

One Person, One Phone

As Wi-Fi networks link with cellular networks, telephonic unity nears. **BY CORIE LOK**

THE USE OF CELL PHONES is likely to expand even further this spring when all U.S. residents gain the ability to transfer landline phone numbers to their mobiles.

But there's a stumbling block in the path of the cell-phone juggernaut: poor reception inside many buildings that makes cellular networks not quite reliable enough to be the main phone systems for offices—or even for residents of many apartment buildings. So despite the rise of cellular service, most people still have traditional business and home phones.

In the next year, though, Wi-Fi—the popular wireless technology installed in many buildings that allows laptop users to surf the Net—will make mobile phone calls work virtually anywhere. An emerging crop of technologies will stitch Wi-Fi networks and existing cellular networks together, allowing calls to automatically switch between the two. The percentage of mobile phones that are Wi-Fi enabled will grow from near 0 percent last year to 85 percent by 2007, predicts On World, a San Diego, CA-based wireless-market research firm. “I’m very optimistic that within 10 years, most people will be carrying a single

phone and making and receiving most of their personal and business calls on that one device,” says J. Gerry Purdy, an analyst with Mobiletrax, a Cupertino, CA, mobile- and wireless-research firm.

This trend could boost the use of the Internet to carry telephone calls, too. Internet calls have accelerated in recent years, as more people have gained access to faster connections, which improves service quality. Adding Wi-Fi to the mix means users no longer have to be sitting directly in front of their computers when they make calls.

And once cell phones can also understand Wi-Fi signals, callers can

IN THIS SECTION

24 Tired of booting up? A promising “instant-on” chip makes its market debut.

26 Magnetic pulses near your skull ease depression by altering brain chemistry.

28 No fish story: the Big Apple is using bluegills to test reservoirs for terror toxins.

enjoy the best of both worlds—the cheapness of Internet calls and the flexibility of mobile phones.

Such dual-mode phones are on the horizon; Motorola of Schaumburg, IL, plans to start selling one such phone—cellular one minute, Wi-Fi the next—later this year. Once dual-mode phones and the merger of Wi-Fi and cellular take hold, you can make and receive all your calls on one phone no matter where

incoming calls through the Internet, and ultimately through the local access point. Three carriers in the United States and Europe are now testing Kineto’s technology; Kineto expects dual-mode service to be available this year.

Meanwhile, a related trend is emerging: Wi-Fi communications systems that replace paging systems in workplaces

phone calls at work. And that market is predicted to grow from \$16.5 million in 2002 to \$500 million by 2007, according to the Scottsdale, AZ, market research

firm In-Stat/MDR. “This is only going to expand,” predicts Purdy, who says the technology will soon branch out from hospitals and retail settings to business offices.

Of course, a number of significant hurdles remain. Wi-Fi sucks up a lot of power, so the new dual-mode phones will need to be very power efficient or have better batteries. Voice quality over the Internet—despite having improved in recent years—is still rougher than what’s available on traditional landlines. And putting too much voice traffic on Wi-Fi networks can slow



A badge enables push-button Wi-Fi calls in settings like hospitals.

them down.

Still, with more phone calls going over the Internet, more Wi-Fi networks being installed, and cell carriers looking to spread their coverage indoors, more and more people are likely to cut their telephone cords. ■

Future mobile phones will use Wi-Fi at the office and seamlessly switch to cellular on the road.

you are. Forget about dead spots inside your office building: your calls will switch unnoticeably from your office Wi-Fi network to the cell towers lining the highway and finally to your in-home Wi-Fi network.

Indoor Wi-Fi coverage would be offered by cellular carriers as an added service. Subscribers would likely have to pay an extra \$5 to \$20 a month for it, says Ken Kolderup, vice president of marketing at Kineto Wireless in Milpitas, CA, but they’d get cheap Internet calls when they were on the Wi-Fi network. And by providing more reliable service indoors, the cellular carriers would be able to fully compete with traditional telephone companies.

Realizing this vision will require new hardware. Motorola, for instance, has partnered with Avaya, a Basking Ridge, NJ, voice- and data-networking company, and Proxim, a Sunnyvale, CA, wireless-equipment company, to develop telephone-networking hardware for office settings.

And Kineto has developed a network controller that can be installed on a cellular-telephone company’s network to bridge cellular and Wi-Fi. If a cell-phone user is indoors and near a Wi-Fi access point, his or her phone would sense the stronger Wi-Fi signal and tell the controller that it should route any

like hospitals. For example, Vocera Communications of Cupertino, CA, installs a server that routes voice data over the workplace’s internal computer network, to and from Wi-Fi access points in the ceilings.

Workers have conversations via special badges that respond to voice commands. This is quicker and more convenient than pagers, and provides more reliable connections than cell phones.

All told, about 100,000 people in the United States are now making Wi-Fi

A SAMPLING OF WI-FI TELEPHONE TECHNOLOGY

COMPANY	TECHNOLOGY
Avaya (Basking Ridge, NJ)	Internet-based telephone system switches calls between cellular and Wi-Fi
BridgePort Networks (Chicago, IL)	Software on cellular networks allows Wi-Fi devices to make phone calls
Kineto Wireless (Milpitas, CA)	Cellular-network controller allows cell-phone users to roam between home and business Wi-Fi networks
Motorola (Schaumburg, IL)	Dual-mode cellular and Wi-Fi mobile phone
OnRelay (Leatherhead, Surrey, England)	Software turns mobile phones into wireless extensions of office desk phones
Proxim (Sunnyvale, CA)	Next-generation Wi-Fi hardware enables more secure and higher-quality voice calls
Vocera Communications (Cupertino, CA)	Hands-free, voice-controlled system using wireless badges allows workers to communicate via Wi-Fi

COURTESY OF VOCERA COMMUNICATIONS

HARDWARE

A Chip Worth Remembering

First magnetic RAM product raises hopes for “instant-on” computing

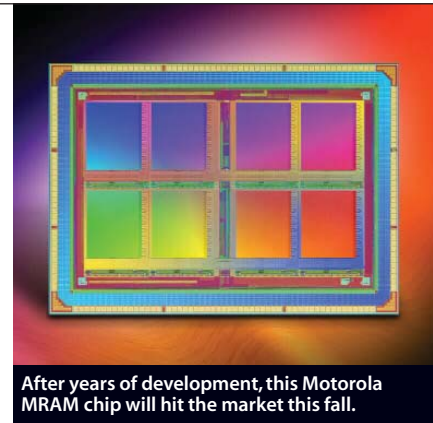
FLIP ON YOUR PC OR LAPTOP, AND start waiting. The reason you need to boot up—loading software from your hard drive into your random-access memory (RAM) chip—is that most electronic computer memory requires power to keep data intact. Take away the power, and the memory evaporates. For years, researchers have tried to develop fast and cheap memory that stores data as magnetic orientation, which stays fixed whether or not the power is on. Now, an early version of this technology—called magnetic random-access memory, or MRAM—is moving into production.

The MRAM chip, built by Motorola, holds only four megabits of data and is expensive, which means its first applications are likely to be in high-end security systems and gaming machines, where small amounts of crucial code could be stored without fear of loss. But by the end of the decade, MRAM chips may be suitable for gadgets like digital cameras and handheld computers, says Saied Tehrani, Motorola’s

technology director for MRAM in Tempe, AZ. Motorola says it is working with several customers to improve prototypes of its first-generation chip before starting full-scale production late this year.

Researchers, including those at Motorola and IBM, have been working on MRAM for more than a decade but kept encountering the same problem: recording information magnetically on one memory cell tended to disturb the magnetic orientation of its neighbors.

Motorola’s solution is a two-step data-writing method that effectively isolates bits from one another. Bob Merritt, an analyst at Semico Research in Phoenix, calls the Motorola advance “a substantial breakthrough.”



After years of development, this Motorola MRAM chip will hit the market this fall.

It might be a decade before the technology is ready for PCs, but one intermediate goal is replacing the flash memory used in digital cameras and cell phones. Unlike RAM, flash memory retains data when the power is off, but it’s expensive, slow, and too bulky to accommodate the memory demands and size constraints of next-generation devices. Motorola’s MRAM chips are 1,000 times

faster at storing new information than flash memory, so they could, for example, record digital-camera images more quickly, eliminating the delay before the next picture can be taken. While it remains to be seen whether Motorola will deliver an instant-on computer, its MRAM chip is an important first step. **Russ Arensman**

THE ATTRACTION OF MRAM

COMPANY	STATUS
IBM/Infineon Technologies (Armonk, NY/Munich, Germany)	Joint venture in France, which has delayed MRAM production until at least late 2005
Motorola (Schaumburg, IL)	Commercial MRAM production by late 2004
NEC/Toshiba (Tokyo, Japan)	MRAM joint venture, which has prototypes but no commercialization plans so far
Philips Electronics/STMicroelectronics (Eindhoven, Netherlands/Geneva, Switzerland)	Collaboration with Motorola to develop denser, higher-capacity MRAM chips

SOFTWARE

TRACKING OPEN-SOURCE’S ORIGINS

The open-source software movement—in which programmers freely share and build on each other’s work—has successfully churned out everything from operating systems to photo editors. But there’s a hitch. Sometimes a program’s open-source components turn out to be governed by conflicting licenses. A \$3 billion suit filed against IBM in March 2003 by software maker SCO Group—which claims IBM contributed code owned by SCO to the open-source Linux project—is just the most glaring example of the potential dangers.

But a solution is emerging. A

Chestnut Hill, MA, company, Black Duck Software, has built software that reviews open-source programs, flagging licensing and potential copyright infringement problems. Black Duck’s program compares a new piece of open-source software to thousands of existing, well-documented open-source programs. If it finds any matching code, it can tell users whose permission must be obtained—or who must be paid a licensing fee—before the new code can be released. And that’s critical for stopping potential litigation, says Ted Schadler, an analyst at Forrester Research.

“It has become very important to do an inventory,” he says. “Black Duck’s technology will tell you what [code] you are running. It’s very effective.”

Black Duck launched its software—the only system of its kind so far, says founder and CEO Doug Levin—in January 2004. If it gets off the ground, the software could help keep disputes from derailing the open-source movement—and depriving businesses and consumers of a low-cost alternative to software from the likes of Microsoft, Adobe, and Oracle. **Wade Roush**

COURTESY OF MOTOROLA



A doctor demonstrates the use of a handheld device that administers magnetic pulses.

MEDICINE

Zapping the Blues

Magnetic therapy for depression enters widespread trials

EVERY YEAR, CLINICAL DEPRESSION afflicts more than 18 million Americans, many of whom don't respond to conventional antidepressants like Prozac and Zoloft. But a promising new type of therapy is gaining wider use. The technique, called "transcranial magnetic stimulation," uses pulses of magnetic energy to induce electric currents in specific brain regions. While no one knows exactly why it works, researchers say the treatment can alleviate depression.

Magnetic brain stimulation has been used experimentally for years. Mark George, a neurologist and psychiatrist at the Medical University of South Carolina in Charleston, SC, says that in a number of limited trials, the technique helped severely depressed patients—though modestly and for short periods. These early results have led to government approvals in Israel and Canada. But magnetic therapies have only recently entered large-scale human testing in the United States. A new study, launched in early 2004 and involving hundreds of patients at numerous centers, "should be pivotal" in gaining the U.S. Food and Drug Administration's approval for the therapy in one to two years, says George. "It

would be surprising if the therapy didn't prove effective," he adds.

A doctor typically holds a powerful magnet over the frontal regions of the patient's skull and delivers magnetic pulses for a few minutes a day, over the course of a few weeks. The treatment alters the biochemistry and firing patterns of neurons in the cortex, the part of the brain nearest the surface. Preliminary research indicates that the treatment affects gene activity, levels of neurotransmitters like serotonin and dopamine, and the formation of proteins important for cellular signaling—any of which could play a role in alleviating depression. What's more, magnetic stimulation seems to affect sev-

eral interconnected brain regions, starting in the cortex and moving to the deep brain, where new cell growth may be important in regulating moods.

One problem: doctors can't be sure they are stimulating the same brain regions from patient to patient, or from session to session. A system developed by Malvern, PA-based Neuronetics is part of the new trials; it uses state-of-the-art magnetic materials to generate pulses efficiently and a positioning system that supports the magnet and records its location in three dimensions. That means more repeatable treatments and clearer study results, says Bruce Shook, Neuronetics' president.

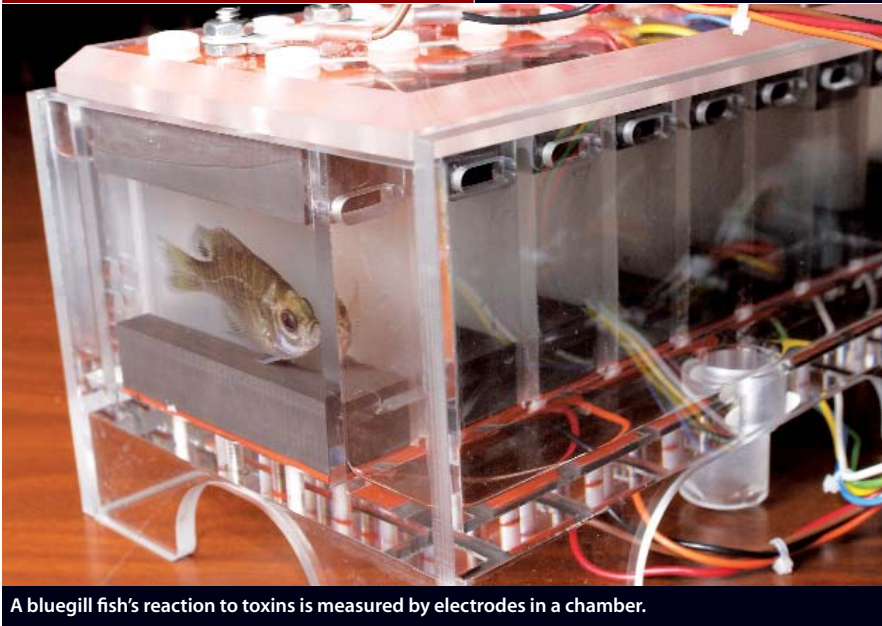
Researchers are beginning to understand how the therapies affect patients. Columbia University psychiatrist Sarah Lisanby is investigating a type of magnetic therapy in which seizures are induced under anesthesia. She is comparing its effects to those of electroconvulsive therapy, in which electrodes on the head provide electrical stimulation. In addition to noting effects on brain cells, she has found that magnetic seizure therapy produces fewer side effects, such as memory loss, than electroconvulsive therapy. "Activating these pathways in real time, we're learning a lot about the brain circuits involved," says Lisanby. And that allows doctors to hone the therapy by adjusting location, intensity, and pulse frequency.

One of the chief remaining questions is whether the positive effects of brain stimulation can be sustained. "It will take a few years to know how effective it is in patients" over the long term, says René Hen, a Columbia neurobiologist. But meantime, magnetic stimulation is attracting much attention from those trying to fight depression. **Gregory T. Huang**

LEADERS IN MAGNETIC BRAIN-STIMULATION THERAPIES

RESEARCHER/ORGANIZATION	PROJECT
Mark George , Medical University of South Carolina (Charleston, SC)	Imaging the brain and improving techniques for treating depression
Leon Grunhaus , Sheba Medical Center (Tel Hashomer, Israel)	Conducting clinical trials of depression treatments
Sarah Lisanby , Columbia University (New York, NY)	Conducting clinical trials with magnetic seizure therapy and studying biochemical mechanisms in the brain
Bruce Shook and Mark Demitrack , Neuronetics (Malvern, PA)	Developing more efficient and reliable hardware

COURTESY OF THE COLUMBIA UNIVERSITY MAGNETIC BRAIN STIMULATION LABORATORY



A bluegill fish's reaction to toxins is measured by electrodes in a chamber.

SENSORS

Swimming Sentinels

Fish enlisted in protecting water supplies from toxins

A HIGH-TECH ICHTHYOLOGICAL version of a canary-in-the-coal-mine warning system is nearing market. It's a system that monitors fish behavior as an early general warning of water purity problems. The system is being tested in several places, including New York City's reservoir system, ahead of commercialization later this year.

The system, developed at the U.S. Army Center for Environmental Health Research at Fort Detrick, MD, uses bluegill fish to detect a broad range of toxic chemicals. It doesn't look for anything specific; it detects anything that would stress a fish, from chlorine to cyanide. Each fish serves two-week tours of duty inside a plastic chamber containing two electrodes. The electrodes sense electrical signals from the fish's muscle movements. During an initial calibration period, software learns an individual fish's normal breathing rate and depth, gill movements, and overall body activity. During water monitoring, software detects departures from normal measurements, which can indicate the fish is stressed.

The advantages of using a fish is that it's a 24-hour warning system that can call

early attention to a broad range of problems, allowing officials to shut down a water system as a precaution. While the system cannot determine what's bothering the fish, it does provide a general alarm, says the director of the monitoring program, William van der Schalie, an army toxicologist. "Traditional sensors may focus on one particular chemical. A fish biomonitor rapidly detects toxicity from a wide range of toxic chemicals and pesticides. It will tell you there's a problem to look further into," he says.

In testing by the U.S. Environmental Protection Agency in Cincinnati, OH, the system worked well, says Roy C. Haught, chief of the EPA's water quality management branch. "Any time there's a change in water quality, the fish detect it immediately," Haught says. In the case of New York City, the system has been installed for homeland security purposes, to provide an early warning of chemicals introduced into the water supply. The system will be released commercially late this year by Intelligent Automation of Poway, CA. In the meantime, it needs refinement to weed out false alarms. As Haught puts it, "We don't want to be crying wolf every time a fish coughs." **David Talbot**

VENTURE CAPITAL

SPINOFF DOCTORS

A Lucent Technologies venture capital spinoff—initially launched to commercialize underused technologies from the company's labs—has secured sole rights from British Telecom and Philips Electronics to do the same job for them that it's doing for Lucent.

An early success made this leap possible. In 2002, the Lucent spinoff, New Ventures Partners of Murray Hill, NJ, sold one of its first companies—Celiant, which took a radio amplification technology out of Lucent's Bell Labs and developed it for next-generation cell-phone networks—for \$470 million. And that meant New Ventures Partners had cash and credibility "to talk to other corporations and say, 'We'll put up the capital and do this for you too, and in return, we'd just like to have exclusive access to your labs,'" explains managing partner Andrew Garman.

British Telecom was the first to grant this access, in return for benefits such as a part of any future sale or public offering of resulting companies. In 2003, New Ventures Partners launched four new companies based on technologies from BT's labs. One was Microwave Photonics, a Los Angeles concern developing a radio-over-fiber technology that makes it possible to expand cell-phone networks without adding base stations. Maurizio Vecchione, Microwave Photonics' president and CEO, says New Ventures went well beyond the role of the traditional venture capital firm—most importantly, negotiating licensing agreements with BT that didn't burden the startup with royalty payments.

Late last year, Philips entered into a similar agreement with New Ventures. While other companies, such as Arch Venture Partners in Chicago, specialize in building startups around technologies from large R&D organizations, New Ventures "probably has the most advanced set of processes and the deepest network of contacts," says Henry Chesbrough, a professor in the Haas School of Business at the University of California, Berkeley. British Telecom and Philips are now tapping that network. **Wade Roush**

COURTESY OF THE U.S. ARMY CENTER FOR ENVIRONMENTAL HEALTH RESEARCH