California Researchers Offer Open-Source Platform To Speed Wireless Development

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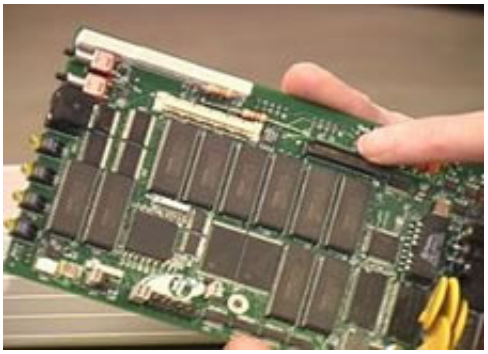

In a bid to speed development of new wireless protocols and networking standards, the California Institute for Telecommunications and Information Technology (Calit2) at UCSD has begun distributing for alpha testing a hardware-and-software platform for wireless research and development. Called CalRadio 1.0, the open-source device gives academic and corporate researchers unprecedented freedom to develop new radio frequency (RF) solutions.

"CalRadio 1.0 is a software-defined radio platform that allows researchers to test out new algorithms and new techniques for wireless communications," said Douglas Palmer, principal development engineer at Calit2. "The first generation of this platform is based on the 802.11b Wi-Fi standard, but we are already developing future generations that

will make it possible to use CalRadio in other wireless standards or even design entirely new ones."

The R&D device will be on display at MobiQuitous 2005, the second annual conference on mobile and ubiquitous systems, networks and services, which runs today through July 21 in San Diego. An early CalRadio prototype took the Best Demo prize in April at IPSN-SPOTS, an international conference that drew academic and industry researchers working on sensors and networks. "They were excited to see a new platform come along," observed Palmer.

Several companies cooperated in the development of CalRadio, which took nearly two years to develop. Symbol Technologies contributed the RF module and early media access control (MAC) code, and Texas Instruments donated the development system. The first version of CalRadio is powered by a high-performance TI TMS320VC5471 ARM (Advanced RISC Machine) + DSP (Digital Signal Processor). The ARM processor runs ucLinux for convenience of software development, and the DSP implements the MAC for the 802.11b Wi-Fi standard in C code.

"Since all aspects are coded in C, they can be altered quite easily," noted Palmer. "Until now, if you wanted to do anything in the Wi-Fi area, you were stuck with what manufacturers offered: usually dozens of functions implemented on a single piece of silicon. There was no flexibility to alter algorithms. With CalRadio, they can be altered easily to fit a particular type of research, including queueing, ad hoc networking, security, and power management."

CalRadio is also designed to be a valuable teaching tool for graduate and undergraduate researchers. "It's important that students get hands-on experience," said Ramesh Rao, Calit2's division director at UCSD. "With CalRadio, they can try out all their wireless networking dreams

and visions on a real working box that is software configurable."

In what one engineer calls a "garage shop operation," Calit2 researchers are building the first 50 boxes on campus, for distribution at cost plus an administrative handling fee (price tag: $2,000 per unit). Calit2 expects to outsource manufacturing and distribution of the devices, but intends to remain a nexus for promoting CalRadio as an open-source platform for research.

"We want everything to be open source and available to any researcher who wants it, and Calit2 will act as a clearinghouse for information on improvements as they happen," said Palmer. "Researchers can create new CODEC algorithms, new modalities of communications, and even new types of wireless systems."

CalRadio researchers believe that their device can provide a platform for development and even publication of the next generation of RF specifications. In the past, a new standard such as IEEE 1394 (FireWire) was published as a written specification and interpreted in different ways by different researchers. By contrast, the code for JPEG was written, posted, and deployed almost instantly and universally. "We are trying to duplicate that same success story for wireless communications standards," said Calit2's Rao, a professor of electrical and computer engineering at UCSD's Jacobs School of Engineering. "The next Bluetooth or ZigBee could be developed on this kind of platform, with the specifications being published as a real working device. That eases the speed of deploying new standards."

Initial shipments of the new box - which can double as a Wi-Fi access point or client - have gone to researchers at Hughes Research Laboratories and several Calit2-affiliated projects that are developing emergency-response technologies. They include the National Science Foundation-funded Responsphere and RESCUE, as well as WIISARD

(Wireless Internet Information System for Medical Response in Disasters), underwritten by the National Institutes of Health's National Library of Medicine.

WIISARD researchers - including Doug Palmer - are using ad hoc 802.11b networks deployed at disaster scenes to give first responders the connectivity they need to track victims and provide situational awareness to emergency officials and hospitals removed from the scene.

"The 802.11 standards were first conceived for someone with a laptop, sitting down in an auditorium, to give them access to the outside world," explained Palmer. "Very often, if you try to use Wi-Fi in a mobile environment where users are rapidly moving between access points, communications fail miserably. New types of mobile standards are needed, so for that kind of development, having a low-cost platform where you can buy 20 or 30 of these and deploy and experiment with them is going to be very valuable."

CalRadio sports 16 megabytes of memory and 4 megabytes of EEPROM [electrically erasable programmable read-only memory] for data and code storage. Its digital signal processor runs at 100 megaherz and has considerable throughput. "CalRadio packs a lot of power," added Palmer. "You can monitor energy use for every single sub-system on the board. If you are doing algorithms that are sensitive to energy usage, as you alter the algorithms, you can monitor power consumption very precisely, and even track the temperature on the board."

Initially CalRadio equipment will be distributed through Calit2's project support office at UCSD. All orders must be placed through Erica Negretti at (858) 822-4735. Complete details about CalRadio 1.0's architecture, data sheets, schematics, descriptions of the board and RF module and other specifications are available online at calradio.calit2.net/calradio1.htm