By Harry Goldstein

LOSER A TOUCH TOO MUCH

NTT's shaky approach to data transfer targets a solved problem

IN THE *MATRIX* MOVIES, artificially intelligent overlords use humans as batteries to power their empire. Nippon Telegraph & Telephone Corp., in Tokyo, has a different take on the idea: instead of using people as power sources, use them as 10-megabit-per-second communication links to each other.

This year NTT is working to perfect the networking technology it calls RedTacton ("Red" for warmth, "T" for touch, and "acton" for action), which could ultimately let people transfer data to each other's handhelds by means of a handshake or a slap on the back. The company claims that you will see RedTacton devices rolled out by mid-2007, though it declines to say exactly what they will be. While NTT has already made prototype devices available to potential partners for inspection, the Japanese giant doesn't yet have commercial-grade RedTacton devices customized for specific uses or any applications that aren't already served by RF technologies such as Wi-Fi and Bluetooth. Nor does the company have a bill of materials that won't exhaust consumers' wallets.

There's always been something whimsical and just a tad creepy about near-field intrabody communication, as it is technically known. It leverages the conductive properties of the human body to transfer data among electronic devices—an MP3 player to wireless headphones, for instance. Conceived and patented in the mid-1990s by Neil Gershenfeld and Thomas G. Zimmerman at the MIT Media Lab, in Cambridge, Mass., the Personal Area Network (not to be confused with the IEEE 802.15 standard of the same name) made a big splash among technophiles in the run-up to the dot-com boom. By 1996, Zimmerman was ensconced at IBM's Almaden Research Center, in San Jose, Calif., trying to commercialize the concept.

Zimmerman started to explore potential applications for personal area networks (PANs). He and others envisioned personal digital assistants that would let people exchange business card information merely by shaking hands, PDAs that would automatically sync with PCs when you walked into the office, and even door locks that would open after receiving the proper identification data when you touched the knob. But Zimmerman quickly realized that emerging radio-based cable-replacement technologies, such as the IEEE 802.11 Wi-Fi standards and the IEEE 802.15 Bluetooth standard, would allow products from many different companies to communicate and essentially render PAN technology redundant before it could be commercialized.

"PAN was lots of fun," says Zimmerman, "and we got some great PR and parlor tricks out of it"—the magicians Penn & Teller used a PAN in their Las Vegas act to play a set of 128 invisible drums. "But at IBM, we make products," he told *IEEE Spectrum* in a rare interview. With radio-frequency alternatives on the near horizon, IBM couldn't come up with a business model to make PAN viable. So Zimmerman set aside his brainchild and began working with Wi-Fi, Bluetooth, and other RF technologies.

If there's a lesson in Zimmerman's experience, it's been lost on NTT. Despite the thriving array of standardized, short-range wireless networking technologies—Wi-Fi (11 to 54 Mb/s), Bluetooth (1 to 3 Mb/s), ZigBee (250 Kb/s), and Ultrawideband (40 to 600 Mb/s)—NTT is plunging ahead with its "human area network," or HAN. A PAN by any other name is, according to MIT's Gershenfeld, a potentially patent-infringing technology. And unless NTT can overcome some major technological, psychological, and economic hurdles, a HAN won't ever amount to anything more than a flash in the PAN.

RedTacton was developed by a seven-person research team led by Yuichi Kado, executive manager of the Smart Devices Laboratory at NTT's Microsystems Integration Laboratories, in Atsugi, west of Tokyo. Using a transmitter embedded in, say, a PDA, RedTacton sends a 5-volt pulse along the surface of the body. The human body shunts most of this electricity to the ground, resulting in a weak electric field that can be modulated to carry signals. The receiver is located either on another part of the body—a component of a hands-free headset, perhaps—or nearby, say, in an acquaintance's PDA. As it senses modulations in the electric field, the receiver decodes them to recover the data.

JOHN WEBER

Exactly how the receiver senses these modulations in the electric field generated by the transmitter is one of the major differences between PAN and RedTacton. An electro-optical sensor embedded in the receiver and composed of an electro-optical crystal, a laser diode, and photodetectors reads the body's electric field through an electrode, which then transmits that field to a bismuth silicon oxide optical crystal. The electric field changes the refractive index of the crystal, which in turn changes the polarization of the sensor's laser beam as it shines through the crystal. Photodetectors register polarization changes as changes in light intensity and convert those changes into electrical signals, which are then processed by your cellphone or PDA.

Experiments with a prototype transceiver embedded in a PC Card attached to a PDA have resulted in a two-way 10-Mb/s Ethernet-speed connection that can transmit data in both directions, but not at the same time. NTT is also trying to shrink the RedTacton transceiver down to the size of a compact flash card or smaller so it can be slotted into cellphones, PDAs, and digital cameras. In theory, this would let you upload a spreadsheet from the PDA in your pocket to a friend's smartphone by touching hands.

This year NTT started sharing RedTacton prototypes with "attractive partners," as Kado calls them. They're going to help develop what he hopes will be irresistible products.

These products are likely to be quite costly, at least initially, says Bert Gyselinckx, a researcher specializing in body area networks at the Interuniversity MicroElectronics Center (IMEC), in Leuven, Belgium. He estimates that each of RedTacton's components—the electro-optical crystal, laser, photodetectors, battery, and microprocessor—will be in the US $1 to $5 range.

In addition, the components have to be assembled on printed circuit boards and packaged. Add in some software for error correction and signal modulation, and you have a device that sells for between $50 and $100. That is simply too much money. "If you want to go mainstream, you're going to have to do something for around $10, and that, I think, cannot be done today," Gyselinckx concludes.

But Kado is confident that consumers will pay a premium to get the combination of features RedTacton will provide: speed, security, and lack of interference. Kado suggests that a user could transform into a human Ethernet cable by simultaneously touching a RedTacton-equipped PC and printer to print documents. It's not clear why that would be preferable to using Bluetooth or even a plain old cable. But "simple touch is a more natural and intuitive operation of a computer-based system," Kado argues.

Then there's the holy grail of near-field intrabody networks—the exchange of business card information with a handshake. Two people, each with a RedTacton-enabled cellphone, clasp hands and automatically transfer contact information to each other's phones. It would be undeniably appealing, if it actually worked. Unfortunately, it doesn't, at the moment. A year ago, the RedTacton research team reported in *IEEE Transactions on Instrumentation and Measurement* that its test of a handshake intrabody communication "was unstable, and almost every packet was destroyed in the worst case.... It is thought that the electric coupling between two persons varied because of their movement." Alternatively, those communicating could stand still as statues in hopes of achieving a satisfying electric coupling.

Though the handshake exchange certainly has a way to go, Kado says his team is developing a dynamic transmitter that compensates for parasitic capacitances produced by bodies as they move.

Maybe a killer app lurks in the health-care sector? Kado points out that RedTacton medicine bottles could sound an alarm when you're taking a pill at the wrong time. That could be good for the elderly, but how many seniors will flock to an unproven technology, especially one that they might think would endanger them?

"Although [it is] unsubstantiated, the RedTacton technology can be a potential risk for people with medical problems," says Benny Bing, associate director of the Georgia Tech Broadband Institute, in Atlanta. "Electric field signals traveling though the body—no matter how small these signals are—may trigger a heart attack or a stroke." He points out that some people still have a phobia about holding cellphones close to their heads, despite plenty of studies that show there is very little to worry about. Without the facts, this phobic reaction "may just be psychological, but it will prevent people from using the technology," Bing adds.

Surely there's an application compelling enough to induce people to throw their inhibitions out the window and their credit cards on the counter. Kado thinks it might be the ad hoc creation of peer-to-peer networks of personal music and video players, allowing people to touch hands to share photos, videos, and songs.

Of course, there are some pesky copyright-protection issues that would have to be dealt with, not to mention interference and security problems. Though RedTacton users would not suffer the same interference issues that occasionally vex Bluetooth and Wi-Fi users, RedTacton users packed closely together could interfere with each other, as researchers from NTT and NTT DoCoMo Inc. reported in a paper delivered in Tokyo last September, at the Seventh International Conference on Ubiquitous Computing.

And even though RedTacton signals can't be snooped from a distance, what's to stop people with bad intentions from bumping into you on the street to transfer a computer virus or maybe even steal your identity?

Some NTT customers might well brush aside security and health concerns and buy RedTacton devices. After all, Japan is home to some rather intimate electrotechnologies, including Matsushita Electric Industrial Co.'s DL-MS1 toilet seat, which measures body fat by sending a mild electric charge through the user's buttocks.

But "in all likelihood [the NTT team] will find it extremely hard to marshal enough momentum and win over people's hearts," says Chatschik Bisdikian, coauthor of *Bluetooth Revealed: The Insider's Guide to an Open Specification for Global Wireless Communications*. "And they will need to, because people themselves need to be an integral part of the communications loop with these technologies." ■

RedTacton

GOAL: Perfect a networking technology that transfers data to devices through people's bodies.

WHY IT'S A LOSER: It has no compelling applications that aren't already available, it doesn't work reliably yet, cost is still unknown, and it will likely face perception problems among the general public.

ORGANIZATION: Nippon Telegraph & Telephone Corp.'s Smart Devices Laboratory.

CENTER OF ACTIVITY: Atsugi, Japan.

NUMBER OF PEOPLE ON THE PROJECT: 7.

BUDGET: Not available.