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Near-Field Magnetic Communication

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E ven as cell phones have shrunk in size while boasting an ever-increasing array of features, two things about them haven't changed, much: they still (generally) sprout a stubby antenna, and, if you want to use a headset, you have to put up with an unwieldy wire connecting the headset and the phone. As antenna engineers, we know that the antenna can be made to vanish inside the cell-phone case if a microstrip-style printed version is used. Now, thanks to a patented technology called near-field magnetic communication (NFMC), from Aura Communications, one can also cut the cord between the phone and the headset [1-4].

NFMC Technology

According to the Web site for Aura Communications [3], "While the concepts behind magnetic induction communication have been around for decades, Aura's engineers are the first to develop and implement practical solutions capturing the benefits of this technology." NFMC communicates wirelessly by coupling a very-low-power quasistatic magnetic field at 13.56 MHz (one of the frequencies available worldwide for unlicensed industrial, scientific, and medical (ISM) applications). Such a field may be produced with an electrically small loop antenna (a "magnetic dipole"), for example. Polarization diversity is employed to provide nearly omnidirectional reception [3]. In analogy with the electric field of an electric dipole (think *duality*), the magnetic field of a magnetic dipole exhibits a $1/r^3$ dependence on distance in the near zone. Normally, this range-limiting rapid rate of decay would be a serious handicap, compared with the $1/r$ drop off of the far field of more familiar RF wireless technologies, e.g., Bluetooth, operating at 2.45 GHz. But in really short-range (1-2 m) applications – such as the link between a cell phone or an MP3 player and a headset – this rapid fall off is exploited to provide each user with his own private "bubble," without having to worry about mutual interference among multiple users, and permitting bandwidth reuse. (Theoretically, a wireless link based on a quasi-electric field should work just as well, but the quality of such a link suffers greatly in the presence of commonly encountered conduct-ing objects. Magnetic fields, on the other hand, are not affected by human bodies and non-magnetic objects in the vicinity [3].)

Advantages

The physics of quasistatic magnetic fields leads to a number of desirable features in devices equipped with the NFMC technology:

Lower power consumption: Since signals are limited to a two-meter range at the most, NFMC devices require very little power, and may have up to a six-fold advantage in terms of battery power over Bluetooth-enabled devices [3]. One of the commercial NFMC products, the LibertyLink Docker, is claimed to be good for several hours of talk time on a single AA battery [2].

Available bandwidth: Since NFMC devices do not operate in the crowded 2.45 GHz band, and since each user is "sealed" within his or her own bubble, frequency reuse is greatly facilitated for NFMC devices. For streaming music applications, such as MP3 players, a bandwidth of 384 kbps, with a bit-error rate (BER) of 10^{-5}, may be needed to provide the equivalent of hard-wired service quality [4]. With NFMC technology, that is easily achievable for multiple users in the same area.

Increased reliability: Because the magnetic near field falls off rapidly with distance, NFMC devices do not have to contend with fading due to multipath. As a result, NFMC devices offer a much more robust service quality compared with Bluetooth-type devices [3].

Retrofitting: To use a Bluetooth link, one has to pay for a Bluetooth-enabled appliance. On the other hand, commercial products based on NFMC devices can be used with regular cell phones. Typically, the small base unit plugs right into the cell phone, using the port normally used for wired headsets [1, 2].

Conclusion

Motorola is one of the key investors in privately held Aura Communications. Several companies have already licensed Aura's

technology, and are offering modestly priced (less than $100) products to consumers. In an interview, Aura CEO Kokinakis recently told *The New York Times* [1], "I want to become the de-facto standard for personal-communications devices delivering voice and audio." That, of course, is a tall order, but the concept of using near-field magnetic fields for communication certainly shows a lot of promise.

References

1. A. Krauss, "For Audio Players, A Chance to Cut the Cord," *The New York Times*, March 4, 2004.

2. D. Wolfson, "The LibertyLink Docker Wireless Headset," [product review], *Computing Unplugged*, January 1, 2004; available at http://www.computingunplugged.com/.

3. Aura Communications Web site: http://auracomm.com

4. V. Palermo, "Near-Field Magnetic Comms Emerges," *Electronic Engineering Times*, November 3, 2003. ⊕

Editor's Comments *Continued from page 97*

In Don Bodnar's Measurements Column, Jukka Ruoskanen, Pekka Eskelinen, Heikki Heikkila, Petri Kuosmanen, and Tero Kiuru present a very useful millimeter-wave radar calibration target. It is based on a flat plate, and provides the very large RCS values necessary for accurate calibration over substantial distances at these frequencies. They achieved very accurate calibration and pointing-resolution values. ·

With this issue, we welcome David Thiel as Co-Associate Editor for Stand on Standards. As he explains, the *IEEE Standard Definitions of Terms for Antennas* needs updating. In particular, the listing of antenna types and their definitions needs to be given careful consideration. The list is available on the Web, and David has solicited input from the AP-S membership regarding this part of the standard.

In Christos Christodoulou's and Tuli Herscovici's Wireless Corner, Stelios Mitilineos, Pantelis Varlamos, and Christos Capsalis describe a method for estimating the bit-error-rate performance for arbitrary angle-of-arrival channel models.

Further Comments on Plagiarism and Multiple Submissions

There has been a lot written recently regarding IEEE policies on plagiarism and multiple submissions. Based both on what has been written, and comments and questions I've received from some of our members, there is some confusion regarding what is going on. Without getting into too much unnecessary detail, I'll try to summarize the situation as I understand it.

The IEEE Periodicals and Products Board (PSPB) is in the process of adopting a new policy regarding plagiarism. Most of this new policy will be incorporated into the PSPB Operations

Manual. This is expected to be approved at the June, 2004, IEEE Organizational Unit Meetings. It includes a clear definition of plagiarism ("the reuse of someone else's prior ideas, processes, results, or words without explicitly acknowledging the original author and source"), detailed guidelines identifying various levels of plagiarism, specific corrective actions to be taken for each level, and the processes to be followed in cases of plagiarism. While Editors responsible for IEEE publications (and this includes *Transactions*, *Journals*, *Letters*, magazines, and conference proceedings: *all* IEEE publications) will continue to have some ability to exercise judgment in differentiating between plagiarism and unintended omissions of proper credit (and instances of the latter must certainly be properly addressed), the new policy will make the identification, handling, and consequences related to instances of plagiarism much more uniform across the IEEE. They also require that an Editor take action if he or she believes an instance of plagiarism has occurred. The message to authors is simple: it's quite OK to use someone else's ideas, processes, results, or words (within the limits of copyright law) *if* you give proper credit, and *if* you make it clear that what is being used belongs to someone else. Give proper credit. Include proper references. Clearly identify quotations. If something is paraphrased from or the ideas are based upon another source, make that clear, and provide a proper reference.

· The plagiarism policy makes it clear that it applies *only* to the misuse – or use without proper identification and credit – of material belonging to someone else. The issue of multiple submission – the reuse by the original author of material that in some way has been published before – is different. Originally, the plagiarism policy was to have incorporated a policy dealing with multiple submission. However, it quickly became apparent that common practice related to multiple submission varies widely across IEEE Societies and publications. This is particularly true when it comes to publication in a peer-reviewed IEEE publication of material that at least partially has previously been presented at a conference (and may therefore appear in a conference proceedings). As a result of the feedback received, the PSPB has delayed adopting a policy relating to multiple submissions. Indeed, it may not be appropriate to try to adopt an IEEE-wide policy beyond that already in place (see below). I frankly think it is best to leave this issue to the individual Societies, and their Editors, AdComs, and publication committees.

One reason this issue has been recently receiving much greater scrutiny is that most IEEE conference proceedings are now available (and searchable) online, as part of IEEE *Xplore*. This is true for essentially all IEEE material from 1988 forward. Furthermore, AP-S (and at least 12 other IEEE Societies) paid a substantial amount of money to have *all* of the Society's archival material, back to the founding of the Society – including conference proceedings – put into a form that is now available on *Xplore*. As an example, this means that when someone searches for a specific result by a specific author, they may well find both a conference paper and a *Transactions* paper or a *Magazine* article on that result. If the person doing the searching is at a company that is paying a large annual fee to access *Xplore* through the IEL (the IEEE/IEE Electronic Library), they may well wonder if they are paying to get the same thing in two only slightly different forms. In most cases – and this is certainly true for AP-S material – the answer is clearly "No," for at least two reasons (the following comments obviously apply to AP-S).

First, we almost never publish a conference paper as it was submitted to the conference. To use the words from the editorial that appeared in the February issue ("Publishing in AP-S Publica-