopes to develop and market a performance analysis package that has a greater faithfulness to the increasingly complex traffic patterns, and thus get network traffic back up to speed.

Team Classifies Biodiversity Info on Web

Susan Gauch, associate professor of EECS, has partnered with James Ashe, professor of ecology and evolutionary biology, to create an intelligent searching program for biodiversity information on the Web.

Gauch, who specializes in information retrieval on the Web, and Ashe, the senior curator of KU's Natural History Museum, received $99,820 from NSF to complete the project, entitled "Biodiversity Information Organization using Taxonomy (BIOT)."

Using biological taxonomy, BIOT will classify and organize the ever-growing pool of online resources, from pictures and maps to databases and papers, and provide an easy click-through navigation system. Once in place, BIOT will automatically classify new sites according to the taxonomy.

BIOT will provide scientists with better access to research sources and allow public officials to see how policy is affecting biological resources. The project will be completed in May 2003. ■

Tickets Can Clear Networks During Emergencies

As Americans heard of the tragic events of Sept. 11, they frantically called loved ones near the disaster's epicenter. Others rushed to their computers for the latest developments. They logged on for answers but found few—the overloaded networks were slow to respond or were completely shut down.

In crisis situations, networks have proven to be unreliable. The influx of traffic, which can be a five-fold increase, leaves communications systems unable to cope. To alleviate the problem, **Cory Beard**, former ITTC student and now an assistant professor at University of Missouri-Kansas City, and **Victor Frost** developed a ticket server architecture that would give high-priority users access to critical information at the right time. They detailed their work in the October issue of *IEEE/ACM Transactions on Networking*, with the article, "Prioritized Resource Allocation for Stressed Networks."

Beard and Frost explained that in an emergency environment, the ticket server would have credentials for emergency personnel. As events changed, the priority list could be revised, giving highest rank to those most critical to the rescue operation.

"Because a large number of people perform lots of different activities to support emergency response, not all of them have the same priority at the same moment, so some need to be given priority over others," Beard said. "For example, during the first moments after a disaster, a person performing search and rescue operations would be of higher priority over a person providing economic relief."

In other national disasters, such as the Oklahoma City bombing, emergency personnel faced overloaded networks that slowed communication. Immediately after the bombing, congestion occurred for cell phones. AT&T segmented cellular resources into priority and non-priority services, giving emergency workers special phones with priority status. It took 90 minutes to set up the system and more than two days to fully unclog the network.

The paper detailed how the ticket server would have lowered blocking within minutes for all users. All emergency personnel would have received priority clearance, not just those with special phones. People would gain access to communication resources through their ticket.

"What complicates the matter is that not all people who need priority would be members of a federal response agency," Beard said. "Some could be local workers (fire, police, etc.), and some could be the general public. A ticket server allows everyone, regardless of organization, to request tickets for priority status."

The obvious, immediate impact would be for cell phone users, but Frost said the ticket server could have a broad effect on emergency situations. In the future, emergency personnel could receive 3-D architectural drawings, medical information, maps, and a host of other information.

"Managing the scarce communication resources on a stressed network supporting the multimedia requirements is a continuing challenge," Frost said. "The architecture presented in this paper is just the beginning."

While progress is being made, a new sense of urgency erupted on Sept. 11. The federal government has asked the wireless communication industry for an effective way to provide safety workers with priority access in emergency situations. The government first approached communication companies in 1995, but little progress has been made. Difficulties, such as a shortage of spectrum dedicated to wireless calls and conflicting technical formats, have caused the delay, wrote Simon Romero in a *New York Times*' article, "Hurdles to Wireless Priority Access." The industry also struggles to create an inclusive priority list.

"People are worried that someone from the general public could have an urgent need as well (like making a call from within a collapsed structure)," Beard said. "A ticket server approach would provide the ability to give anyone priority, whether it be someone from the general public with an urgent need or someone that works with an emergency response organization." ■

To find the article, "Prioritized Resource Allocation for Stressed Networks," by Beard and Frost go to http://www.ittc.ku.edu/publications; find "sort by publication year" and choose "2001."

"In times of severe wireless network congestion, call completion percentages can drop well below 5 percent. It is essential that we work with industry to deploy priority access service for use in crisis situations as soon as possible."

—Richard Clarke
the president's special adviser on cyberspace security

quoted in the Oct. 22, 2001 *New York Times*

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Achievements and Acclaim

Recent Graduates

The following list includes all students who have defended their theses since October 2000, their degrees, and their advisors.

Srinivas Akkipeddi, M.S., P. Alexander; **Abhijit Apte**, M.S., J. Stiles; **Ravi Chamarty**, M.S., G. Minden; **Disha Chopra**, M.S., J. Evans; **Arun Dugganapally**, M.S., D. Niehaus; **Ryan Eakin**, M.S., C. Allen; **Renxiang Huang**, M.S., R. Hui; **Yoganandhini Janarthanan**, M.S., G. Minden; **Suresh Krishnaswamy**, M.S., J. Evans; **Towela Nyirenda-Jere**, Ph.D., V. Frost; **Rameshbabu Prabagaran**, M.S., J. Evans; **Balasubramanian Ramachandran**, M.S., J. Evans; **Chandrasekar Ramachandran**, M.S., J. Evans; **Bhavani Shanmugam**, M.S., D. Niehaus; **Dragan Trajkov**, M.S., J. Roberts; **Poojah Wagh**, M.S., G. Minden; and **Vishal Zinjuvadia**, M.S., G. Minden. ■

Gauch Receives Patent for VidWatch

When television distributors send video content to subscribing stations, the distributors need to verify that the signal is reaching the customers correctly. That means that the signal is free of abnormal distortions and unauthorized insertions. **John Gauch**, associate professor of electrical engineering and computer science, developed and recently patented a video-watchdog technology called VidWatch. It provides around-the-clock, web-based monitoring of broadcast video around the world.

Using a PC-based system, VidWatch analyzes every frame of video signal in real time to be sure it matches with the original broadcast. If VidWatch detects any differences, it digitizes and encodes the broadcast video and the customer video, then generates daily, video-authentication reports. VidWatch has been deployed and successfully field-tested for two years in cooperation with a major, international television network. ■

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Students Go Abroad to Complete Final Research Project

Raquel Martinez and **Alvaro Alvarez** had finished their mandatory five-year course work at the University of Cantabria in Santander, Spain. The two students needed only to complete their research project to graduate. Their advisor recommended they do their final project at the University of Kansas with **Sam Shanmugan**. The telecommunication-engineering students arranged to research ultra wide band technology under the direction of Shanmugan, Southwestern Bell distinguished professor of electrical engineering and computer science.

"They have a very strong wireless communication program at the University of Cantabria," Shanmugan said. "Our programs are very complementary. We do a lot at the system level, and they work with hardware development."

The students will research the third-generation of wireless communications, studying how waveforms are reflected through the air, Shanmugan said. Greater understanding of the transmission channel will allow for a faster and more effective communication system, he added. This new generation of wireless communication will allow more users to operate their cell phones simultaneously and with higher data rates. The differences in speed and reliability between this new technology and older wireless systems can be compared to the differences of using of a cable modem to connect to the Internet and using a dial-up, telephone modem.

Raquel Martinez and Alvaro Alvarez traveled from Cantabria, Spain to work alongside Sam Shanmugan in researching ultra wide band technology. Their work will fulfill the requirement of a final project for graduation.

"It's a very new technology," Martinez said. "I think this technology will be the way things are done in a few years. People will use this for communication and radar systems in the future."

After the two students return to Santander, they will defend their work to a panel of professors. While Martinez plans to work in her native Spain, Alvarez said he would like to work in the United States and continue to develop ultra wide band technology.

"I prefer to do research," Alvarez said. "I love my studies because telecommunication is all about antennas and waves. It is so magical how people can communicate without wires." ■