Robert Taylor: Building the Internet

By Marion Softky

"The Internet is not about technology; it's about communication," says Robert W. Taylor of Woodside. "The Internet connects people who have shared interests, ideas and needs, regardless of geography."

This vision drove Mr. Taylor for 35 years as he promoted development of the Internet, the personal computer, and the technologies that support the computer revolution worldwide.

Mr. Taylor's success in these ventures earned him the National Medal of Technology for 1999. The citation reads: "For visionary leadership in the development of modern computing technology, including initiating the ARPAnet project -- forerunner of today's Internet -- and advancing groundbreaking achievements in the development of the personal computer and computer networks." Now happily retired in Woodside, Mr. Taylor is not even a scientist himself, nor a Ph.D. Yet, he is credited with tenacious vision in pursuing projects, and with extraordinary skill in assembling and managing the teams of scientists who made it all happen.

"I had some of the very best people in the world working in my labs," he says with pride during an interview in his Skyline home overlooking the Silicon Valley he helped to create.

Mr. Taylor's accomplishments built up over three successive careers. In Washington in the 1960s, he conceived and directed federal funding for the original ARPAnet in his position as a civilian manager in the Advanced Research Projects Agency of the Department of Defense.

At the Xerox Palo Alto Research Center (PARC) in the 1970s, he supervised the legendary incubator where key technologies for the personal computer and computer networking were born, and where companies such as Adobe, Novell, and 3Com got their start.

And at the Digital Equipment Corporation's new research center in Palo Alto, he oversaw development of electronic books, modern work stations, and the precursor to the Java programming language.

"He's a visionary and a missionary; he's like a bulldog," says Severo Ornstein of Skyline, who worked on one of Mr. Taylor's ARPA projects, and later worked for him at PARC. "He's the most superb technical manager I ever encountered. He knew whose advice to follow."

Mr. Taylor's life now seems a world away from the pressures of guiding the exploding technologies of the last 40 years. He's mostly found at his home in Skywood Acres where a visitor is greeted by two large and rambunctious black poodles, Max and Lara, who are the loves of his life. He reads, listens to music, cooks, grows superb tomatoes. While he sometimes amuses himself playing computer games, he has no cell phone, copier, FAX or scanner.

"I don't travel unless I have to," he says happily. "I have my dogs, books, computer, and air that smells better at 1,400 feet."

In fact, Mr. Taylor wouldn't even go back to Washington last spring to accept the National Medal of Technology from President Clinton. He recalls with relish the day the secretary of commerce called to tell him he would receive the nation's highest honor, and to invite him to a series of festivities capped by a reception at the White House.

Mr. Taylor replied he had traveled enough in his life and preferred to stay in Woodside. "He was taken aback," he says gleefully.

Eventually, Charles Herzfeld, his former boss at ARPA, and one of Mr. Taylor's sons accepted the award from President Clinton.

Texas preacher's son

The son of a Methodist minister, Bob Taylor spent an itinerant childhood, moving from parish to parish a dozen times or more. He started at Southern Methodist University at 16, served a stint in the Navy during the Korean War, and went back to school (the University of Texas) under the GI Bill. There he was a "professional student," he says, taking courses for pleasure. He finally put them together for a degree in experimental psychology, with minors in math, philosophy, English and religion.

Mr. Taylor got as far as a master's degree in experimental psychology -- and stopped. "I didn't want a Ph.D. in psychology. No thanks," he says.

For a while, Mr. Taylor taught math and coached basketball at a co-ed prep school in Florida. "I had a wonderful time but was very poor, with a second child -- which turned out to be twins -- on the way," he says.

He gave up poverty for a couple of engineering jobs with aircraft companies at much better salaries. After writing a proposal to the National Aeronautics and Space Administration (NASA) for a flight-control-simulation display, he ended up working for NASA in Washington before he was 30.

Here, young Mr. Taylor was swept up in the heady atmosphere of post-Sputnik Washington, gearing up to put a man on the moon. He became enamored with new possibilities for computers, and met two of the field's visionaries: Douglas Engelbart at SRI (then the Stanford Research Institute) in Menlo Park; and J.C.R. Licklider, who was heading the new Information Techniques Processing Office at ARPA.

While still at NASA, Mr. Taylor directed funding to Mr. Engelbart's studies of computer-display technology at SRI that led to his most famous invention, the computer mouse.

Partly through Mr. Engelbart, who has been pursuing ways of augmenting human intelligence through computers for more than 40 years, Mr. Taylor met Mr. Licklider, who had written a seminal article in 1960 foreseeing new, more powerful ways to use computers. Mr. Taylor soon moved sideways to ARPA, where he assisted and later followed Mr. Licklider, his mentor, as director of the chief office that funded programs in advanced research in computing and early networks throughout the country.

A second paper, published in 1968 by Licklider and Taylor, lays out the future of what the Internet has indeed become. Titled "The Computer as a Communication Device," it starts out: "In a few years, men will be able to communicate more effectively through a machine than face to face."

ARPAnet

When Mr. Taylor first became involved with computers, they were large and cumbersome. People punched instructions onto cards, loaded them in batches into a computer, and got the results a day or so later. If there was even a tiny mistake: too bad, start over.

Among the computer projects that Mr. Licklider and ARPA supported was time-sharing, where many users could work at terminals and share a single large computer that was so fast that each user felt he had the computer to himself. "Interactive computing is like a conversation. It's a huge change," Mr. Taylor says. "Now I wanted to interconnect them. That's what ARPAnet is all about."

As time-sharing systems came to life, Mr. Taylor observed they began to acquire communities of users who worked together but knew each other only through computers. "That's a very powerful and interesting sociological phenomenon," he says. "Then it was brand new."

About 1966, Mr. Taylor recalls, his office in the Pentagon had a terminal connected to time-sharing community at MIT, a terminal connected to a different kind of computer at the University of California at Berkeley, and a third terminal to the Systems Development Corp. in Santa Monica. "To talk to MIT I had to sit at the MIT terminal. To bring in someone from Berkeley, I had to change chairs to another terminal," he says. "I wished I could connect someone at MIT directly with someone at Berkeley. Out of that came the idea: Why not have one terminal that connects with all of them?

"That's why we built ARPAnet," he says.

With the immediate assent of his boss, ARPA started funding projects to make the world's first interactive computer network. It contracted with Bolt, Beranek and Newman (BB&N) to build the brand new system; it arm-wrestled universities and computer centers to install stations to test the network.

Dr. Engelbart remembers a pivotal meeting in 1967 when most participants resisted testing the new network; they thought it would slow down their research. Not Engelbart: "I thought, Boom! Here comes an offer for a community," he says. "To me it was the way we're using the Web today."

SRI set up a center, node for the new network. In 1969, the first message on ARPAnet went from Santa Monica to SRI.

Mr. Taylor also directed funding to Dr. Engelbart's famous 1968 public demonstration in San Francisco to several thousand computer experts. Dr. Engelbart showed on a big screen how he could manipulate a computer remotely located in Menlo Park, while sitting on a San Francisco stage, using his mouse.

"It was stunning," Mr. Taylor says. "It really waked a lot of people up to a whole new way of thinking about computers -- not just as number crunchers."

Vietnam

Mr. Taylor took on another role during the Vietnam War.

President Johnson was micro-managing the war from the White House, Mr. Taylor recalls, and didn't like getting contradictory reports from the field. He said, do something.

Mr. Taylor was sent to Vietnam to straighten things out. Only about 35 years old, he was given the honorary rank of brigadier general so he could deal with senior officers.

Mr. Taylor recalls finding that different people were using different definitions. So he revised protocols, put things in a single consistent form, and set up a program to build a computer center near Saigon.

"After that, they may still have been lies, but they weren't contradictory lies," he says.

During this period, Congress began pushing to focus ARPA's work -- which was completely unclassified -- toward advancing military missions. Mr. Taylor, whose personal mission was to make the new computer technology available to the whole country, decided to move on.

"It crippled a lot of research," he says. "By 1969 I knew ARPAnet would work. So I could leave."

After a year decompressing at the University of Utah, Mr. Taylor took on his most famous job -- managing the Computer Systems Laboratory (CSL) at the new Xerox PARC. In 1970 he moved to Palo Alto where for 13 years he was nursemaid-in-chief to the extraordinary group of geniuses who have transformed the world through computers and local computer networks.

Nursery for genius

A dozen or more books have been written about the miracle of Xerox PARC and the billion-dollar companies it has spawned or contributed basic technology to. They avidly chronicle the in-fighting, and the extraordinary disconnect between the free-wheeling culture of PARC and corporate Xerox, which let many technologies of the future slip through its fingers.

"Most of what we take for granted in today's Windows and Macintosh personal computer systems were invented at CSL. Indeed it was a visit to CSL by Steve Jobs in 1979 that led to the Apple Macintosh," says the biography that accompanies the National Medal of Technology. "Taylor did not simply run CSL; he built it from scratch, and he provided much of the vision that enabled the lab to create systems that were much more than the sum of their parts."

The technologies developed at PARC between 1970 and 1983 focused on reaching beyond ARPAnet to develop what has become the Internet, and the systems that support today's personal computers. They include:

**The Alto and Dorado, powerful personal computers with windows-type displays that were the basis of the Macintosh.

**Ethernet, which networks local computers within a building or campus; and the Internet, a network that connects local networks.

**The electronics and software that led to the laser printer and the graphical programs that allowed John Warnock and Chuck Geschke to take off and found Adobe Systems.

**"What-you-see-is-what-you-get (WYSIWYG) word-processing programs that Charles Simonyi took to Microsoft to serve as the basis for Microsoft Word.

"We did a number of separate things, but they fit together as a single computer architecture," says Mr. Taylor.

Dozens of PARC alumni still live on the Peninsula. They all carry vivid memories of the electric atmosphere, creativity, and often conflicts, of those yeasty years. "All the best minds in the computer field were at Xerox," says Mr. Ornstein.

Mr. Taylor created a free-wheeling culture among the semi-hippie young geniuses he assembled that contrasted starkly with staid Xerox and the conventional suit-and-tie image of IBM.

Everybody remembers the "Dealer's Room," where long-haired, sandaled, brainy people went at each other every week in sometimes brutal intellectual free-for-alls. The room had comfortable bean-bag chairs, double-thick carpet, one wall made completely of white board to write on, and amazing coffee, recalls Ken Beckman, who ran the video lab at PARC.

"Kids with long hair and pony tails could relax, think wonderful thoughts and come up with great ideas," he says. "Bob created an environment that allowed people to do their best work. He'd say, 'Of course; that's a good idea. Do it.'"

One of Mr. Taylor's missions now that he's retired is to clear up myths and inaccuracies about the history of the Internet and computers. "I'm helping authors with books on computer history," he says. "Several books and stories are quite off the mark."

Primary among them, he says, is the myth that Steve Jobs stole the idea of the Macintosh from Xerox. "Xerox gave them to him," Mr. Taylor says. "I was out of town that day."

Another myth is that Xerox lost money on PARC because of all the technologies it did not exploit. Mr. Taylor says that the first laser printer alone became a billion-dollar business for Xerox. "We more than paid our freight." he says.

Nevertheless, the dream organization frayed, and corporate Xerox couldn't deal with the eccentric style and rapid pace of PARC's innovations. Mr. Taylor left in 1983.

"Xerox continued to ignore our work," he says. "I got fed up and left, and about 15 people came and joined me at DEC."

At DEC's Systems Research Center, now owned by Compaq, Mr. Taylor built another world-class computer systems laboratory. Among the technologies it generated were high-performance work stations, a computer language later developed into Sun Microsystems' Java, a number of advanced networking and storage technologies, and electronic books.

Mr. Taylor is particularly fond of electronic books, the hand-held devices into which users can load text and pictures. They are getting cheaper, better and lighter, he says. The whole book will be less than two pounds, and will have a beautiful display, he says. "You don't need a reading light. The whole idea is to read in bed."

Vision

Today's Internet revolution is evolving in very much the way Mr. Taylor and Mr. Licklider envisioned in 1967, he says. "I'm not surprised by the widespread use of the Internet; I predicted it," he reflects. "I didn't anticipate (its use for) pornography and crime."

Mr. Taylor also did not anticipate the rich and varied details of how people use the Internet. A family in Western China, for example, got help for a sick boy through the Internet, he notes. "The Internet saved that boy's life. Western China is a long way away."

Mr. Taylor is surprised the Internet has taken so long to develop. "By 1975, most of the technology was availa
ble; by 1985 it was affordable; but it didn't take off until 1995," he says. "My timing was awful."

Looking forward, Mr. Taylor voices two concerns about the future of the Internet: control and access.

Comparing the Internet to a highway network, he argues there needs to be a system of licensing users of the Internet just as people need licenses to drive on the roads. "There are many worse ways of endangering a larger number of people on the Internet than on the highways," he warns. "It's possible for people to generate networks that reproduce themselves and are very difficult or

impossible to kill off. I want everyone to have the right to use it, but there's got to be some way to insure responsibility."

Mr. Taylor also feels strongly that there should be no economic barrier to going on-line. "Will it be freely available to everyone?" he asks. "If not, it will be a big disappointment."

Mr. Taylor suggests these books for people wanting an accurate history of the Internet: **"Dealers of Lightning" by Michael Hiltzik. HarperCollins Publishers, New York, 1999. $26. **"A Brief History of the Future: Origins of the Internet" by John Naughton. 2000. $30.