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UWB gaining infrastructure

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Santa Clara, Calif. - A sure sign that ultrawideband (UWB) radio concepts are starting to move toward commercial implementation is the emergence of a design and verification infrastructure. Instances of both were evident this month.

On the design side, Ansoft Corp. has developed a reference design for a UWB transceiver, while eInfochips Inc. has put together a package of intellectual property (IP) and services for UWB verification.

Ansoft's design implements a Mode-1 radio under the Texas Instruments Inc. proposals in the Multiband OFDM Alliance. That is, the radio would operate as a very low-power, multiband orthogonal frequency-division multiplexing transceiver in the range between 3.168 and 4.752 GHz.

This band needs no license and has very tight power constraints and short operating distances. Ansoft's design is meant to operate over no more than 10 meters. Such radios would replace USB or Firewire physical connections with a wireless link.

Why would an EDA developer known for simulating electromagnetic effects be doing a radio reference design? That's what a nervous customer in Asia asked Lawrence Williams, director of business development at Ansoft. Williams said the design was originally meant to study the application of Ansoft's design flow to UWB radios. In particular, he said, Ansoft wanted to confirm its belief that at these frequencies, even with direct-conversion transceivers that minimized the number of RF blocks, electromagnetic analysis was important to the flow.

"In principle, electromagnetics should be very important here," Williams said. "It is vital to correctly predict the quality factor for the passive components, as this directly impacts the very delicate noise margins. Similarly, there are effects like substrate coupling between the VCO and the power amplifier. These normally don't get modeled in RF designs."

So the company put together what would be a pretty standard OFDM transceiver design, except for a couple of constraints. Because this is a UWB radio, the useful bandwidth of the RF section has to be pretty enormous: over 1.5 GHz around a 3.9-GHz center. And because of the very low power, and hence the very low energy on any one OFDM channel, the link budget for the radio is extraordinarily tight.

The company's designers put together a behavioral simulation of the digital blocks that would attach to the data converters, and then did detailed circuit designs for the antenna switch, low-noise amplifier, synthesizer, I/Q modulator and power amp.

All of this turned into a different kind of project when Ansoft partner United Microelectronics Corp. saw the design and said, in essence, hey, why don't we fabricate this thing? So UMC is doing the layout and intends to build the radio. The companies expect to tape out in March.

What will they do with the silicon? To start with, they will use it to verify the simulations from the design flow. Then, probably, UMC will distribute the silicon and Ansoft the schematics, as a reference design. "We don't expect this to be a turnkey product for anyone," Williams said. "We believe it is a real radio that meets realistic specifications for USB applications. But we think just about any design team would want to tweak it." Ansoft has no plan to implement the data converters or baseband processing.

If the RF bandwidth and link budget of UWB radios are intimidating, so are the protocols being suggested for applications. Most scenarios for USB now involve very short-range transceivers that can wake up, establish what their surroundings are-both in terms of other radios and in terms of the electromagnetic environment-and configure themselves to accomplish the user's desires. This means significant issues in terms of detecting beacons, negotiating coordinator and player status, and configuring for robust data transmission over those very narrow noise margins.

"This is really challenging," warned Pratik Vasavda, project manager at design services vendor eInfochips. "Neither Bluetooth nor 802.11 had anything like this level of flexibility."

To help designers cope with the complexity of these protocols, eInfochips is offering a UWB-specific version of its VeriSuite. The centerpiece is a set of verification blocks in SystemC that perform functional checking, data generation and data-monitoring operations. "The real challenge here was getting the IP to be flexible enough to cover the full range of operating modes with pretty much any kind of MAC," Vasavda said. He pointed out as well that since the blocks are in SystemC, users don't have to acquire a language license to employ them.

Reference designs and flows are coming on the RF side and third-party verification IP is accumulating on the protocol side, sure indications that early designs are going on somewhere. Certainly Texas Instruments, which proposed the multiband arrangement in the first place, is a likely candidate. And eInfochips said it was working with at least one customer on UWB VeriSuite. Things are moving out of the realm of papers and standards reviews, and toward early silicon.

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