U.S. 'smart lighting' effort targets LED-based wireless nets

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PORTLAND, Ore. — A "smart lighting" initiative being funded by the government seeks to piggyback wireless communications capabilities onto future LED lighting installations to provide more broadband access points.

The $18.5 million, 10-year National Science Foundation program involves more than 30 university researchers from Boston University, Rensselaer Polytechnic Institute in New York and the University of New Mexico (Albuquerque).

The initiative seeks to use visible light beams for communications between wireless devices and LED-based lighting fixtures. The LED-based scheme could also be used to communicate between automobiles that are increasingly using LEDs. The overall goal is to build new communications capbilities into all LED lights while alleviating congestion in current RF bands.

"There is a long history of communications of this type with infrared, and there is the infrared data association--IRDA--that has had protocols for many years for things like PDAs, printers and laptops," said professor Thomas Little at Boston University. "What we are doing is seizing this opportunity to embed networking in the [LED] lighting revolution. As incandescent and fluorescent bulbs get replaced, we hope to embed a networking technology into [LED] lighting."

Boston University's Thomas Little holds a prototype LED bulb with built-in visible light transceivers.

Light-based communications capabilities that now use infrared LEDs, such as remote controls, will be adapted to using visible light so that transceivers in digital devices can communicate with lighting fixtures. The fixtures would be hard-wired to the Internet. Unlike RF-based Wi-Fi access nodes, which must share spectrum will all users, line-of-sight communications via visible light could enable separate data streams to be fed to each device.

The researchers have experimented with several modulation schemes, including encoders that use standard binary codes, non-return-to-zero encoders, pulse-code modulation and pulse-density modulation. They claim that each of these schemes can be made to work without flickering light, so long as data rates are above 900 KHz.

Initial prototypes, which will be demonstrated next year at speeds of 1-10 Mbits per second, will use off-the-shelf LEDs and photodiodes to handle transmission and reception functions. The researchers also plan to develop novel semiconductor technologies that could eventually allow visible light transceivers to be built.

"We would as part of the system need a receiver, typically done with a photodiode." One idea is "to use the same LED with a reverse bias and, in effect, as a part of the manufacturing process, make some of the LEDs receivers and some of them senders," said Little.

The group will also experiment with using multiple light wavelengths to encode multiple data steams on the different colors of light that together create white LEDs. Light polarization also will be a focus of multiplex communication strategies using visible light.

Boston University will focus on system-level issues, including computer networking application development. Semiconductor device development will be handled by Rensselaer Polytechnic Institute and University of New Mexico researchers.

Boston University has set up a Web site to disseminate information about the smart lighting initiative.