Fast Intrabody Signaling (Demonstration)

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Intrabody signaling is a communication mechanism that transmits data through the human body electrically [1]. Low power insures that the signal cannot be felt, and low frequencies prevent the signal from propagating to devices not in physical contact with the person. Intrabody signaling is well suited to ubiquitous computing environments in which the user wishes to exchange data with objects in the immediate vicinity. For example, objects in office environments could personalize behavior to specific users [2], or biotech laboratories could record all steps of an experiment.

Intrabody signaling has several advantages over competing technologies such as ISM-band RF, infrared, or conductive fabric:

- **Touch sensitivity**. Existing radios propagate signals omnidirectionally, and therefore cannot distinguish between multiple individuals or objects in a common space. Intrabody signaling requires touch or near-touch to communicate. The alternative of identification by keyed-in ID or by fingerprint is more cumbersome, and may cause inconsistencies if forgotten.
- **Less constrained**. Fabric-based communication imposes fashion constraints upon color or patterns. It also requires long-sleeves to reach the hands, which is uncomfortable or unfashionable in some environments.
- **Interception difficulty**. Because intrabody signals are very faint far from the user's skin, eavesdropping requires proximity, which may alert the user, or specialized equipment.
- **Lower power**. Signal frequencies are low and human body impedance is less than free space, so the transmission power may be less than conventional radios. Battery life can be extended.
- **Less channel consumption**. Because the signal is not propagated, there is less contention for public channels such as the ISM bands, which are shared by 802.11, Bluetooth, cordless phones, and other devices.

Of course, there are disadvantages. Public acceptance is a significant one. Many find the idea of sending even imperceptible electricity through one's body disturbing. Many are also concerned about possible long-term health effects. Differences in frequencies and power from existing field strengths make it difficult to make any conclusions in this area. Another drawback is low data rates. The highest data rate of previously published systems is 9600 baud.

THE DEMONSTRATION

We present a new design that is capable of reaching speeds up to 56K baud. Our design differs from previous designs by its lack of an initial LC filter on the receiver, which constrains usable bandwidth. The lower data rates of previous systems limited applications to exchange of identifiers, and proposed negotiating other physical links for transfer of large amounts of data. With higher speeds, some applications of intrabody signaling may not need other media, which reduces device cost, simplifies system design, and reduces bandwidth contention.

Our demonstration will be self-contained; we will require only a table to set up the devices. We will demonstrate a simple data transmission test. If the companion demo, "Demonstration of Ubiquitous Computing in the Biology Laboratory," is also accepted, then we will show the application to that domain.

We hope to foster discussion concerning novel applications of this technology, particularly given the higher data rate. We also would like to see what usability questions and concerns workshop participants have, as well as what challenges intrabody signaling poses for system software for ubiquitous computing.

[1] Zimmerman, T.G. Personal Area Networks (PAN): Near-Field Intra-Body Communication. Masters Thesis, Massachusetts Institute of Technology, 1995.
[2] Matsushita, N., Tajima, S., Ayatsuka, Y., Rekimoto, J. Wearable Key: Device for Personalizing nearby Environment. International Symposium on Wearable Computers, 2000.