He Sees IT

Story by Nikki Goth Itoi

For decades, Larry Smarr has helped shape information technology that has given us the Internet, special effects for blockbuster movies and more.

Larry Smarr sits in front of a 3 million-megapixel display in the Cal-(IT)² Visualization Center at Scripps Institution of Oceanography on the University of California, San Diego, campus in La Jolla, Calif. On the screen are data in the form of a 3-D rendering of Lake Tahoe's floor. Researcher Graham Kent uses these data to study how seismic activity affects the lake. Visualizing large-scale data in the earth sciences is a major thrust of the OptIPuter project that Smarr leads. The facility is linked to a second center at San Diego State University, which allows geophysicists to collaborate on research "immersively" and in real time.

Coming

Whether we are sending e-mail to far-flung friends and relatives or shopping for exotic goods right from the source, Larry Smarr has helped make possible today's split-second, far-reaching communication. For more than 20 years, Smarr has been instrumental in influencing information technology that touches our lives daily.

Unlike programmers at a company such as Microsoft, who build products that go directly to consumers, Smarr, AB, MS '70, works backstage and focuses on the very foundation of our national information network. In the early 1990s, he directed the national center that prototyped software systems that help us navigate the Web today, and aid in the production of special effects that Hollywood uses to make animated thrillers such as *Jurassic Park* and *The Perfect Storm*. In the future, we may thank Smarr for innovations that prevent traffic jams, safeguard our city water supplies and connect us with our doctors' offices without leaving home.

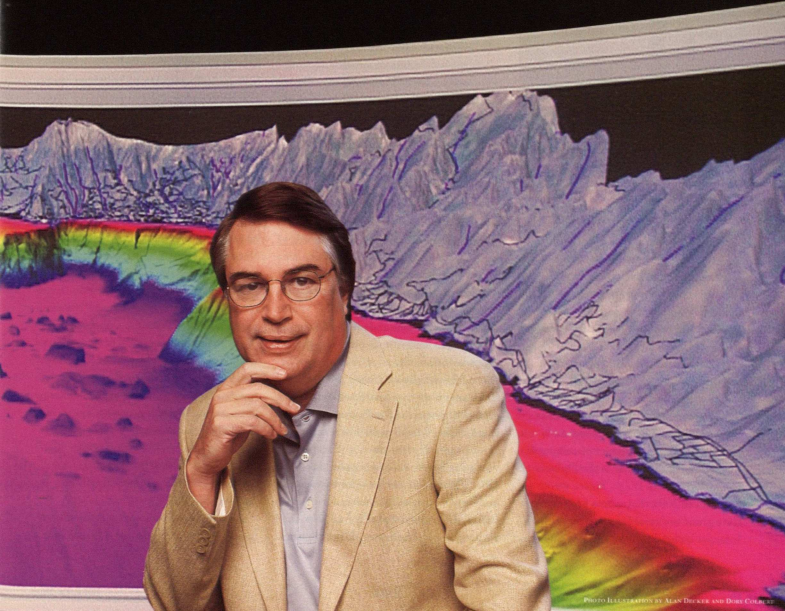

Photo Illustration by Alan Decker and Dori College

Although he's clearly a big-picture person, Smarr also can focus on the everyday problems that groundbreaking technology can solve. His ability to distill a dream into a practical application reflects both the progress of technology and the evolution of his own interests. As a child in Columbia, Smarr developed his fascination with technology as he worked side by side with his grandfather, an inventor. The youngster was fascinated by seemingly impossible problems, and by the time college rolled around he was investigating mysteries such as black holes. At

PHOTO COURTESY OF LARRY SMARR

From an early age, Smarr has been figuring out how to make the world spin a little faster. He created this carousel in first grade.

Mizzou he earned bachelor's and master's degrees in physics in the same year. He then earned two more degrees, a master's at Stanford University and a doctorate at the University of Texas at Austin. He remains tied to Columbia through his father, mother and two brothers there.

A world-renowned astrophysicist, Smarr not only has million-dollar ideas, but he also has garnered the means to pursue them. As a professor of computer science and engineering at the University of California, San Diego, Smarr wrote a proposal in 2001 that won a $100 million state grant to explore the impact of Internet technologies on society. The award provided the capital for the two buildings (at UC-San Diego and UC-Irvine) for the California Institute for Information Technology and Telecommunications, Cal-$(IT)^2$ for short, which Smarr directs. He led the institute to raise an additional $200 million in private and campus funding and organized a cross-disciplinary team of 200 faculty members from various universities and 30 companies, including IBM, Sun Microsystems and Microsoft.

One of the institute's major tasks is to study how the wireless Internet might be spread throughout the physical world to improve the quality of life, particularly for Californians. "The Internet is going to permeate everything, and people don't quite see this coming yet," Smarr says.

Rewiring Without Wires

In one of his projects for the new Internet, Smarr's researchers plan to place sensors inside automobiles, reservoirs and even human bodies. The sensors will transmit critical data to massive databases, which scientists will use to predict what could happen to society if variables change. For example, in the emerging field of intelligent transportation, they are studying cameras, microphones and proximity detectors placed in cars to create "smart roads" that could self-regulate traffic flows in congested areas. In such a future, when an accident occurs on one freeway in Los Angeles, the wireless network would alert drivers to alternative routes.

The environment and civil infrastructure also are well-suited to wireless intervention. In fact, the new Internet will be powerful enough to simulate the entire California water system. Residents of major cities such as San Francisco and Los Angeles, who depend on the state's alpine reservoirs for water, will rest easier when engineers can predict the harmful effects of changes such as global warming or development near a water source. Smarr also expects Cal-$(IT)^2$ to help authorities experiment with information technology to help manage other natural resources, preserve and restore ecosystems, and respond to environmental disasters.

Some of the most promising innovations will involve the human body itself, as doctors combine advances in personalized or genomic medicine with digitally enabled delivery of health care services. Patients at risk of cardiac arrest or other medical emergencies will wear tiny biosensors that alert doctors of complications. The technology could help doctors administer treatments more quickly and accurately and, in turn, save more lives.

Smarr has surmounted huge challenges before. In the 1970s, America reserved its fastest computers for running bomb codes; Smarr and other scientists could only ask for off-hours use of the machines. To run his numerical experiments, Smarr spent frenzied summers at Lawrence Livermore Labs in California or hopped on a plane to a German lab — both poor alternatives to full-time supercomputer access.

Developing the Internet

In 1979, Smarr joined the faculty at the University of Illinois at Urbana-Champaign. He was determined to solve computing problems for himself and his peers. In the early 1980s, he sent an unsolicited proposal to the National Science Foundation to create a new national information infrastructure that would enhance both academic research and industrial competitiveness. Smarr imagined that researchers in disciplines from engineering to drug design would take great strides forward if they could harness the power of emerging supercomputer technology and remote networking. Smarr's proposal was so compelling that the NSF awarded $50 million, a sum few researchers receive in their whole careers, to create the National Center for Supercomputing Applications (NCSA).

The supercomputing project launched in 1985 with Smarr at the helm. "The

major task in starting NCSA was to pull together not only the program, but also industry participation," recalls Erich Bloch, president of the Washington Advisory Group and a former director of the National Science Foundation. "That was exceptional, given Smarr's background. Not all academics are able to bridge that gap."

Smarr did more than bridge a gap — he catapulted computing into another realm. Five supercomputing centers became the nodes on a primitive electronic network called NSFNet, the precursor to today's commercial Internet. Smarr's center hired dozens of bright undergraduate and graduate students to work on new Internet software ideas. One of them was entrepreneur Marc Andreessen, who started Netscape after working at Smarr's center at the University of Illinois on browser technology called NCSA Mosaic.

Despite the financial success of several supercomputing center spinoffs, Smarr hasn't been tempted to join his former students in the business world. "I believe that universities have a unique role in society," he says. "They are constantly renewing the human resource where ideas come from." For Smarr, the private sector requires a focus too narrow to be much fun. He'd rather foster big ideas.

Case in point: To further his vision of an advanced communications infrastructure, Smarr formed an alliance of 50 universities and businesses that has worked since 1997 to design a grid connecting supercomputers, scientific instruments, large databases and research teams. Participants now use the grid for a variety of projects, from monitoring the water quality in the Chesapeake Bay to designing new earth-moving machines.

Passion and Reason

A genuine and deep-rooted passion for science drives Smarr to continue his work. But he is also one of a small group of scientists around the world who is concerned about the implications of unchecked technology development. He fears a perfect storm may be brewing on the horizon as the currents of cutting-edge research in telecommunications, biology and nanotechnology (the building of atomic-scale structures) begin to collide. "The convergence of these forces is deep stuff," he warns.

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The day may not be far off when robots will gain intelligence capabilities more powerful than the human mind; the re-engineering of life forms will become commonplace; and society will be connected through a pervasive, wireless supercomputing infrastructure. Such advancements might allow humankind to eradicate diseases or reintroduce extinct species. On the other extreme, they might also prove life-threatening if, for instance, genetically altered viruses that are immune to traditional vaccines create global epidemics.

At a minimum, Smarr suggests the coming wave of scientific discovery will challenge our existing social, economic and political systems. Already the Internet is being used by terrorists to plan attacks and by the West to counter them. We are seeing in Iraq and Afghanistan the emergence of a new warfare in which robots and chemical and biological agents are potential weapons. Smarr wants intelligent people to pay attention.

In a letter to the editor of *Wired* magazine in 2000, Smarr wrote, "I was one of the national organizers of the nuclear war education movement in the early 1980s and understand what is involved in trying to get society to look at unpleasant but imminent dangers." To discuss those dangers, he proposed a global summit, similar to one in Asilomar, Calif., in 1975, when molecular biologists gathered to talk through the dangers of recombinant DNA. Smarr concluded: "The odds of something going really wrong were very remote and the cost of containment very great, but because the scientists took the trouble to have the discussion and exhibit self-restraint, the public gained confidence in them, and the field has flourished."

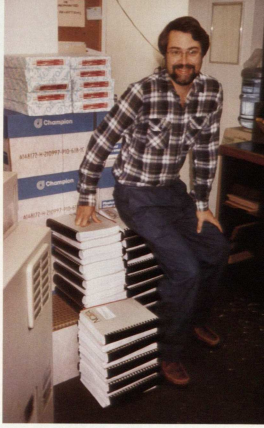

Photo Courtesy of Larry Smarr

After receiving a $50 million grant proposal from Smarr in 1984, the National Science Foundation funded the National Center for Supercomputing Applications. Here, after a long night of work, Smarr sits atop the five-year renewal grant, which was funded for $123 million.

Still, Smarr remains mostly optimistic about the potential of Cal-$(IT)^2$ to encourage a healthy dialogue about the impact of technology on society. He has proven himself one of few technology experts who can walk the middle ground comfortably; he acknowledges the risks of innovation while simultaneously charting a path to realize the benefits. If in the near future our lives become even a little bit safer and more enjoyable through the use of advanced wireless Internet technology, then Smarr will have succeeded in the next phase of his career. ❋

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