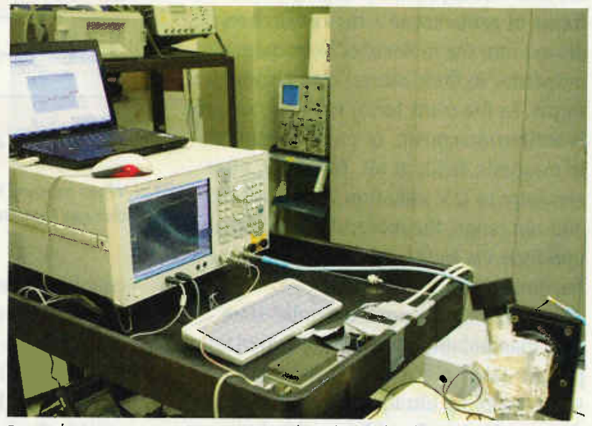
Optical WLAN is fast, secure and green

UNIVERSITY PARK, Pa. – Researchers at Pennsylvania State University have demonstrated optical wireless transmission using a diffused light setup with speeds exceeding 1 Gb/s, opening the door for bandwidth-hungry applications such as high-resolution video to go wireless. And the optical implementation comes with the benefit of being intrinsically safe.


Pennsylvania State University researchers have developed a diffused light setup for optical wireless transmission with speeds exceeding 1 Gb/s.

Indoor optical wireless communication was proposed as early as 1979, when scientists at IBM Research in Zürich, Switzerland, developed the first prototype. At the time, there was no Internet and little need for widespread use of such technology. The researchers used a diffuse implementation, which requires high-power transmitters and/or highly sensitive receivers.

However, these tend to be expensive, and multiple light paths using room reflections can cause echoes, degrading the performance. The alternative would be a transmitter and a receiver pointing directly at each other, but such a "line of sight" configuration is not practical because it is prone to "shadowing" and does not tolerate any movement of the user in the room without readjusting the link.

The Penn State researchers, Mohsen Kavehrad and Jarir M. Fadlullah, found a promising compromise, however, which they presented in a paper at SPIE Photonics West 2010 in San Francisco in January. They use a multi-input multi-output architecture, in which a multielement transmitter sends several copies of the signal to the room ceiling, where it is reflected, and a multibranch receiver collects the returned signals. A holographic beam former disperses light in various directions, generating the transmitted light grid, and a receiver, fitted with a similar "fly eye" holographic optic, collects all replies.

"Sending and receiving several copies of the signal offers better performance, minimizes echoes and lets the user move around freely," Kavehrad said.

The researchers demonstrated data rates well beyond 1 Gb/s – "a bandwidth very difficult to achieve at safe radiation levels with radio waves, even millimeter waves," Kavehrad noted. But he sees many further benefits, one being increased security. "Applying security at the physical layer is the safest" because light cannot leave rooms as easily as radio waves. Also, light does not interfere, and the same frequencies can be used in adjacent rooms.

The researchers compared wireless technologies with respect to their energy-per-bit-per-meter range performance and found that optical free-space solutions, despite still being in their infancy, are much "greener" than today's radio technologies, including IEEE 802.11g, 3G or Bluetooth.

Beyond that, there is another forward-looking angle being worked on by Kavehrad's team and other groups, including Boston University's Smart Lighting Engineering Research Center. The investigators propose replacing existing lighting with low-power, high-efficiency white LEDs – using the light sources as wireless transmitters rather than having the signal sent up and reflected by the ceiling. Where infrastructure exists, such as light fixtures, power lines or network cabling, these could be reused; otherwise, the technology could be combined with power-line broadband, delivering not only electricity but also broadband all the way to the end user.

Asked what is needed for this technology to advance, Kavehrad said: "Wake up the industry."

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