Making the switch to polarization diversity

January 31 2017

Vast amounts of data transmit across the Internet and telecommunications networks delivering, for example, real-time video calls from one cell phone to another - across the world. As people send and receive increasing amounts of data like ultra-high definition (4K, 8K) images over these largely optical fiber-based networks, and the demand for such increases, so too does the need for new technologies to transmit that data at enhanced speeds, with increased energy efficiency, and at lower cost. A promising way to do that is by using optical switches that relay signals carried by optical fibers from one circuit to another. One new technology in particular now offers significant improvement to the optical switches used by fiber optic networks.

In work they will present at the Optical Fiber Communication Conference and Exhibition (OFC), held 19-23 March in Los Angeles, California, USA, researchers with Japan's National Institute of Advanced Industrial Science and Technology (AIST) describe the development of a new kind of an integrated optical switch, made using silicon photonics technologies in highly efficient ways.

One requirement of such optical switches is that they be able to handle light signals with both vertical and horizontal polarizations. This is because optical signals carry data with both polarizations, a technique known as polarization-division multiplexing. To achieve this dual transmission, a separate switch circuit must be used for each polarization. In doing so, this doubles the size of the chip and increases the cost of the system.

The new device, referred to technically as a "fully integrated non-duplicate polarization-diversity silicon-photonic switch," consists of a single 8 x 8 grid of 2 x 2 element switches. The researchers found that a single 8 x 8 grid with novel unique port assignments could take the place of two synchronized grids, and thus be used to simultaneously manage both polarizations of light, a method known as polarization diversity.

"In this way, the switch chip achieves polarization "insensitivity" without doubling the size and cost of the chip, which is important for broadening the practical application of such photonics integrated devices, said lead author Ken Tanizawa of AIST. "We strongly believe that a silicon-photonic switch is a key device for achieving sustainable growth of traffic bandwidth in optical networks, including both telecommunications and data communications, and eventually computer communications."

The new device also features polarization splitter-rotators integrated onto the chip. The splitter-rotators take input light signals with both horizontal and vertical polarizations, divide them into separate polarizations, and rotate one 90 degrees to match the orientation of the other. Both polarizations are synchronously switched on the single 8 x 8 grid with the unique port assignments. The switched polarizations are then recombined by the polarization splitter-rotator so that they return to their original state.

The researchers designed the device so that the distance traveled by any signal passing through the 8 x 8 grid is identical, regardless of its path. This means that the attenuation and delay of the signal are also the same, allowing for a consistently high-quality signal.

The new switch is a proof-of-concept design. The researchers are now working to further improve the device and to create a design with a larger number of ports (such as a 32 x 32 grid) that would allow for the transmission of a greater amount of data. These advances promise to not only enhance network flexibility, but also open up new possibilities for the use of optical switching in future energy-efficient optical networks.

Provided by Optical Society of America

Citation: Making the switch to polarization diversity (2017, January 31) retrieved 26 April 2024 from https://phys.org/news/2017-01-polarization-diversity.html