Boston University partners in NSF challenge to create wireless network using visible light

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Boston University's College of Engineering is a partner launching a major program, under a National Science Foundation grant, to develop the next generation of wireless communications technology based on visible light instead of radio waves. Researchers expect to piggyback data communications capabilities on low-power light emitting diodes, or LEDs, to create "Smart Lighting" that would be faster and more secure than current network technology.

"Imagine if your computer, iPhone, TV, radio and thermostat could all communicate with you when you walked in a room just by flipping the wall light switch and without the usual cluster of wires," said BU Engineering Professor Thomas Little. "This could be done with an LED-based communications network that also provides light – all over existing power lines with low power consumption, high reliability and no electromagnetic interference. Ultimately, the system is expected to be applicable from existing illumination devices, like swapping light bulbs for LEDs."

This initiative, known as the Smart Lighting Engineering Research Center (http://smartlighting.bu.edu), is part of an $18.5 million, multi-year NSF program awarded to Boston University, Rensselaer Polytechnic Institute and the University of New Mexico to develop the optical communication technology that would make an LED light the equivalent of a WiFi access point. This innovative alternative may one day replace most of today's lighting devices.

Rensselaer and UNM will work on creating novel devices along with systems applications to better understand the proliferation of smart lighting technologies plus materials
needed for wireless devices to interface with the network. Together with BU, the three partners will have 30 faculty researchers plus students, postdoctoral researchers and visiting industry engineers as regular contributors to the research conducted by the Smart Lighting ERC.

Boston University researches will focus on developing computer networking applications, notably the solid state optical technology that will form the network's backbone. Funding for the BU portion of the program is expected to total about $1 million per year for the next 10 years plus additional funding from industrial partners and possibly the formation of new businesses by entrepreneurs.

"This is a unique opportunity to create a transcendent technology that not only enables energy efficient lighting, but also creates the next generation of secure wireless communications," Little added. "As we switch from incandescent and compact florescent lighting to LEDs in the coming years, we can simultaneously build a faster and more secure communications infrastructure at a modest cost along with new and unexpected applications."

Little envisions indoor optical wireless communications systems that use white LED lighting within a room – akin to the television remote control device – to provide Internet connections to computers, personal digital assistants, television and radio reception, telephone connections and thermostat temperature control.

With widespread LED lighting, a vast network of light-based communication is possible, Little noted. A wireless device within sight of an enabled LED could send and receive data though the air – initially at speeds in the 1 to 10 megabit per second range – with each LED

serving as an access point to the network. Such a network would have the potential to offer users greater bandwidth than current RF technology.

Moreover, since this white light does not penetrate opaque surfaces such as walls, there is a higher level of security, as eavesdropping is not possible. LED lights also consume far less energy than RF technology, offering the opportunity to build a communication network without added energy costs and reducing carbon emissions over the long term.

"The innovative LED-based networking research that Smart Lighting ERC is conducting has the potential to be extremely positive and disruptive to the market," said Inder Monga, Leader, Advanced Networking Research at Nortel. "Nortel believes the era of hyperconnectivity is upon us and the potential new applications that this visible light-based networking could enable with its energy efficient qualities, privacy and its ubiquitous nature is very exciting."

The ability to rapidly turn LED lights on and off – so fast the change is imperceptible to the human eye – is key to the technology. Flickering light in patterns enables data transmission without any noticeable change in room lighting. And the technology is not limited to indoor lights; its first real test may very well come outdoors, in the automotive industry.

"This technology has many implications for automobile safety," Little said. "Brake lights already use LEDs, so it's not a stretch to outfit an automobile with a sensor that detects the brake lights of the car in front of it and either alerts an inattentive driver or actively slows the car."

Source: Boston University