Developing power-over-fiber communications cable: When total isolation is a good thing

January 18 2012

Titus Appel, left, and Steve Sanderson of Sandia National Laboratories' mobility analysis and technical assessment division display a first-generation power-over-fiber cable that converts a signal from electrical-to-optical-to-electrical, thus emulating an electrical cable in total isolation.

(PhysOrg.com) -- Sometimes total electrical isolation is a good thing — and that's the idea behind a power-over-fiber (PoF) communications cable being developed by engineers at Sandia National Laboratories.

It's common to isolate communications between systems or devices by using fiber optic cables, said Steve Sanderson of Sandia's mobility analysis and technical assessment division. But when power also is required, sending it down a copper wire can at times be a safety issue, and substituting it with battery power may not be suitable or practical, he

said.

Sanderson, Titus Appel and Walter Wrye, a former Sandia intern, are co-inventors of a hybrid cable design that uses fiber to send and regulate optical power to the communications electronics integral to the cable. A patent is pending on the design.

The developers envision their cable replacing existing copper cables in applications related to safety, such as security, explosives, explosion-proof devices, aviation and medical devices.

“The PoF cable has power limitations,” Sanderson said. “It’s not to be construed as a means to power your house, for example, or handle the high speeds of a computer network.

“But because there are growing needs of low-power sensor/control applications related to safety, having convenient optically generated power available is a tremendous benefit.”

The PoF cable ends resemble a typical copper electrical cable with pin and socket connectors. However, optical interface circuits integrated into the connector housing, called a backshell, provide fiber optic transmission of both data communications and optical power.

To conserve energy, optical power is delivered only on demand, Sanderson said.

“The key issue here is to maintain total electrical isolation from any stray electrical energy and high-voltage electrical surges caused by such things as lightning strikes,” he said.

The first-generation PoF cable just delivers optical power to the cable’s internal electronics for data communication between devices. The

researchers now are adding the capability to deliver electrical power externally to a connected low-power device, Sanderson said.

In the cable's current version, the backshell encapsulates circular stacked circuit boards with LEDs coupled to plastic optical fibers for communications, and a laser diode and miniaturized photovoltaic-type cell coupled to the ends of a single glass fiber to deliver optical power.

In the next version, the team plans to use only glass fibers. "Although plastic fiber requires less preparation time than glass, it takes up more room," Sanderson said.

The team recently tested a PoF low-energy detonator firing cable with fireset electronics built into the backshell. The optically powered fireset embeds a microcontroller that reports such things as detonator resistance, temperature and charging voltages, and receives command messages to fire the detonator. When it's idle or powered down, the circuitry is designed to short the detonator input leads to prevent unwanted electrical energy from reaching it.

The researchers are working with next-generation microcontrollers, new packaging layouts and new optical devices to reduce the size. Team members also are developing a rugged, production-ready PoF cable and are working to reduce the backshell's length, decrease the weight and lower costs.

"One of our ongoing objectives is to reduce the physical size so that it's more widely used," said Sanderson.

Provided by Sandia National Laboratories

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