

# Internet on a Chip

**T**EN YEARS AGO, ONE OF THE biggest hits at a major trade show on new network technology was the Internet Toaster. By typing a command on a networked computer anywhere in the world, you could turn the modified Sunbeam Deluxe on and off, or have the toast pop up.

The Internet was still small back then, with a mere 300,000 computers online. But it was growing like a weed. And one of the big jokes was that we would soon be putting our toasters, microwave ovens, and refrigerators on the Net. The joke was all the funnier because nobody could quite figure out

why this kind of connectivity for household appliances would be desirable: we just knew that networked appliances would be part of our collective future.

Connecting a toaster to the Internet was not easy. For starters, the toaster needed a computer powerful enough to “speak” the so-called Internet Protocol—the digital standard that allows computers on the Net to communicate with one another. The contraption’s creators—Internet pioneers John Romkey and Simon Hackett—linked their toaster to a power switch that was in turn hooked to the printer port of a Net-connected laptop computer. Romkey and Hackett tin-

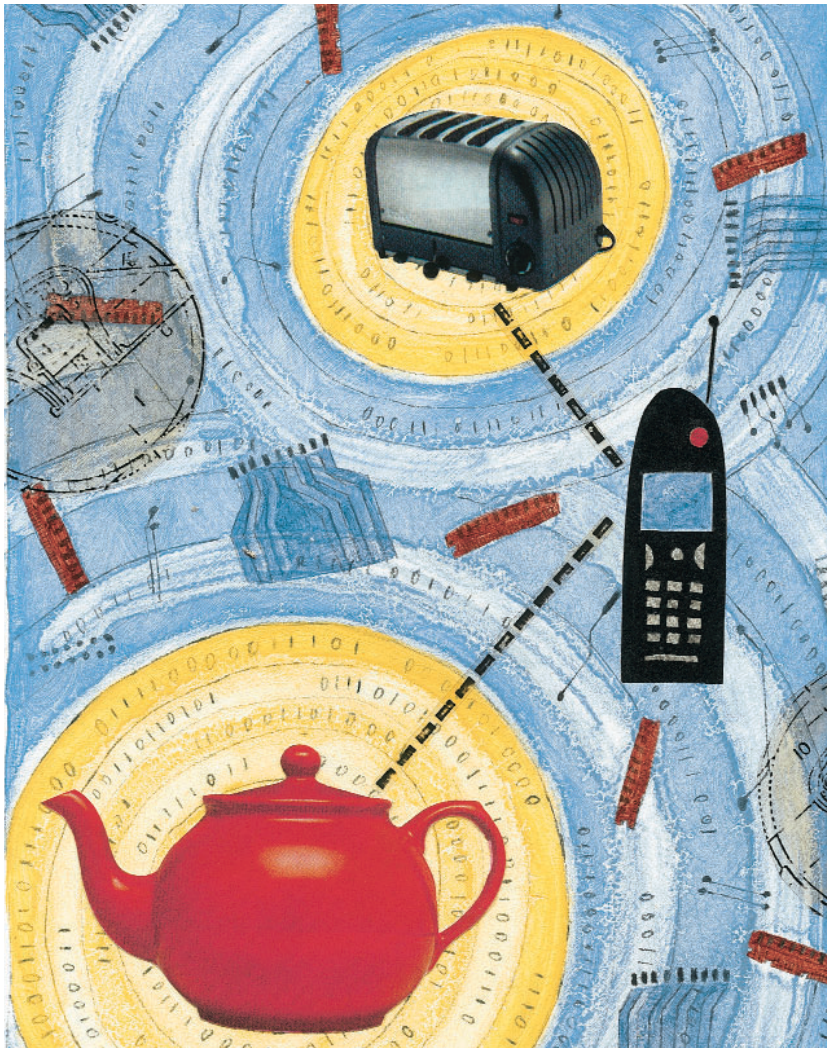
tered for a year to get it to work.

Fast-forward a decade. More than 300 million computers are connected to the Internet—but there aren’t many more household appliances than there were back when the Internet Toaster debuted. The inexpensive microcontrollers that are typically found in microwave ovens and fancy toasters lack the power to implement the Internet Protocol and therefore cannot practically go online.

That barrier is starting to crumble, thanks largely to a bit of technical wizardry by Santa Clara, CA, startup iReady. This company has reduced the Internet Protocol circuitry onto a silicon chip. The device, dubbed the Internet Tuner, lets companies connect dumb machines to the Internet without using expensive microprocessors. This technology could be the engine behind home networks of the next decade—but the developments made so far already have me worried about the potential for abuse.

I still can’t figure out why you would want to put a toaster on the Net. But early this year, Japanese housewares manufacturer Zojirushi plans to begin marketing an Internet-enabled hot pot that can send short messages to cellular telephones using a built-in wireless modem. Zojirushi will pitch the hot pot to the adult children of aging parents. Whenever the pot is used, explains iReady president Ryo Koyama, it automatically transmits a message letting the child know that the parents are okay and enjoying a cup of fresh tea.

iReady doesn’t market chips. Instead, it sells intellectual property—specifically, the wiring diagram for the tens of thousands of transistors and resistors that constitute the Internet Tuner. Companies such as Zojirushi can then use this information to build Internet functionality into the silicon chips that they are already putting into their products—an incremental cost of virtually zero. Essentially, the iReady



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technology makes it possible to add Internet access to a device for little more than the cost of the patent license.

Other applications are more commercial and less social. A soda vending machine equipped with the Internet Tuner, for instance, could report its status via the Internet to a regional distributor. There's nothing revolutionary

### **Distilling the essence of Internet communications into silicon makes it practical to wire dumb appliances to the Net. But will merry pranksters wreak havoc with your coffeepot?**

about soda machines reporting their inventory over dial-up networks; what's new is the idea of using the Internet as a unified network for collecting and distributing this and other kinds of data. Consider Zojirushi's hot pot. It never would have been cost-effective for the company to build its own wireless data network. What can make a lot of economic sense, though, is renting time on a network that already exists—particularly if the typical hot pot is sending less than 500 bytes of data each day. The Internet is ideal for this purpose. Thus the ability to implement the Internet's basic communications protocols in silicon will dramatically lower the cost of building online access into relatively dumb devices, which in turn should cause the number of Net-connected devices to skyrocket.

In the United States, companies such as EarthLink and America Online have built huge Internet dial-up systems. Serving mostly residential customers, these networks are nowhere near capacity during business hours or late at night. Combine iReady's Internet dialing technology with a cheap modem and you have a recipe for wiring the world.

Take this idea from YSI, a maker of environmental measuring instruments based in Yellow Springs, OH. YSI recently partnered with Aquadyne Computer of San Diego to create a system for monitoring the quality of water used in aquaculture. Sensors make a variety of water quality readings, then dump the data onto the Internet. The

system can also monitor parameters like dissolved oxygen and automatically send e-mail messages when it detects a problem. "In a typical project like this you would need to embed a 16- or 32-bit processor and 100 or so kilobytes of memory," says Aquadyne president Dean McDaniel. By adopting iReady's technology, YSI cut the component cost

of Internet access in its hardware from \$79 to \$9.

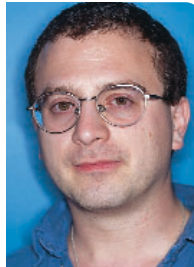
If iReady's technology becomes widespread, Koyama says, it could change the way that Internet service providers collect revenue. Today these companies mostly sell "all-you-can-eat" service for about \$20 per month. Companies that build the Internet Tuner into their products are likely to want a different kind of pricing. The idea is that a million devices might each dial into the Net once or twice a day and stay online for less than a minute. In all likelihood, manufacturers will purchase Internet bandwidth in bulk and then fold the cost of the service into the price of the appliances—an approach that would take less accounting than managing a couple million individual accounts or implementing some sort of global micropayment system. To kick-start the new pricing model, iReady is forming DeviceNet—a consortium of Internet service providers dedicated to providing online access to devices other than PCs.

While companies have developed the technology that such a system requires, they don't necessarily possess the wisdom that such capabilities demand. Pervasive telemetry will create unprecedented opportunities to collect personal information. An engineer at Zojirushi, for example, proudly showed iReady's Koyama a cell phone, displaying a message indicating that the engineer's grandmother had used her wireless hot pot that very morning.

"What does she think of this?"

Koyama asked the engineer.

"Well, she doesn't know!" answered the engineer—who then said that if his grandmother were aware that her hot pot was monitoring her actions, she almost certainly would object. "There is this whole Little Brother aspect" to the project that is a little unsettling, Koyama concedes.



Security presents another tricky issue. iReady's second component set is designed for wired networks, rather than dial-up services. Called the Internet Tuner Ethernet, the technology is designed to be bundled into all sorts of equipment that could be wired around an office or building—including thermostats, valves, lights and even cash registers. But iReady's Ethernet logic makes no provision for security—no usernames, no passwords and no encryption. If you can reach the Ethernet Tuner over the Internet, it will tell you its secrets.

Koyama says he's not concerned with this issue, explaining that Ethernet Tuner is designed to be used behind a company's firewall. But given all the security lapses that have been publicized in recent years, that's hardly reassuring. Many Ethernet Tuners will undoubtedly end up on the open Net—and even many of those that stay behind firewalls will lack proper protection. Experience has shown that when security protections are not built in from the beginning, many users will neglect to add them later. I can imagine Internet pranksters searching for Ethernet Tuner-enabled light switches and then making the lights flash on and off until the company disconnects from the Net. And no doubt the pranksters can come up with something far worse.

iReady is sure to respond if there are any high-profile incidents. But its patent creates a unique opportunity. If iReady builds in technologies that protect privacy while enhancing security, such protections will become standard on billions of devices over the next few years. Let's hope that the company rises to the occasion. ■