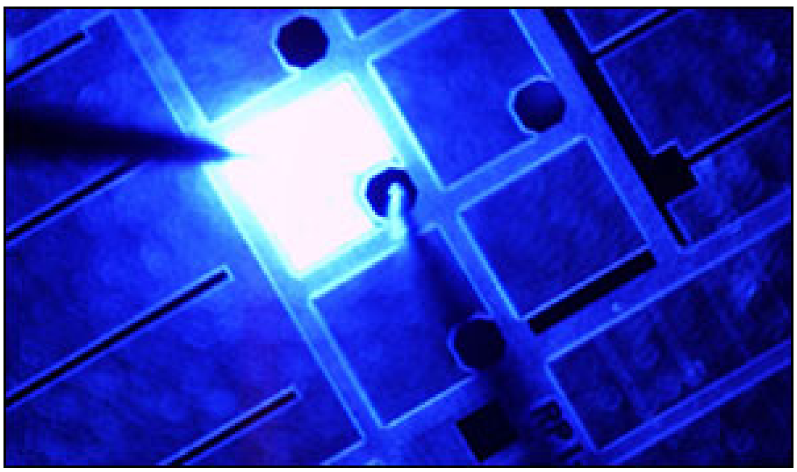
Center Aims for Smarter LEDs

TROY, N.Y., Oct. 8, 2008 -- A new research center that aims to replace existing lighting with smarter and greener LEDs and integrate them with optical wireless communications has been funded by a five-year, $18.5 million grant from the National Science Foundation (NSF).

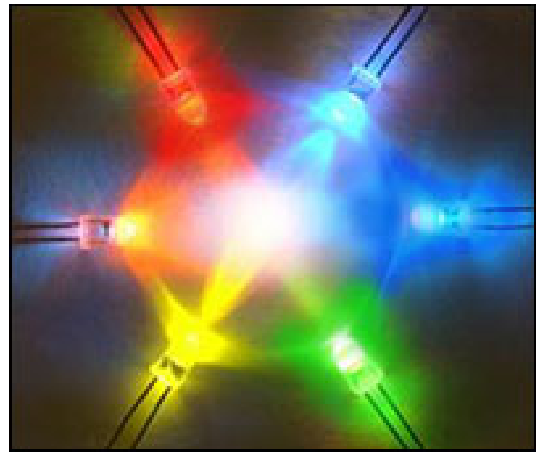
The Smart Lighting Engineering Research Center (ERC) will be based at Rensselaer Polytechnic Institute in Troy. With partners Boston University (BU) and the University of New Mexico (UNM), the center aims to create new solid-state lighting technologies to enable rapid biological imaging, novel modes of communication, efficient displays, and safer transportation. 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.



This blue LED is an example of the technology to be used at the National Science Foundation Smart Lighting Engineering Research Center at Rensselaer Polytechnic Institute. (Photo: E. Fred Schubert, RPI)

"This new center will energize the field of photonics, and it reinforces the vision that smart light sources will soon antiquate Thomas Edison's light bulb," said E. Fred Schubert, Wellfleet Senior Constellation Professor of Future Chips at Rensselaer, who leads the center. "The Smart Lighting ERC will also be a catalyst for developing and realizing new, yet unexpected applications for photonics."

At the heart of smart lighting are powerful techniques to control the basic properties of light. With recent breakthroughs in the first true antireflective coating, nanoemitter growth, in the unprecedented control of the refractive index of materials, and the demonstration of the first viable polarized LED-based light sources, researchers are now better able to control almost every aspect of light.



NSF Smart Lighting ERC researchers will investigate and use the distinctive properties of advanced materials to create lighting devices that are similar to LEDs, but possess fully controllable and tunable characteristics. (Photo: E. Fred Schubert, RPI)

“The capabilities of smart lighting surpasses and transcends the abilities of conventional lighting,” Schubert said. “With smart lighting, we have absolute control over every aspect of the light, from polarization to temporal modulation and spectral composition. We can custom tailor a light source for nearly any imaginable scientific or commercial application.”

Solid-state lighting, from sources such as LEDs, is more efficient and durable than incandescent and fluorescent lighting. ERC researchers will investigate and exploit the distinctive properties of advanced materials to create new lighting devices and systems with fully controllable and tunable characteristics, innovations that will make the lighting significantly more functional and easier to manufacture.

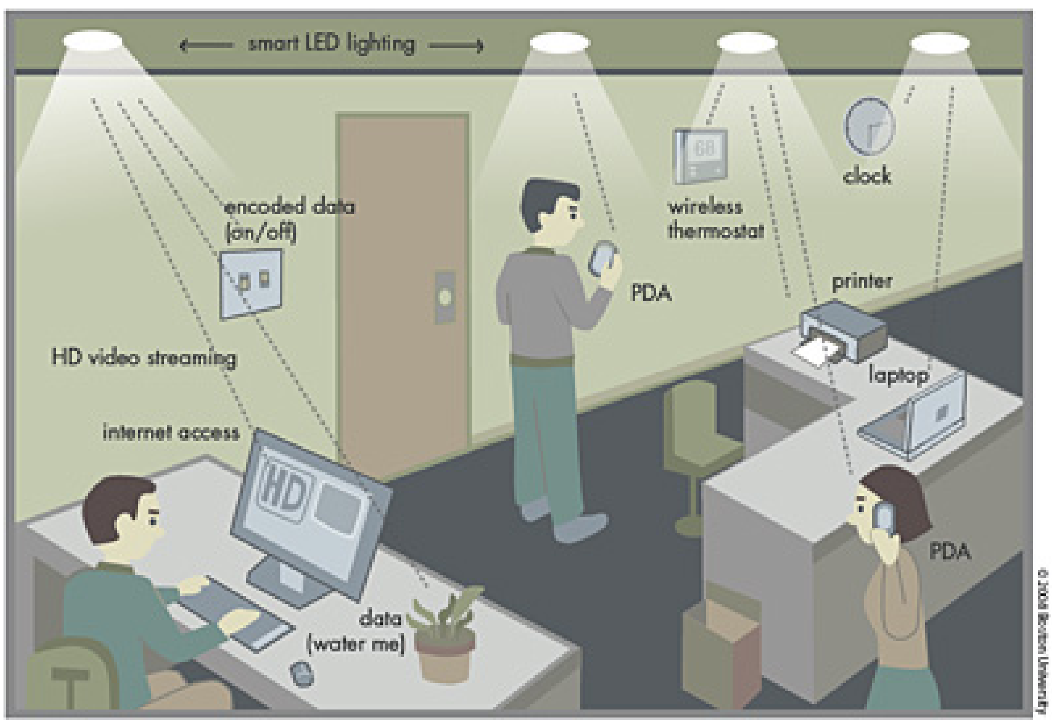
Thomas Little, BU lead and Smart Lighting Center associate director, with a consumer LED light bulb. (Photo: Copyright ©Boston University)

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. BU researchers will focus on developing computer networking applications, notably the solid-state optical technology that will form the network's backbone.

One of the center's goals is 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 LEDs to create smart lighting that would be faster and more secure than current network technology. The idea is to develop the optical communication technology that would make an LED light the equivalent of a Wi-Fi access point.

"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 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," he said. "As we switch from incandescent and compact fluorescent 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."



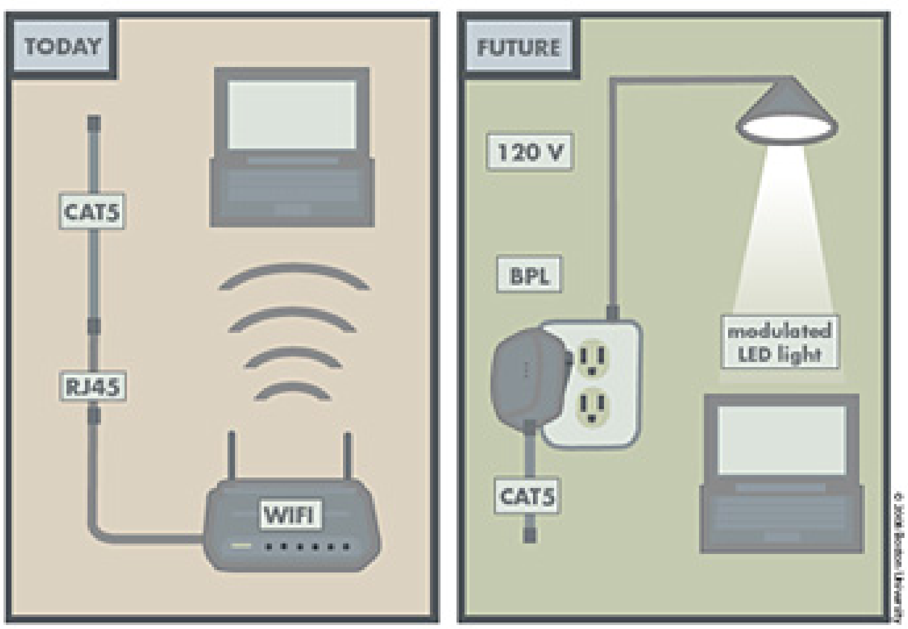
This illustration shows dual use of LED lighting for illumination and communication in a future office setting. Ubiquitous lighting enables ubiquitous computing. (Image: Copyright ©Boston University)

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 said. 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 radio frequency (RF) technology.

Another benefit is that, 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 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.



Deployment of wireless networking in current and future scenarios. Wi-Fi relies on network cabling and access points. Future systems leverage existing wiring -- networking or power lines –- to disseminate data to LED lighting as the new access point. (Image: Copyright ©Boston University)

"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."

By allowing humans to better support their natural circadian rhythm, smart lighting also holds the promise for reducing individuals' dependency on sleep-inducing drugs, and even reducing the risk of certain types of cancer.

Outreach partners for the Smart Lighting ERC are Howard University in Washington, Morgan

State University in Baltimore, and Rose-Hulman Institute of Technology in Terre Haute, Ind. Additionally, Chonbuk National University in Korea, National Chiao Tung University in Taiwan, Taiwan National University, and Vilnius University in Lithuania will support the ERC with expertise and international perspectives.

The project is expected to receive up to $50 million in funding over the next 10 years, the bulk of it coming from the NSF, with additional support from New York state, Rensselaer, and 18 industrial partners. NSF funding began in September with $3.25 million for the center's first year, a figure forecast to increase over the next several years. New York has committed $700,000 to the center's first year, and first-year funding from industrial partners is expected to approach nearly $1 million. Rensselaer is committing more than $500,000 to help launch the center.

For more information, visit: http://smartlighting.rpi.edu or http://smartlighting.bu.edu

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http://www.photonics.com/content/news/2008/October/8/93565.aspx