# Wireless Lighting Controls Make Retrofits Practical

PIER Buildings Program Research Powers the Future www.energy.ca.gov/research

## The Problem

Lighting accounts for about 35 percent of the electricity used in California's commercial buildings. Digital lighting controls that allow daylight harvesting, occupancy control, and personal control (allowing individuals to adjust lighting in their own areas) could reduce that percent dramatically. However, retrofitting these systems into existing facilities is not often done because it is expensive and disruptive.

## The Solution

An innovative wireless lighting-control, monitoring, and management system developed by Adura Technologies is easy to install, cost-effective, and can provide significant energy savings (**Figure 1**). It eliminates the costly and time-consuming installation of control wiring and can be easily installed by facilities personnel or contractors. The technology was originally developed at the Center for the Built Environment at the University of California at Berkeley (UCB) with funding from the California Energy Commission's Public Interest Energy Research (PIER) Program. With venture capital funding, it is now being developed by Adura. The system has been successfully installed in several pilot applications and will be fully commercialized by 2009.

## Features and Benefits

The heart of the system is Adura's wireless relay transceiver/microprocessor unit. These devices, called LightPoints, are installed inside a fluorescent light fixture and can control the ballasts individually or in zones. The system's capabilities are similar to those provided by existing Digital Addressable Lighting Interface products, but without the need for wiring. The LightPoints are linked together wirelessly and communicate in a configuration known as a mesh network.

In a mesh network, data are routed among the different LightPoints so that there are multiple, redundant paths through the network, allowing communication between two LightPoints that might have no direct link to each other because of some transient problem. It also makes it possible for large distances to be covered, despite limited transmitting power, because the LightPoints can hand off data to one another.

The system is tied together by web-based software that configures and sends commands to the proper devices. The system currently includes wireless, battery-powered wall switches and can also be controlled via software. Future plans call for wireless occupancy and photo sensors, and switches that don't require batteries but instead make use of the mechanical energy of pushing the switch.

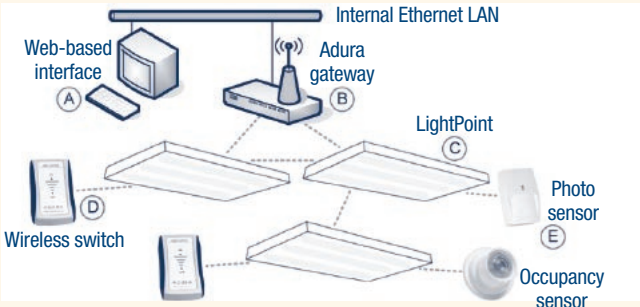
The benefits of this wireless approach include energy savings through economical application of multiple lighting-control strategies, ease of installation, and the ability to reconfigure the system as the needs of the space change.

**Saves energy.** Energy savings come from the ability to provide scheduling, occupancy, daylight, and personal control. In 2005, a prototype installation of personal controls involving 33 light fixtures at a UCB building showed a 65 percent reduction in lighting energy. It was found that energy efficiency and occupant satisfaction could be increased by simply allowing the occupants to control the overhead lighting in their personal space according to their individual needs. Research has shown that personal control is best used when lighting fixtures are dedicated to the individuals who will control them, to avoid conflict with neighbors who may have different visual preferences.

Currently, the Adura system is being used at two UCB libraries (**Figure 2**). The two projects, installed for $28,000, are expected to cut annual electricity use by a combined 170 megawatt-hours (MWh) and will pay for themselves in less than a year. In the Moffitt Library, the system allows the lighting to be scheduled according to the nuances of an academic schedule—allowing different hours for exam periods, holidays, and recess—through a web interface. In the Doe Library, the system turns off the fluorescent lights during the day when daylight is provided by a series of skylights. Previously, the lights were on 24/7 in both facilities.

Figure 1: Elements of a wireless lighting-control system

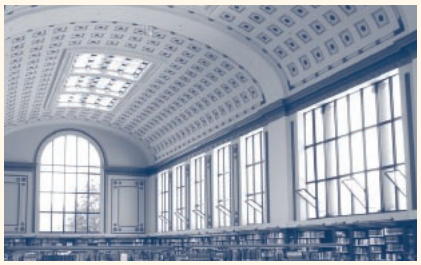
The lighting-control system being developed by Adura Technologies features a set of controllers and switches that communicate with one another wirelessly over a network with multiple redundant paths. Ongoing research will add photosensors and occupancy sensors to the mix.




Note: LAN = local area network.

Figure 2: LightPoint saves energy at Doe Library

A LightPoint wireless network installed at two libraries at the University of California, Berkeley is expected to cut annual energy use by 170 megawatt-hours.



**Easy to install.** Because no new communication wiring is required, it is simple to install—the installer unclips the ballast channel cover, unscrews the wire nuts between the ballast and mains power, and connects the LightPoint to the ballast and mains power with the wire nuts. An installation at UCB's Marchant Building took just six minutes per light fixture by facilities maintenance staff who had no previous experience installing the devices. Also, because the system does not require any new wiring, installation is relatively quick and minimally disruptive.

**Flexible.** Building owners can reconfigure their lighting network as building occupancy and use change, without costly rewiring. In UCB's Moffitt Library, the retrofit allowed facility managers to control their lights with a customizable scheduling application that is accessible via a web portal while also allowing local overrides for the cleaning crew. The system also allows the control of any number of luminaires in a curcuit run, from a single fixture to the entire circuit.

**Scalable.** The system can be used in installations as small as a single office to as large as an entire college campus. Also, once a wireless network is established, additional sensors and controllers can be easily added at the cost of an additional wireless device, with minimal labor.

**Compatible.** The LightPoint in the Adura Technologies system has one or two 4.9-amp relays that can switch a variety of lighting loads, including any fluorescent ballast. The software is designed to be compatible with all open communication protocols for building automation.

## Applications

The system can be applied to any fluorescent lighting application in new construction or retrofit. The wireless feature enables an economical upgrade of any commercial building to provide a full-featured, digital lighting-control system. Energy savings can be dramatic by adding lighting control to existing bilevel switched rooms and open spaces. The quickest returns are expected in commercial offices, educational campuses, big box retail facilities, assembly spaces, and food stores.

## California Codes and Standards

The Adura Technologies lighting-control system has a two-relay LightPoint designed specifically for Title 24 (bilevel) switching applications. With two relays, the LightPoint can independently control two ballasts so a single LightPoint can provide three light levels in a fixture with bilevel switching.

## What's Next

As part of the PIER Lighting California's Future program, Adura Technologies is working to enhance the technology to provide integrated motion and photosensor capabilities. Several field tests are underway and more are planned through the end of 2008.

## Collaborators

The organizations involved in this project include Adura Technologies and the Center for the Built Environment.

## For More Information

For more information on this project, please contact the California Energy Commission researcher listed below.

More PIER Technical Briefs can be found at www.energy.ca.gov/research/techbriefs.html.

For more information on this product and other lighting research activities, please visit the Lighting Portal at http://thelightingportal.ucdavis.edu/index.php.

## Contacts

California Energy Commission, Michael Seaman, mseaman@energy.state.ca.us, or visit www.energy.ca.gov/research

Adura Technologies, Zach Gentry, zach@aduratech.com and Jim Sekinger, jim@aduratech.com

## About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) Program. PIER supports public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

**Arnold Schwarzenegger, *Governor***

**California Energy Commission**

**For more information see** www.energy.ca.gov/research

*Chairman:* Jackalyne Pfannenstiel *Vice Chair:* James D. Boyd
*Commissioners:* Arthur H. Rosenfeld, Jeffrey Byron, Karen Douglas

PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"

CEC-500-062-FS
September 2008