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WHAT'S NEXT

## Beaming Data Holds Promise, With Limits, for Networking

By DAVID F. GALLAGHER

**R**ESEARCHERS of infrared networking would like to bounce data off your nose. Or your desk. Or the coffee machine.

Their goal is to use beams of infrared light, reflecting from all surfaces in a room, to create high-speed information networks. While local networks using radio waves, like Apple's AirPort system, have been getting the attention, scientists working on infrared say that in the long run, light might be a better and faster alternative.

"Radio cannot compete with this performance," said Dr. Mohsen Kavehrad, a professor of electrical engineering at Pennsylvania State University.

Dr. Kavehrad and a colleague, Dr. Svetla Jivkova, have been researching a system that sends pencil-thin infrared beams bouncing around a room, connecting computers to one another and to a central transmitter and receiver that is wired to a larger network. The researchers said the technology could transmit two gigabits a second, or about a thousand times as much data as a cable modem, with few transmission errors.

Anyone who has used a remote control to change the channel has seen infrared in action. The technology is also used in laptop computers and Palm-type devices for wireless communication over short distances. But these links work best when the transmitter is pointed at the receiver, something that would not be practical when linking an entire office or offering network access in a public place like an airport or a restaurant.

One way around the problem is to bounce wide infrared beams off the ceiling, scattering the reflections around the room. This allows receivers to be pointed in any direction. While some networking products already use this approach, Dr. Kavehrad said the scattered beams created something similar to an echo, causing data loss and limiting the network's speed.

The Penn State researchers think they have solved the echo problem by using a holographic filter to produce thin beams that create a large grid as they reflect around the room. The university is seeking a patent on the technology.

"It's a really cheap and easy way of producing these multiple beams," he said. "Having the pencil beams allows you to send the signals very fast, and not relying on just one of them allows you to move around, and you can do this whole thing at low power levels."

Researchers at the University of Kassel and at the University of Siegen, both in Germany, have approached the problem differently, focusing on improving the receiver's ability to separate signals from echoes and interference. The researchers say the resulting network would be fast enough to allow everyone in a meeting to receive and transmit video streams on their laptops simultaneously for videoconferencing.

Providing enough bandwidth for activities like videoconferencing is one area where infrared has an advantage; the radio spectrum is tightly regulated so only certain frequencies can be used for data transmission. Manufacturers can push into higher frequencies in search of free space, but at the same time, the components needed become more expensive.

Infrared has no such problems, because its frequencies, which are just below visible light on the electromagnetic spectrum, are unregulated. And because infrared transmissions do not penetrate walls, there is no chance of interference or overlap in neighboring rooms. That also can be a security advantage; radio-frequency networks open the possibility of eavesdropping, perhaps by someone sitting in the parking lot with a laptop and an antenna.

But infrared's inability to pass through walls and other objects may also be its downfall. The technology requires at least one receiver and transmitter in each room to be connected to a wired network. This makes it an unlikely choice for, say, someone wanting to stay online wirelessly while moving a laptop among different rooms. And forget about going online from the backyard via infrared ?the beams need surfaces, particularly ceilings, to bounce from.

Joseph M. Kahn, a professor of electrical engineering and computer sciences at the University of California at Berkeley, said the first users of new networking equipment have been companies and schools, and "they don't want to put an access point in each room."

Dr. Kahn, who did research on infrared networking for much of the last decade, said he had based some of his work on research by Dr. Kavehrad. In a report, he and his colleagues demonstrated about a year ago that an infrared network could handle a separate video stream for every passenger on a jetliner. But he said he had moved on to other things.

"It has some technical advantages," he said, "but it just hasn't taken off commercially, and I see no signs that that's going to change, unfortunately."

In addition, he said, companies are investing more money in radio research, limiting advancements in infrared.

Meanwhile, radio-based networking is entering the mainstream. Much of the focus is on a standard known as 802.11b or Wi-Fi, the technology used in Apple's AirPort and other low-cost networking products. Starbucks ([news/quote](#)) is putting Wi-Fi into its stores, allowing customers to surf while sipping.

One thing that might give a lift to infrared would be research demonstrating that the radio energy used in mobile phones and other devices is actually hazardous to human health, Dr. Kahn said.

Studies so far have been inconclusive, and there is only a slim chance that something more definitive will appear, he said. At the low level of energy needed for networking, researchers say, infrared beams cannot hurt the eyes or anything else.

Dr. Kavehrad said that he was concerned about the long-term effects of bathing people in radio waves and that infrared light offered a safer alternative.

"We've lived under God-given sunlight for zillions of years," he said.

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