

IP-Enabled LED Lighting Supporting Indoor Mobile and Wireless Communications

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Abstract—As the cost and quality of light-emitting diode (LED) lighting improve, and as people strive for greater energy efficiency, adoption of LED lighting systems will continue to grow. Unlike the conventional incandescent and fluorescent lighting commonly used today, LED lighting offers more control: not only can the brightness, color, and color temperature be specified, LEDs can also modulate the light output to transmit data wirelessly to devices within the field of illumination. This demonstration shows an optical transceiver designed to provide illumination-quality lighting with an Internet Protocol (IP)-enabled control module.

Many types of optical transceivers exist; some are designed to send light through waveguides, such as fiber-optics, and others, like the transceiver demonstrated, are free-space optical (FSO) transceivers that are able to transmit and receive data without the aid of a waveguide. Unlike most FSO transceiver though, the demonstrated transceiver generates and modulates “white” light in the visible spectrum. This feature allows the transceiver to be used in lieu of regular lighting devices, allowing this versatile and controllable lighting to replace conventional lighting.

To manage each of these controllable lights and to integrate the optical transceivers into a larger network, such as the Internet, a control module was created using a Gumstix embedded MCU. Through this embedded computer, the control module offers an Ethernet interface that allows the control module to easily connect to most networks. Together, they form the IP-enabled illuminator and optical transceiver.

When connected, the control module bridges the optical and wired networks. Through these networks, each module can receive commands and information about the environment; with this information, the control module can dynamically

optimize the lighting with on/off and dimming control that can be combined with occupancy sensors or other facilities management control systems. The control modules may also exchange information with one another to coordinate handoffs for devices under mobility from one transceiver’s coverage area to another’s.

Combined, the FSO networking and the adaptive lighting form a basis for a smart room: one which can tailor itself to improve its efficiency and comfort. For example, if the room’s occupants decide to watch a movie the television might automatically dim the room’s lights to improve the contrast.

Furthermore, the improved connectivity provided by the optical network will enable more advanced cooperation between devices by facilitating communications between those devices. Eventually, in addition to dimming the lights, a television might also silence sources of noise and switch other entertainment devices to a lower-power mode when showing a movie.

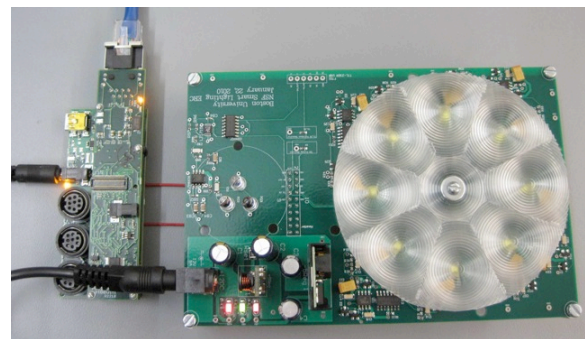


Figure 1: The demonstration includes a control module (left) connected to an optical transceiver (right).

Demonstration Requirements: Power strip with at least 8 outlets.