De-multiplexing to the max: 640 Gbits/second

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Sliced light is how we communicate now. Millions of phone calls and cable television shows per second are dispatched through fibers in the form of digital zeros and ones formed by chopping laser pulses into bits. This slicing and dicing is generally done with an electro-optic modulator, a device for allowing an electric signal to switch a laser beam on and off at high speeds (the equivalent of putting your hand in front of a flashlight). Reading that fast data stream with a compact and reliable receiver is another matter. A new error-free speed-reading record using a compact ultra-fast component—640 Gbits/second (Gbps, or billion bits per second)—has now been established by a collaboration of scientists from Denmark and Australia, who report their results in the journal *Optics Express*.

New technology and new ways of doing business require new approaches to old procedures. Conventional readers of optical data depend on photo-detectors, electronic devices that can operate up to approximately 40 Gbps. This in itself represents a great feat of rapid reading, but it's not good enough for the higher-rate data streams being designed now. The data receiving rate has to keep up.

Sometimes to speed up data transmission several signals are multiplexed: each, with its own stream of coded data, is sent down an optical fiber at the same time. In other words, 10 parallel streams of data could each be sent at a rate of 10 Gbps and then added up to an effective stream of 100 Gbps. At the receiving end the parallel signals have to be read out in a complementary de-multiplexing process. Reliable and fast multiplexing and de-multiplexing represent a major bottleneck in linking up the

electronic and photonic worlds.

In 1998 researchers in Japan created a data stream as high as 640 Gbps and were able to read it back, but the read-out apparatus relied on long lengths of special optical fiber. This particular approach is somewhat unstable. The new de-multiplexing device demonstrated at the Technical University of Denmark, by contrast, can handle the high data rate, and can do so in a stable manner. Furthermore, instead of fibers 50 meters long, they accomplish their de-multiplexing of the data stream with a waveguide only 5 cm long, an innovation developed at the Centre for Ultrahigh Bandwidth Devices for Optical Systems, or CUDOS, in Australia. Another benefit of the new device with the compact size is the potential for integration with other components to create more advanced ultra-fast functional chips. The dynamics involved in the CUDOS device could even allow for still higher data rates approaching terabits/second (Tbps, or trillion bits per second).

One of the authors of the new report, Danish scientist Leif K. Oxenløwe, says that the record speeds of de-multiplexing represented by his tiny glass microchip is a boon to circuit designers and opens the door to faster network speeds. In the near future, the Danish and Australian researchers hope to achieve 1 Tbps Ethernet capability.

Paper: "Breakthrough switching speed with an all-optical chalcogenide glass chip: 640 Gbit/s Demultiplexing," Leif Oxenløwe et al, *Optics Express*, Vol. 17, Issue 4, Feb. 16, 2009.

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