# A Trillion Points of Data

How tracking cell-phone users via GPS could do for the real world what Google did for the virtual world.

*By* BARRETT SHERIDAN

NEXT TIME YOU GLANCE AT YOUR BLACKBERRY, IT MAY BE USEFUL to know you're not only checking e-mail, you're making a contribution to the central nervous system of the world. A mobile phone is, after all, a kind of sensor: every time you send a text message, make a phone call, or download an e-mail, cellular towers pinpoint your position. With 4 billion handsets in use worldwide, that makes for trillions of data points flowing through the network every month and creating digital graphs of our paths through time and space. When aggregated, those individual paths convey a picture of a block, a community, a city—even a whole society. As Sandy Pentland, a professor at MIT's Media Lab, puts it, our cell phones have become the neurons in "an emerging—and truly global—nervous system."

Until recently, the information cascading out of our mobiles has been more or less ignored. In the past two years, however, there's been a paradigm shift as mobile companies seek new sources of revenue
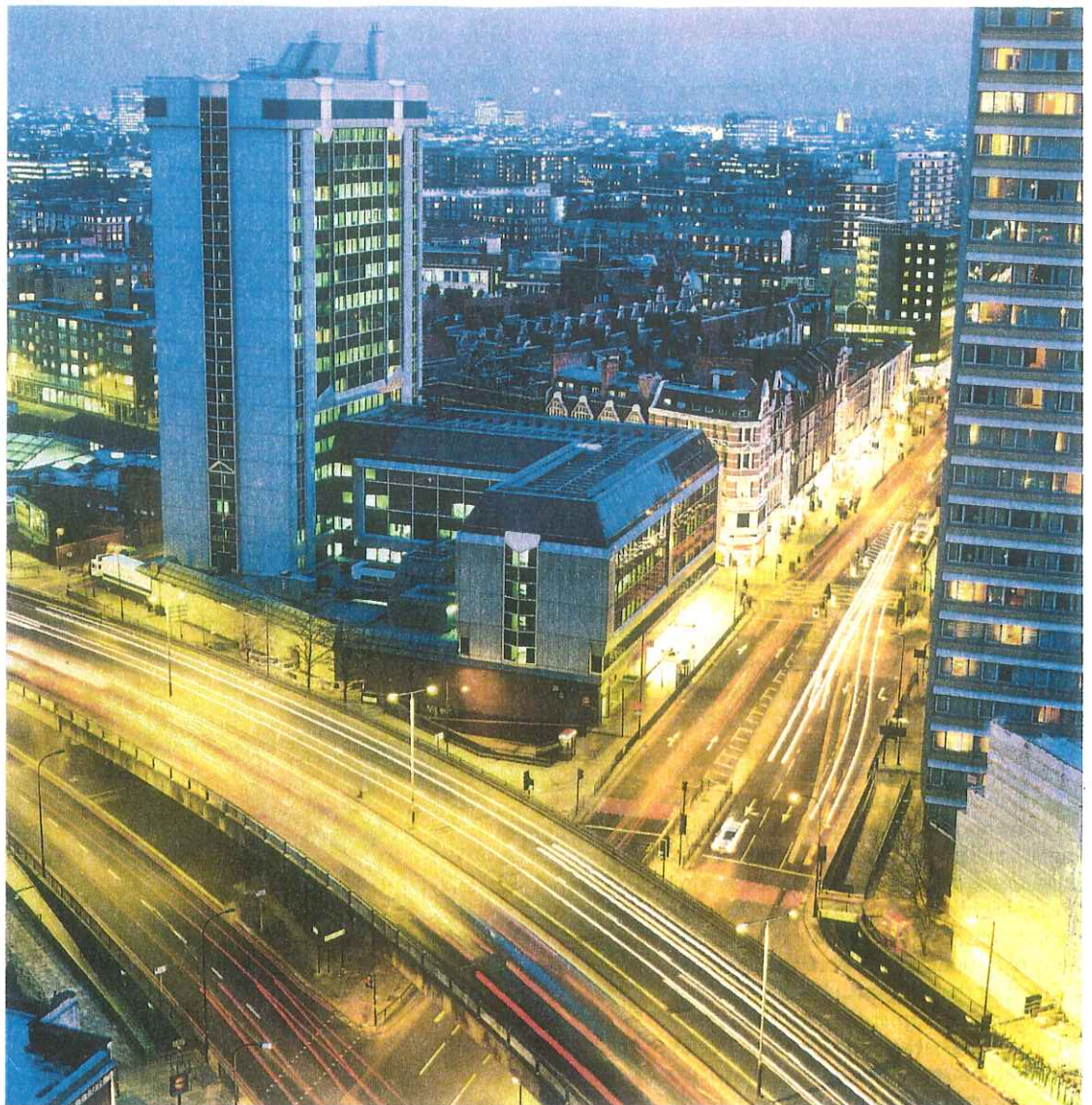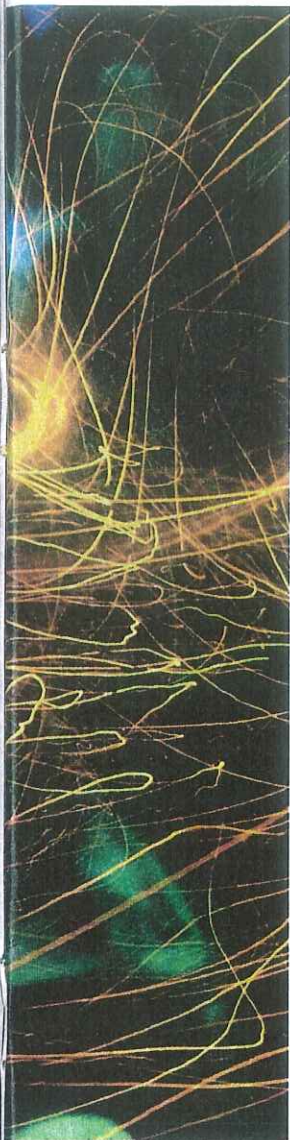
**LOCATION, LOCATION, LOCATION:** *Mobiles can pinpoint individuals in a disco in Melbourne (left) or a street in London*

and smarter, more powerful phones embolden a new generation of software designers. Taken together, these pressures have cracked the data vault. Established companies such as Nokia, Microsoft and Google, as well as ambitious startups and academic researchers, are beginning to interpret the data sloughing off our digital selves. They're doing for real-world sites what the first Internet search companies did for Web sites in the late 1990s: index them, chart their relationships, and in the process learn about the people who move between them. As the world descends into the biggest financial trough in a generation, this fresh technology provides a glimpse of a way forward.

The search-engine comparison is apt for another reason. Although few predicted it, the Web search industry became a goliath, and its leader, Google, quickly became the business success story of the

early-21st century. Experts expect our digital selves to increasingly center on the mobile phone, and as this shift happens, savvy businesses sense an opportunity. "Mobile is really the next frontier" for technology-oriented businesses, says Charles Golvin, an analyst with Forrester Research. "If you look at the next 1 to 3 billion online users, these people are going to be online on phones," making location an essential new data point for aspiring Googles to consider. Last year, for instance, Nokia spent $8.1 billion to buy digital mapmaker Navquest. It was the largest acquisition in the history of Finland, where Nokia is based, and a sign that the company is looking to become a player in the location game. "For us, it's a very ambitious and necessary move," says Michael Halbherr, vice president of social location services for the company. "People believe there's this magic box, this one box solving

every problem on the planet," he says in reference to Google. But adding location into the mix changes everything, including search. "We want to create an ecosystem of services that connect people to people and people to places in new ways," he says.

Search is only the beginning. Location data will give marketers and advertisers new insight into consumers. Financiers are using it to predict retail trends and inform their stock trades. And researchers say that understanding the movements of people within a city block or neighborhood will enable policymakers to craft more effective government programs, and provide early indicators of a disease outbreak or other public hazard.

The best example of a problem with a clear need for real-time location data is traffic congestion. Road-side cameras and underground sensors already snoop on current traffic conditions, but those sys-
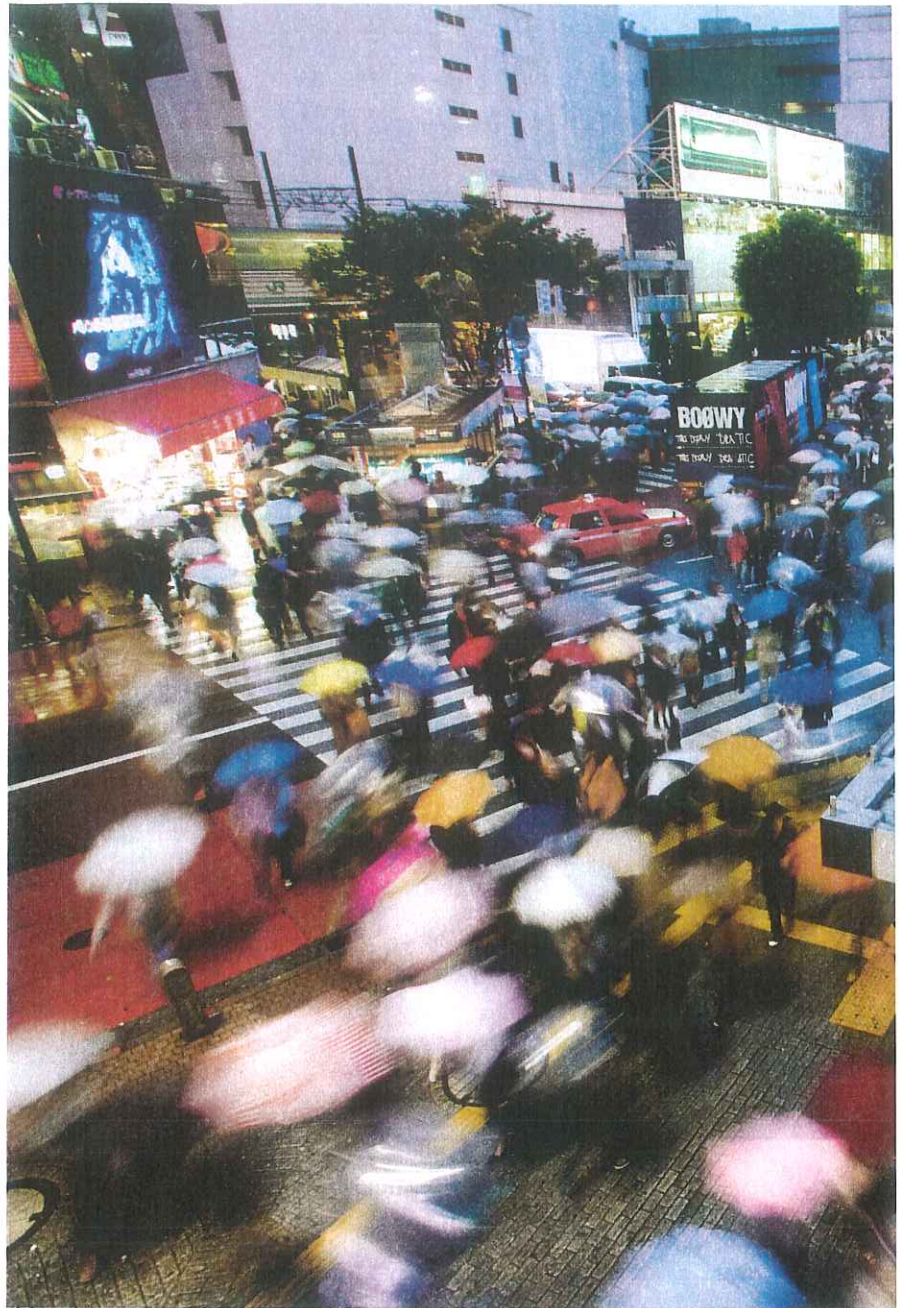
tems are too costly to ever be truly pervasive. By lassoing cell phones, navigation companies can have access to instantaneous, near-universal coverage.

The idea is no pipe dream. TomTom, the Dutch manufacturer of GPS devices, has been using cell-phone data to provide up-to-the-second traffic information in Western Europe since late 2007. "We're able to have almost complete visibility" of the roads, says Tom Murray, the company's vice president of market development. "It's a game-changing, killer application that rounds out our portfolio of navigation tools." Like Nokia, last year TomTom completed its own purchase of a major digital mapmaker, spending $4.2 billion to snap up Teleatlas. Nokia, for its part, is investing in a cell-phone-based traffic system, starting in Northern California. It has partnered with the University of California, Berkeley, to conduct a field test involving 10,000 cell-phone users, and will eventually sync their calendars and commuting habits with current traffic flows. In practice, this means your phone can alert you when you're running late.

Drivers carrying cell phones are creating a wealth of data about average traffic conditions, allowing Eric Horvitz, a computer scientist with Microsoft's research department, to concoct something he calls "surprise modeling." There's no point in being told that Highway 101 in San Francisco is backed up at 6:30 on Friday—the 101 is always backed up at 6:30 on Friday. The useful information is when the road is uncharacteristically crowded, or remarkably clear. "The idea is to harness [these datasets] to let me know in advance of a surprise coming," he says. Inrix, spun off from Microsoft in 2004, provides this kind of information to navigation companies and mapping programs.

Cell phones potentially give us a window into more interesting human patterns than traffic. Having a bird's-eye view of where people are and where they're going, in real time, could be a rich vein of information on behavioral trends. Sense Networks, a three-year-old startup housed in a hip SoHo loft in downtown Manhattan, has 15 researchers (including 5 Ph.D.s) trying to figure out what's possible to glean from location data. The company's goal, says CEO Greg Skibiski, is to index the real world much as Google has indexed the virtual one. "Google looks at the context of a Web page by the pages that link to that page, and the pages that link out from that page," he says. As a result, they "have a good understanding of the whole index. We do the same thing using places and location data."

Too abstract? Here's a real-world exam-

ple: Say a jazz group plays a 10 p.m. set at a downtown bar. Using the location data they've collected, Skibiski and his researchers can see where all the jazz aficionados ate dinner before the show, and what kind of late-night clubs they visit after the trumpets hit the final high C. They're putting the jazz club—and, by extension, its patrons—in the context of the rest of the city. That capability is on display in the company's first application for consumers, CitySense, which shows where everyone is—in real time. Cell-phone users who download it can see which blocks are busier than usual, and even learn the most popular destinations people go to from their current location.

That might not sound like much, but if you're a business owner, it's sweet music.

Businesses spend enormous amounts of time and money trying to understand their customers. Surveys and focus groups, though, are blunt instruments. Sense Networks can craft customer profiles based on where people actually go and what they actually do—not where they say they go and what they say they do. "We're seeing the real, unbiased you," says Skibiski. "And we're removing the bias error without asking you any questions." Consumers, theoretically, should be pleased, too, because businesses will be able to offer targeted services, such as customized Web searches.

Sense Networks has raised $3 million from financiers like Steven Drobny. As Sense began developing its algorithms, the moneymen saw an opportunity to use them for stock-picking. "We can use [our
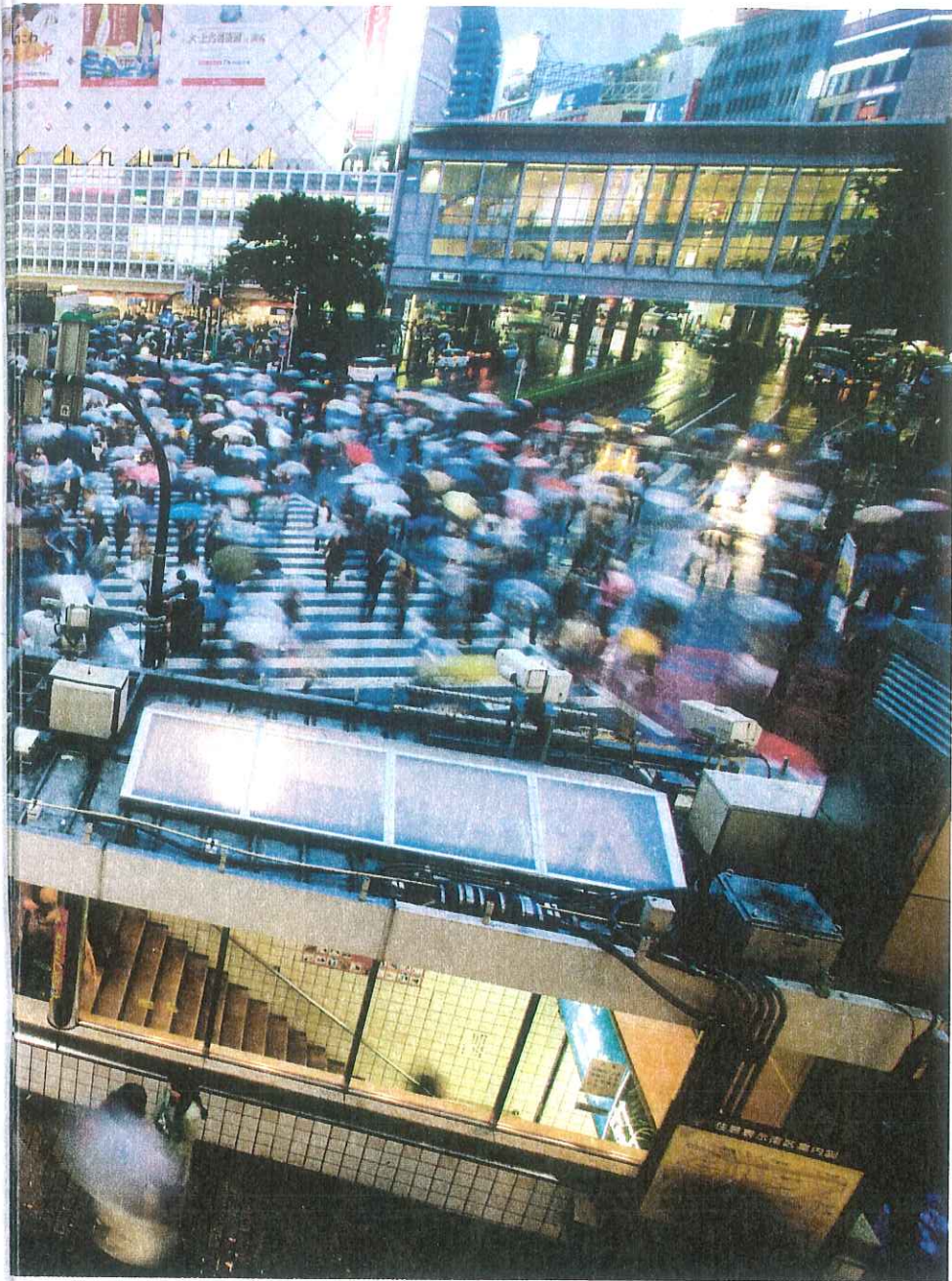
money," he says. "It's something you own, it's something you can loan to people, but you want to get something back" in exchange for it, such as a more useful search engine or real-time traffic information.

Just as money can be taxed, there's a case to be made that the government should be able to appropriate data for the public good. A skilled reality miner could use cell-phone data to pinpoint buildings or blocks where a higher than average proportion of people are at home on a workday. That, in turn, might imply an outbreak of influenza or another contagious disease. The benefits of using this method are enormous—doctors and epidemiologists could track the spread of an illness nearly in real time, and perhaps even issue warnings in communities where infected people have traveled.

That God's-eye view would come in handy in plenty of other scenarios, too. Public-transportation officials could use it to schedule roadwork and determine where infrastructure repairs are most urgent. Similarly, poverty experts could use it to determine whether public policies are working in a given neighborhood. "You can get things out of this data that you wouldn't expect," says Pentland. "Are people working? Are the kids sick? You can tell that from the patterns of communication and mobility that people have."

This might be even more influential in the developing world, where data on all kinds of variables, from population to health, is scarce to nonexistent (but cell phones are plentiful). Developing-world governments could employ reality miners to assess the growth of informal develop-

models] to predict retail demand," says Skibiski. "How many people are coming to Macy's versus Saks versus Nordstrom?" Since mid-2006, the firm has used location data from San Francisco to operate a trading portfolio. "It's in the green," says Skibiski, "so something's working."

The tie between location data and economic activity may even be strong enough to predict imminent financial crises. The company's analytic software charts various consumer habits, culled from location data, against trends in finance. One chart plots San Francisco nightlife patterns on the same graph as the Dow. It shows that, just before the market peak in July 2008, urban partygoers hit the town at later-than-ever times. Velvet-rope lines at nightclubs might just be the

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new leading indicator of financial panics.

Whether you're pinging a person's location to provide traffic information or using it to chart consumer behavior, privacy quickly becomes an enormous concern. For this reason, Pentland (a cofounder of Sense Networks) has called for a "New Deal on data." That means, in part, treating data a lot more like personal property—it is owned by the person who originates it, but companies can borrow it. "You should think of data roughly the way you think of

ments like slums, or find out which neighborhoods are less likely to make use of an AIDS clinic. It could, in short, replace the raft of contradictory, costly and sometimes inaccurate polls, censuses and surveys that much of public policy relies on. "That's a really revolutionary idea," says Pentland, "because today we have no clue whether government works or not." A global nervous system would provide more than a clue, and might reshape the business firmament at the same time.  ∎