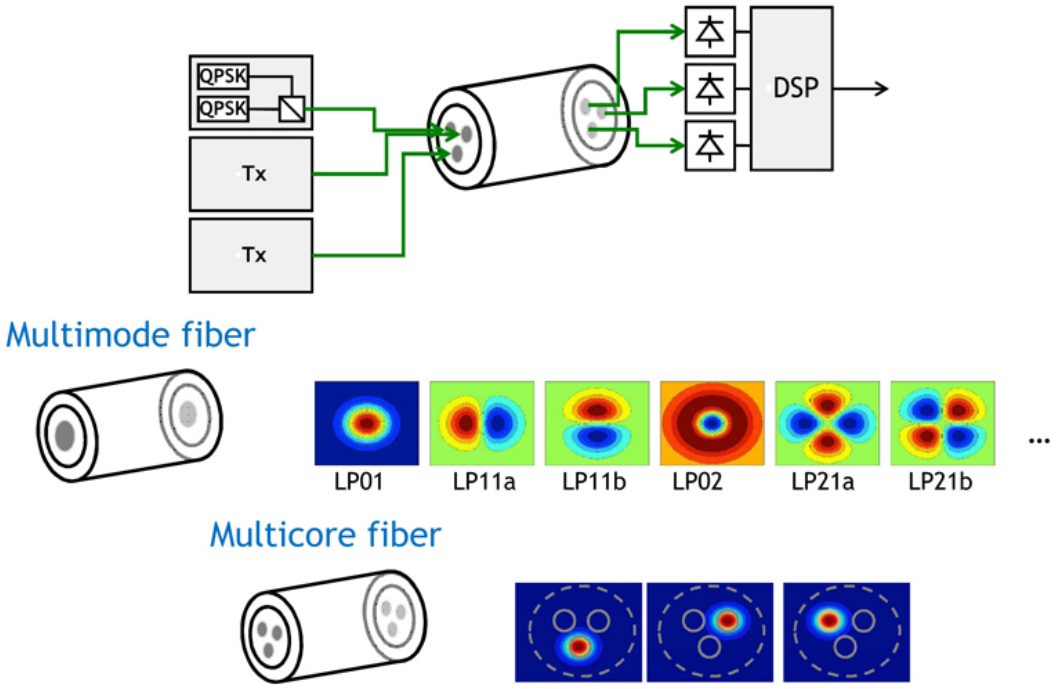

Space-division multiplexing, shown above, can be achieved with either multimode fibers or multicore fibers.

Agrawal, former postdoc team up to study ways to boost capacity of fiber optics

Fiber optics revolutionized telecommunications and made the spread of the Internet possible, thanks in part to the advent of wavelength-division-multiplexing and other capacity-increasing techniques.

Now, however, the widespread use of online learning, video streaming and other data-intensive activities are straining the capacity of fiber-based communications systems.

Govind Agrawal, the James C. Wyant Professor of Optics, is teaming up with Bell Lab researcher Rene Essiambre, one of Agrawal's former postdoctoral students, to study space-division multiplexing (SDM) as a possible solution, thanks to a $380,000 National Science Foundation GOALI (Grant Opportunities for Academic Liaison with Industry) award that encourages university-industry partnerships.

Optical fibers are made of transparent glass or plastic -- about the size of a human hair – and typically consist of a small transparent core of 10 micrometers, surrounded by cladding. For most long distance communication, pulses of light are transmitted through this core as a single stream of data, using a single mode of propagation.

The effort to increase carrying capacity with space-division multiplexing basically involves one of two options: 1. enlarging the single core in a fiber to handle multiple modes, or data streams, at once (multimode fiber), or 2. placing several separate cores in a fiber (multicore fiber), with each core using a different mode to transmit data.

Both approaches have potential drawbacks, Agrawal noted. Multicore fibers are more expensive to make and have non-standard cladding sizes. Multimode fibers are subject to more "crosstalk" -- the interference or other undesired affects that occur when light from one data stream enters another -- because the different modes share the same space.

Agrawal and Essiambre will focus primarily on the nonlinear aspects of this interference, which remains at manageable levels in most of the single mode fibers now in use. That will not be the case with the higher power levels and multiple interacting data streams that occur with multicore and multimode fibers.

"We'll be looking at which one (multicore or multimode) is better from a system design point of view, and how much can we improve the system," Agrawal said.

The grant will fund two PhD students in Agrawal's lab. They will travel to Bell Labs for at least one month during each of the three years of the project, Agrawal said. "This is a great opportunity for them, and will give them a chance to acquire valuable industrial experience."

The groundwork for this project was laid when Essiambre approached Agrawal three or four years ago about doing joint research on SDM-related topics. Bell Labs provided three years of funding for that collaboration. "That gave us the chance to write one or two papers, and make some progress," Agrawal noted. "Based on that, we proposed further work to NSF, and that's how this grant resulted."