MAGAZINE

The Way We Live Now: 9-18-05: IDEA LAB; Talking in the Dark

By CLIVE THOMPSON (NYT) 1306 words

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When was the last time you heard a "busy tone" on a telephone? Probably not for years. Our phone system is so robust, our mobile phones are so ubiquitous and voice mail and e-mail are such reliable backups that instant, unhindered access to friends, colleagues and relatives has come to seem a right and not a privilege. Indeed, if you include instant-messaging, blogs and cellphone text messages, you might think we're living in the golden age of communications.

Except when disaster hits. Two weeks ago, I tried calling a colleague down in New Orleans -- and found myself listening to the annoying honk of a busy signal and the static of a dead phone line. Katrina had disrupted the city's communications grid, and residents and emergency responders were grappling with the chaos that ensued. For a week, just about the only people with communications were those government officials and reporters lucky enough to have two-way radios or satellite phones with adequately charged batteries. Everyone else staggered around in blind ignorance -- which helped produce horrifying pandemonium. We saw a similar lesson in 9/11: When communications crumble, so does society.

Is there a way to prevent such breakdowns in the future? In fact, disaster-preparedness experts and high-tech inventors are already developing the idea of blanketing cities with what they call a "WiFi mesh." WiFi, of course, is the technology you may use at home or in a Starbucks to connect a laptop wirelessly to the Internet; a mesh is a vast, self-correcting network of WiFi antennas that could work together to provide crucial backup in a disaster.

To understand what makes WiFi useful in a catastrophe, consider some frailties of our regular phone-company communications. Phone systems are reliable on a day-to-day basis, but they have a key vulnerability: They're centralized. In any city, a handful of central "switches" handle the work of routing local phone calls. During 9/11, several important switches were located across the street from the World Trade Center and were damaged in the towers' collapse, blacking out parts of New York.

To make matters worse, phone systems are rarely designed to allow more than 10 percent of the population to talk simultaneously, and far more people than that rush to the telephone in an emergency. In the New York City blackout of 2003, while most land lines continued to function, the cellphone circuits were overjammed.

Katrina posed even worse problems. As phone traffic surged, the water was destroying a vast area, including underground phone lines. Mobile-phone networks, too, were ruined, because they're routed through communication towers that crumpled like paper in Katrina's 140-mile-an-hour winds. As a final insult, Katrina knocked out the power grid in swaths of the Gulf Coast -- which was fatal for phone systems that require thousands of watts of juice. The surviving mobile-phone sites in New Orleans could run on diesel-

generator backup, but with just one tank of gas each, they were capable of operating for only a few days. Even the mayor nearly lost contact with the outside world. After their satellite phones ran out of power, employees of the mayor's office broke into an Office Depot and lifted phones, routers and the store's own computer server.

WiFi meshes elegantly dodge our phone system's central problems. They're low-power and ultracheap -- and decentralized like the Internet itself, which was initially conceived to withstand a nuclear attack. You can use WiFi to build a do-it-yourself phone system that is highly resistant to disaster.

In Chicago, the Center for Neighborhood Technology, a nonprofit organization, hooked up dozens of households in the neighborhoods of North Lawndale and Pilsen with WiFi nodes that form a mesh. Each node can communicate with its neighbor a few hundred feet away; by cooperating in this fashion, they form an enormous bucket brigade, each passing the data signal along until everyone is sharing it. If one single household connects to the Internet, all the other households can instantly dip in. Best of all, the WiFi mesh can handle not only data but also phone calls -- via the magic of "voice over IP," an increasingly popular technique for transmitting conversation over the Internet. Should the local phone lines suddenly collapse, the residents of these neighborhoods can still make calls to one another using headsets attached to their computers. In essence, they are their own backup phone company.

Unlike a normal land-line or mobile phone system, a WiFi mesh has no single weak point. Knock out any single node in one of the Chicago neighborhoods -- destroy an entire house, for that matter -- and the mesh has enough redundancy to work around the missing link. The nodes are also durable; they're tiny shoe-box-size devices, which means they're far less likely to be wiped out by hurricanes than enormous mobile-phone-company antennas. "We've been running these little Apollo 13 disaster scenarios where a bunch of our nodes get taken out, and the whole system just reconfigures itself automatically," said Paul Smith, who helped build the Chicago networks.

So why don't cities build their own WiFi meshes to help cope with the next disaster? Scatter enough nodes on rooftops citywide, and then if the phone system collapses, there will probably be a surviving mesh strong enough to serve as a rudimentary backup. Connect even a single satellite uplink to the mesh, and the entire town remains linked to the outside world. Best of all, each WiFi node uses extremely little power -- about 10 watts, barely a sixth of the average light bulb. Even if a city's power grid fails, a car battery or solar panel could keep a node running for days or weeks, filling the gap while the phone companies rebuild their land-line and mobile-phone structures.

These disaster experiments are already under way. When Katrina hit, Smith and other volunteer communications enthusiasts rushed down to Louisiana. In Rayville, his team of techies clambered up a local tower to blast WiFi signals 50 miles through the countryside; their signals reached refugees clustered in church basements with computers but no Internet connections. "We're trying to make sure families can contact each other, and get online to register with FEMA's Web site," Smith told me.

The cost is laughably small. City engineers could build a mesh using parts on sale at any Circuit City. (Smith's neighborhood mesh in Chicago cost $350 per node, and he figures it could take only $650 apiece to equip every node with an emergency battery.) Alternatively, a city could simply hire a mesh-networking company like Tropos Networks, which estimates a cost of $70,000 to cover a square mile with DSL-speed connections. These numbers are so low that they are virtually rounding errors in any city's budget.

WiFi does have its limitations. To begin with, an antenna can communicate with another antenna only if it has a clear line of sight. But because the system is so inexpensive, it wouldn't be difficult to address this problem by placing antennas closely together in congested areas. Of course, a WiFi mesh wouldn't work if its users had no supply of electricity. And emergency responders and the military will always need to rely on their own high-quality two-way radios and satellite phones. But for the rest of us, when disaster next strikes, WiFi meshes could be the clever system that keeps people in contact -- from house to house.

Photo: New Orleans, September 2005. (Photograph by Hector Mata/Agence France-Presse/Getty Images