

***Jacobs's Patter: An Inventor's Promise Has Companies Taking Big Cellular Gamble  
Qualcomm Boss's Innovation In Digital-Phone System Is Problematic -- and Late  
Are Claims Hope or Hype?***

By Quentin Hardy  
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SAN DIEGO -- A multibillion-dollar technology gamble taken by some of the biggest names in telecommunications would never have happened without a tireless champion named Irwin Jacobs.

The question is whether he should be celebrated -- or blamed.

Dr. Jacobs, chief executive of Qualcomm Corp., is a rare corporate hybrid: Pathbreaking engineer and aggressive marketer. In the late 1980s, he invented key parts of an advanced digital-wireless system known as CDMA. Ever since, he has been promising that his invention will vastly expand the capacity of cellular-phone systems and usher in an era of cheap digital superphones.

Telecommunications giants like Lucent Technologies Inc. (formerly part of AT&T Corp.) and Motorola Inc. have poured \$2 billion into developing CDMA-related equipment and are planning to invest billions more. That is on top of the \$18 billion the industry paid the Federal Communications Commission for rights to radio spectrum for digital services like those envisioned for CDMA.

"CDMA is the long-term solution for the cellular industry," says Dr. Jacobs, whose personal fortune as Qualcomm's biggest shareholder has grown to an estimated \$150 million with the rise of the company.

A lot rides on whether Dr. Jacobs is right. His dazzling promises for CDMA -- coming from a famed scientist who won a National Medal of Technology from President Clinton in 1994 -- steered many companies away from an already-established global standard widespread in Europe and Asia. Yet CDMA is more than three years late in coming to market, and it isn't clear it works any better than the existing standard. Dr. Jacobs is blamed by some experts for single-handedly putting the U.S. far behind in the global wireless-communications business, which analysts expect to be a \$100 billion market within five years.

There is also a worst-case possibility: that CDMA doesn't work on the massive scale required, an outcome that would inflict billions of dollars of losses on the equipment makers and network operators that have bought into Dr. Jacobs's promises. That would cause more delays in the spread of digital-wireless phones in the U.S.; there are 16 million digital phones in Europe, compared with about 1.5 million in the U.S.

"They've got fundamental technical problems that they don't know how to solve," says Don Cox, a professor of electrical engineering at Stanford University. "There is no one in the business smarter than Irwin Jacobs, but smart guys make mistakes too." George Schmitt, president of Omnipoint Communications Inc. of Mountain Lakes, N.J., and a former chief executive of wireless giant PrimeCo Personal Communications LP of Westlake, Texas, says Dr. Jacobs "sold the market a lot more than he delivered."

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Dr. Jacobs, no relation to the takeover artist of the same name, concedes that some of his CDMA promises haven't been borne out. The 63-year-old scientist defends his tactics, but does admit to some doubts: "Every other week you wonder, 'Does it work? Will it get to market?'"

Whatever the final answers, Dr. Jacobs's crusade is an illuminating study of the challenges of commercializing high science. CDMA and rival technologies are numbingly complex; suffice it to say that by using radio spectrum more efficiently, they promise leaps in cellular capacity. Dr. Jacobs originally claimed that CDMA -- which stands for Code Division Multiple Access -- could cram up to 40 times as many calls onto a network as old-fashioned analog systems can. (Most cell phones in the U.S. use the analog system.)

Dr. Jacobs also said CDMA would have about 13 times the capacity of its main digital rivals, TDMA and its variant known as GSM. TDMA stands for Time Division Multiple Access, and the predominant companies that use the technology are LM Ericsson of Sweden and Lucent Technologies. Ericsson also dominates the market for GSM, which stands for Global System for Mobile communication.

CDMA would be impossible for cell phones if Dr. Jacobs hadn't tamed one of its top bugs -- fluctuations in power -- with patented control devices he has timed to the ten-thousandth of a second. Qualcomm expects to make money by licensing CDMA technology and building phones; it has an agreement with Sony Corp. to make three million CDMA handsets this year alone, with plans to sell them to big U.S. and foreign digital-wireless companies.

Dr. Jacobs already had a reputation for turning science coups into cash. With partner Andrew Viterbi -- an engineering professor with his own shelf of patents -- he formed Linkabit Corp. in 1968. They developed military-satellite technology and sold the company in a 1980 deal that netted Dr. Jacobs about \$25 million.

Early on, Dr. Jacobs, who holds an engineering doctorate from the Massachusetts Institute of Technology, established an reputation as soft-spoken but hard-driving. "He's mellowed out a lot since those days," says Cliff Vaughan, a sales executive with Oki Semiconductor Inc. in Sunnyvale, Calif., a unit of Japan's Oki Electric Industry Co. Mr. Vaughan recalls arcane price squabbles with Dr. Jacobs. "He used to know everything. Now he just knows half." Tall and lanky and a fearsome basketball player, Dr. Jacobs sometimes settled Linkabit engineering disputes with arm-wrestling matches.

Dr. Jacobs retired in 1985, got bored and started Qualcomm with Dr. Viterbi and four others a few months later. "It was supposed to be a way for us to take it easy and have fun at business," Qualcomm President Harvey White says.

Dr. Jacobs introduced CDMA in 1989, soon after the cellular industry adopted the competing TDMA standard. He and others at Qualcomm claimed CDMA offered 20 to 40 times the capacity of traditional analog-cellular systems. TDMA manages about three times analog capacity.

However, none of the CDMA claims have borne out in the real world; some critics say CDMA is no more

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robust than TDMA. The big claims were "a little bit of hope and a little bit of hype," says David Twyver, former president of the wireless-network division of Northern Telecom Ltd., a CDMA backer in Mississauga, Ontario.

Dr. Jacobs bristles at the mention of hype, and says the capacity claims will eventually be met. "Hype is a colored word," he says. "I've certainly argued strongly."

And often, wrongly. In December 1991, he told the industry press that all questions about CDMA "have been put to rest," a statement since updated and amended with several CDMA "improvements." In January 1992, Dr. Jacobs claimed CDMA would be commercially available in 12 months, a timeline about 40 months off. "I was overly optimistic," he says.

Dr. Jacobs also brought his technical imperiousness, legendary among friends and critics alike, to Qualcomm's crusade. "If you don't agree with him, you're wrong," says Scott Schelle, chief executive of American Personal Communications, a digital-telephone provider running a TDMA network in Washington, D.C. The company turned down CDMA after testing the system for several years, Mr. Schelle says, because it cost too much and "it wasn't ready for market."

Even today, Dr. Jacobs says CDMA will deliver about 15 times as much capacity as analog, and offers scientific explanations few people could follow. Motorola says the real increase is eight-fold, and others say it is less. "In reality, two or three," says Mr. Schmitt, the Omnipoint chief. He is a TDMA backer; indeed, he lost his PrimeCo job because, against his board's wishes, he refused to back CDMA.

But if CDMA is so disappointing, why have telecom giants sunk so much money in it? For one thing, the big companies support all the major systems, from analog to the differing versions of digital. Jack Scanlon, the head of Motorola's infrastructure division, says he and his colleagues believe in Dr. Jacobs. "He's no fake," Mr. Scanlon says, but adds, "a lot of people thought CDMA would be out sooner than this." Scott Erickson, vice president of marketing and operations for Lucent in Murray Hill, N.J., says: "If you look at the long-term needs of wireless access, CDMA is much more promising." Short term, he says, "TDMA is a good technology. We look at CDMA as the long-term air-access technology choice" for voice, data and other potential services like wireless-internet access.

Besides, radio spectrum has become so valuable that Dr. Jacobs's promise to use it more efficiently is seductive. If CDMA works, companies using it could undercut rival TDMA and analog networks in price, and handle more volume with far less investment.

CDMA already has some limited uses. Qualcomm employs it to track trucks via satellite, the main source of its profit of \$13.1 million, or 19 cents a share, on revenue of \$530.7 million for the nine months ended June 30. The military likes it for secure communications.

But the technology breaks down in widescale use unless power levels are balanced to the millisecond. Calls must reach switching stations at identical power levels, even as the mobile customer enters a building or drives through a tunnel, or the computer won't recognize the signal. The more users there

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are, the more power problems to manage. Dr. Jacobs's breakthrough was figuring out how to make the phones transmit the correct power level every split second, without having to run a supercomputer in every phone.

CDMA, however, hasn't yet worked in decent mass-market numbers. Foreign debuts in places like Hong Kong have been limited to just 50,000 users per location, a number many experts see as inconclusive. In Hong Kong, Henry Wong, a senior manager for Hutchison Whampoa Ltd.'s telephone unit, says its CDMA system is "getting better and better" after a rocky start. CDMA drops as many calls, he says, as the company's vastly more extensive GSM system.

Other declarations of victory, such as a recent CDMA introduction in Los Angeles by AirTouch Communications, rest on just 100 handsets in use. Meanwhile, Qualcomm is manufacturing handsets at a rate of 100,000 a month and growing.

The AirTouch rollout, tiny though it may be, is proving to be a challenge for CDMA. Once promised for the entire city, the belated introduction has been limited to the northern area of Los Angeles. Kevin Griffin, a contractor in Ventura, Calif., who is among the 100 users, says CDMA calls are usually clearer than old analog cellular, but complains that calls still get dropped in midconversation and "occasionally people say it sounds like I'm in a tunnel." The price, he grumbles, is the same as his existing analog service.

Price, in fact, is another daunting problem for CDMA. Because base stations are so complex, they cost about \$300,000 each, compared with \$80,000 for TDMA stations (handsets will probably cost about the same). Dr. Jacobs asserts costs will fall as CDMA equipment enters mass production.

CDMA delays have helped slow deployment of any digital-mobile-phone system in the U.S., leaving executives who need a single technological fix fuming. Bert Roberts, chairman of MCI Communications Corp. calls the conflict "a travesty."

He and others say the tardiness of CDMA has set back, perhaps irrevocably, the formulation of a digital-wireless standard for the U.S. That means a caller on the West Coast, for example, could find his CDMA wonder-phone useless in a conflicting East Coast system.

As the verdict on CDMA draws closer, even some of CDMA's backers appear to be flinching. In January, a consortium of companies operating as the Sprint Telecommunications Venture surprised bidders for its \$3 billion CDMA infrastructure network with a last-minute requirement of financial guarantees in case the system fails. STV, which paid \$2.1 billion for spectrum rights covering 183 million potential customers, is the largest of the next-generation digital providers.

Motorola wouldn't make that kind of guarantee for CDMA, and pulled out of talks with STV, which includes Sprint Corp., Tele-Communications Inc., Comcast Corp. and Cox Communications Inc. Nortel and Lucent won the contract by agreeing to guarantees.

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Meanwhile, GSM and other standards have also been refined, with improved capacity and voice quality. CDMA has been adopted as a future standard in several countries, but GSM is up and operating in more than 75 nations. The U.S. had just two cellular-phone providers in each metropolitan area in 1989, but soon there will be six or more mobile-phone providers in most big towns. New alternatives, like satellite systems and Internet phones, have also sprung up; the upshot, say some experts, is a possible glut of wireless services that could destroy CDMA's economic feasibility.

CDMA's fate likely will be determined within the next 12 months. Both STV and PrimeCo, a consortium backed by giants Bell Atlantic Corp., Nynex Corp., U S West Corp. and AirTouch, will soon attempt a nationwide CDMA rollout. Motorola says it will ship thousands of CDMA base stations around the globe this year. Executives at the companies say publicly that there is nothing to worry about. Privately, says one, "we're holding our breath and crossing our fingers." Back at Qualcomm, Dr. Jacobs retains an unearthly calm as his invention's day of reckoning draws nearer. Sipping gently at a stained coffee cup that reads "It's Lonely at the Top," he observes that the billions riding on CDMA aren't as significant as the intellectual challenge of the quest.

"Good arguments are interesting and fun to debate," he says. Besides, "my friends don't think I'm a liar."

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Wayne Arnold in Singapore contributed to this article.