

UNLEASHING *the potential of* COMMUNICATION

Alexander Graham Bell was awarded the patent for the telephone in 1876. It took nearly a century for anyone to think of using telephone lines for anything other than transmitting voltages in a narrow band of frequencies that would carry the human voice. An extraordinary group of engineers finally saw that those existing phone lines had far more potential. One of them was John Cioffi—"the father of DSL." Gentry catches up with this winner of the 2006 Marconi Prize to discuss his revolutionary contribution to communication.

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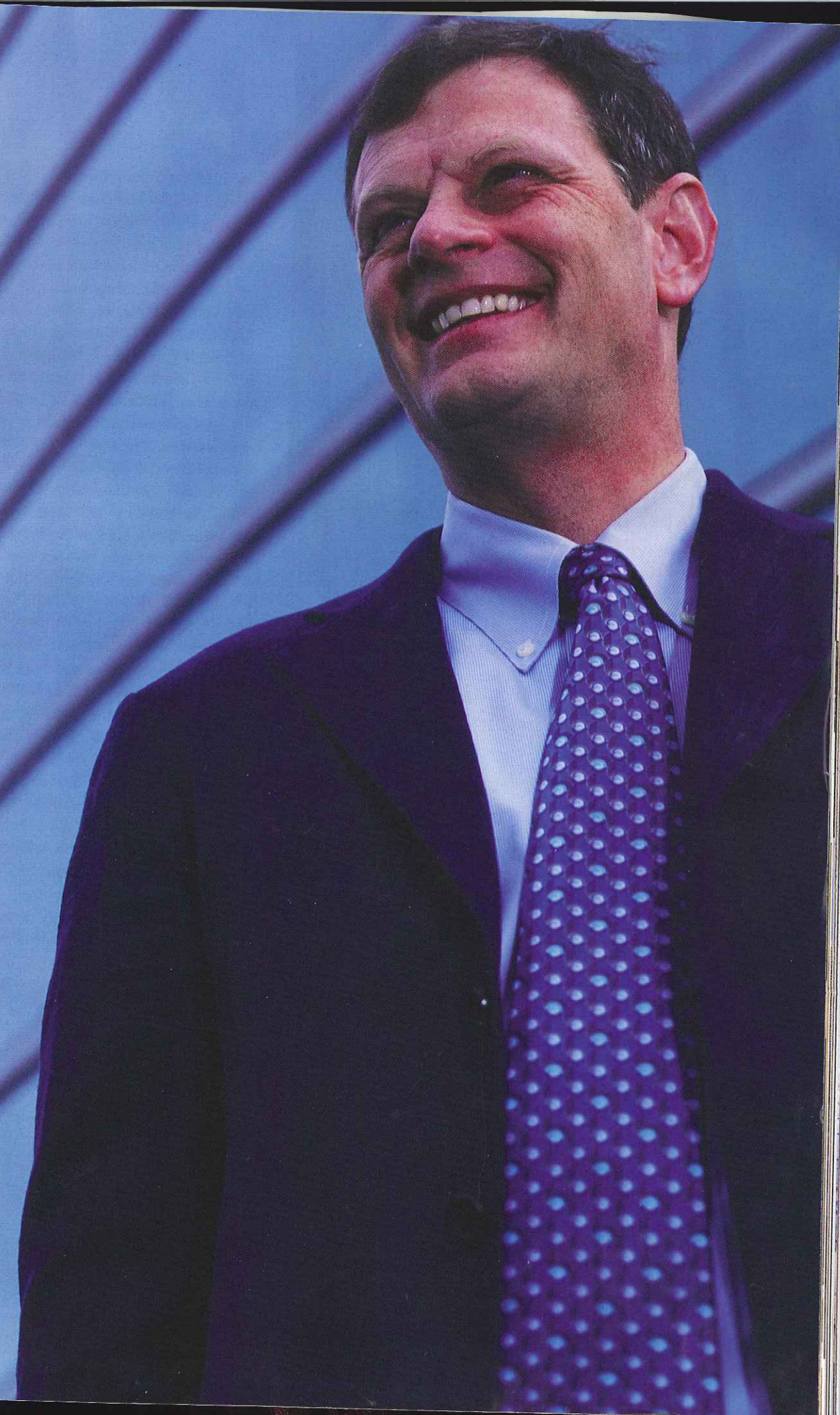
On a sparkling Thursday last October, the atmosphere outside the Computer History Museum in Mountain View was palpable with anticipation. Nearly 200 journalists, students, researchers, and scientists were gathered for a soon-to-be legendary symposium—the first ever Marconi Symposium to be held on the West Coast. The topic of the day was the "Past, Present, and Future of Broadband," and the lineup of speakers included Internet pioneers Robert Lucky, Leonard Kleinrock, Martin Hellman, Federico Faggin, and John Cioffi.

This prestigious group was assembled by the Marconi Society, and the spotlight that day focused on the 2006 Marconi Prize recipient, Stanford Electrical Engineering Professor and Atherton resident John Cioffi, often referred to as "the father of DSL."

Guglielmo Marconi, the winner of the 1909 Nobel Prize in Physics, holds a significant role in history as the man who invented wireless technology, also known as radio. Marconi's invention became a landmark moment in communication history, creating a domino effect that birthed broadcast radio, television, and, of course, the late 20th century's ultimate discovery involving a transfer of information—the Internet.

In 1974, Marconi's daughter, Gioia Marconi Braga, founded the Guglielmo Marconi International Fellowship Foundation (now the Marconi Society) to "sustain those spiritual aspirations that a creative thinker may wish to apply to the establishment of a better world in which to live." The annual Fellowship award celebrates a top mind in the world of communication and information with a prize of \$100,000, and past winners have included World Wide Web creator Sir Tim Berners-Lee; Google founders

John Cioffi





John Cioffi accepts the Marconi Prize presented by his mentor Tom Kailath, Professor Emeritus of Electrical Engineering at Stanford University.

Sergey Brin and Larry Page; Internet pioneers Robert Kahn, Vint Cerf, and Len Kleinrock; and visionary author/thinker Sir Arthur C. Clarke.

The Marconi Prize is a highly exclusive celebration of the world of science and technology. For Cioffi, it was a welcome surprise to join the exclusive names of past winners. Notes the humble scientist, "I was not really in the know that I was even nominated, so to win and be acknowledged was really special."

Where did Cioffi's special interest in telecommunication technology begin? "As a young student, math was my favorite subject," he relates. "Science, and especially Physics, were subjects that I excelled in. As well as, and perhaps surprisingly to some, music, which was something I enjoyed." Cioffi pauses for a second, then laughs. "But my teachers did tell me that my math skills were off the curve when I was about nine years old, so perhaps it was established early on."

Cioffi went on to study at the University of Illinois in Champaign. Upon graduation, he found himself working as a modem designer at Bell Labs in New Jersey, serving a company that for nearly 100 years had carried the progressive vision to improve communication technology. While working at Bell, Cioffi began attending graduate classes through Stanford University under a special program started by Bell that identified rising stars in the field of engineering. Eventually, he earned his PhD and started thinking about DSL technology. "I believe I started pondering the possibilities of this technology when I was at Bell as an engineer, around 1979," Cioffi remembers. "I was working on a related project, but I didn't become extremely serious about DSL until 1987 when I was a professor at Stanford."

The acronym DSL stands for "Digital Subscriber Line," and, in layman's terms, is a technology, or a family

of technologies, that provides digital data transmission over the wires of telephone networks. Without going into the specifics of functionality and synchronization processes, DSL applies to your Internet connection, and the speed in which you can upload or stream your next YouTube video.

After the Bell Systems breakup in 1984, Cioffi was hired as an Assistant Professor of Electrical Engineering at Stanford. This allowed him the time to research and develop the technologies that would lead him to create the blueprints for DSL. Bellcore, a large telecom firm at the time, saw the potential in this research and helped provide capital for Cioffi and his graduate team to pursue this new form of communication science.

In the early 1990s, Cioffi and his newly formed company, Amati Communications Corporation (which would later be purchased by Texas Instruments), along with graduate students working under him, began to experiment with transmitting data between modems and then started to finesse with "bit swapping" that would lead to DSL technology. "In January 1993, an 'Olympics' was held for the US standard in DSL technology," Cioffi says. "Stanford and my own company Amati competed together with a prototype technology we created to see if it could do better than three more traditional entries from ATT, Nortel, and Bellcore. These were the powers of telecom at that time.

"We won in a landslide in the laboratory tests," says Cioffi, "and they were forced to choose the Stanford technology for DSL as the winner." As Cioffi later told the *Stanford Report*, "Nobody at the big telecommunications companies believed our system would work, but we went head to head in that competition. It was like Palo Alto High School taking on the New England Patriots in the Super Bowl, and winning."

Today, Cioffi's technology is used in over 99 percent of the DSL connections worldwide. Cioffi's work and his various ventures have also led to over 70 patents (with 30 of them being licensed through Stanford alone!).

All of these career accomplishments have earned Cioffi the 2006 Marconi Prize. If you ask him how his life has changed since receiving the honor, he says modestly, "It was a nice acknowledgement, but not much has changed. I do feel honored. There does not exist a Nobel Prize for Engineers. The Marconi Prize is our Nobel Prize. And, it's pretty special to be among the list of names who have won and been honored with the Marconi name."

Following the day-long Marconi Symposium last October was the Marconi Society Gala held at the Menlo Circus Club in Atherton. It was the first time in the Society's 32-year history that the Gala was held on the West Coast. As Menlo Park resident and the New Executive Director for the Marconi Society Nancy Collins noted, "It was time to hold the Marconi Prize

events on the West Coast. So many of the inventors and scientists who have impacted our lives in the last few decades hail from the Valley. It was a natural fit."

During his Marconi Prize acceptance speech, Cioffi humbly said of his peers, "It's a great honor to join this group of distinguished Marconi Fellows, and I've admired you all of my career. I just hope I can continue the tradition." He went on to thank all of his current and former colleagues and student researchers, and, perhaps most importantly, his wife Assia for all her support. "I thank her above all," Cioffi said. "She helps me with everything."

As 1999 Marconi Prize winner James Massey said, "John is not only a great engineer and great communicator, but he is a wonderful philanthropist, and a person who really cares about the human race and tries to do things for it. One of the mottos of the Marconi Society is 'Ingenuity for the Good of Mankind,' and nobody fits that bill like John Cioffi." And no better example of Cioffi's philanthropic nature is his taking his \$100,000 prize money and donating it to Stanford University to support research projects in the Electrical Engineering department.

Cioffi continues to teach at Stanford University, but also spends time running ASSIA, Inc. (Adaptive Spectrum and Signal Alignment Incorporated), a research company that provides centralized management of DSL services for phone companies. (Cleverly, Assia is Cioffi's wife's name as well.) And, when he is not spending time in Atherton, Cioffi and Assia, along with their five children, have a residence in Paris.

"The Marconi Prize recognizes living scientists who share the determination that communications and information technology be directed to the social, economic, and cultural improvement of all humanity," says John Jay Iselin, president of the Marconi Foundation. "John Cioffi's remarkable career personifies this spirit." ■

ENCRYPTION PIONEER

MIT Professor Ronald Linn Rivest will be awarded the Marconi Prize this month in Atherton.

Professor Rivest, who collaborated with two other scientists to create the world's most widely used public-key cryptography system, has been named the 2007 Marconi Fellow and prize-winner for his pioneering work in the field of cryptography, computer, and network security.

Rivest, the Andrew and Erna Viterbi Professor of Electrical Engineering and Computer Science in MIT's Department of Electrical Engineering and Computer Science, will receive the award and accompanying \$100,000 prize at the annual Marconi Society Award Dinner on September 28 at the Menlo Circus Club in Atherton.



Cioffi, G. David Forney, Jr., John F. Shoch, and Federico Faggin at the 2006 Marconi Symposium

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James Massey, 1999 Marconi Prize winner



Cioffi giving his acceptance speech for the 2006 Marconi Prize.