

Beyond WiFi: Connecting by light

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BU system could use a fraction of the power, keep data transmissions private

By Hiawatha Bray, Globe Staff | October 13, 2008

Researchers at Boston University say a new kind of light fixture could one day bring digital data into homes and offices.

A team at the school's Photonics Center, led by engineering professor Thomas Little, is sending information between two computers by using subtle variations in light intensity.

"The technique used is to flash the light on and off, or modulate the light, to transmit data," Little said. The pulses are so rapid that they can be picked up by an electronic sensor, but not by the human eye. That allows the lamp to light a room and transmit information at the same time.

Nobody expects light-based networking to replace today's wireless radio systems, like the popular WiFi networking technology. But the BU system could use a fraction of the power of radio systems like WiFi networking. It would also offer greater privacy, because signals from a light-based network won't penetrate walls or doors, as WiFi signals do.

The prototype system can already send thousands of data bits per second - at about the same speed as an old dial-up computer modem. But in a few years, said Little, it will have the capacity to deliver millions of bits of data per second, making the speed comparable to that of a WiFi wireless Internet connection.

In theory, Little said, a light-based network could transmit up to 600 million bits of data per second, more than enough to support a broadband home entertainment system.

"We could deliver high-definition video via light to a laptop," he said. Little said commercially viable LED networking devices could be available in as soon as in five years.

The system uses a lamp that relies on light-emitting diodes, or LEDs, instead of traditional incandescent light bulbs or fluorescent tubes.

"Incandescents can't be modulated at high speeds," Little said; the same goes for fluorescent lamps. But LEDs respond instantly to power fluctuations, enabling them to flicker millions of times a second. This makes them perfect for "smart lighting" applications, which would use the light pulses to transmit information to nearby electronic devices.

Little's research is part of a five-year, \$18.5 million research project on LED smart lighting funded by the National Science Foundation. BU will receive \$1 million a year. Rensselaer Polytechnic Institute in Troy, N.Y., and the University of New Mexico are participating in the project, which will work with corporations to turn their discoveries into commercial products.

Inder Monga, a researcher at the networking equipment maker Nortel Inc. in Billerica, said his company is interested in signing on. The light consumes a lot less energy than other wireless networking technologies like WiFi, said Monga, "and it is more localized . . . This could lead to more energy-efficient communications."

LEDs use about 15 percent as much electricity as light bulbs of equivalent brightness. E. Fred Schubert, a professor at Rensselaer Polytechnic and director of the Smart Lighting Engineering Research Center, said 22 percent of the world's electricity is used for lighting, but it could be reduced to 11 percent if all existing lamps were replaced with LEDs. "This is the only technology that can make a huge dent in electricity consumption," he said.

But for now, at least, it doesn't come cheaply. While a 100-watt bulb costs less than \$1, an equivalent LED lamp can cost as much as \$80.

Little believes that will change as commercial and industrial users with high power costs increase their use of LED lamps, leading to increased production by lighting companies and a lower price per lamp. The cost will come down faster if customers realize LED lamps could double as a data network, he said.

And LED data networks could find applications beyond homes and offices. The smart-lighting scientists are studying automotive applications, such as smart traffic signals.

"We believe that we can make the transportation system much more safe," Schubert said, "including traffic lights that would prohibit cars from running a red light."

Most newer traffic lights already use LED lamps. With the new technology added, they could transmit a message to the onboard computers of approaching cars, perhaps even ordering them to hit the brakes, whether the driver likes it or not. Researchers also want to smarten up the LED taillights on many newer cars. If a vehicle skids on ice while trying to stop, "smart" taillights could relay the information to other cars, allowing them to avoid a collision.

"We believe that we can save thousands of lives," Schubert said.

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