Laser pushes data speed to new limits

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High speed record Scientists have set a new data speed record using just a single laser to transmit the equivalent of 700 DVDs in one second.

They say their discovery will not only help to fulfil the world's burgeoning high-capacity bandwidth needs of cloud computing and 3D-high definition TV, but provide an environmentally-friendly way of transmitting data over long distances.

Earlier this year, Japanese scientists set a world record sending 109 terabits per second using multiple lasers.

But the data rate of 26 terabits per second reported by the group of German, Swiss and UK scientists in today's *Nature Photonics (http://dx.doi.org/10.1038/NPHOTON.2011.74)* is the largest line rate ever recorded using a single light source.

Using a single laser reducing the energy needed to achieve such a high speed, say researchers *(Source: iStockphoto)*

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"Encoding 26 terabits of information per second on a single laser would until recently not only have been considered impossible, but unnecessary," says study co-author, Dr Juerg Leuthold from the Karlsruhe Institute of Technology (http://www.kit.edu/english/) .

"The amount of 26 terabits per second is the amount of data that would be generated by 400 million people making a phone call. Phone calls are not generating data traffic any longer, it is animated high-resolution data traffic that dominates the internet."

The scientists used a single laser to generate 325 optical frequencies within a narrow spectral band of laser wavelengths and transmitted the data over 50 kilometres of single-mode fibre.

They did this using a technique known as orthogonal frequency-division multiplexing (OFDM) that relies on mathematical routines to generate and decode data. While the technique has been used for years in wireless technology, it's only recently been used in optical communications.

While bit-rates are low in mobile communications and the mathematical procedures can be easily calculated with computers, Leuthold says transferring data at high-bit rates in the optical world requires fast processors.

"We had to come up with a technique that can process data about ... one million times faster than what is common in the mobile communications world," says Leuthold.

"Such speeds are well beyond the limits of electronics."

He says encoding the mathematical procedure using optics instead of electronics allowed the group to perform their experiments with no speed constraints using almost negligible energy.

"The experiment shows that we have not yet hit any physical limitations in channel transmission capacity and that an increase in bit-rate does not necessarily mean higher energy consumption," he says.

Breakthrough research

Professor Ben Eggleton, director of the Centre for Ultrahigh bandwidth Devices for Optical Systems (http://sydney.edu.au/science/physics/cudos/) at Sydney University says the research establishes the feasibility of delivering high-bandwidth technologies using a simple technique.

"The real breakthrough here isn't just the capacity, because groups earlier this year have reported beyond

this, it's the fact that it's one laser," says Eggleton.

The use of just one laser could make optic technologies cheaper and easier to deploy, he says.

"It's a simple optical technique that's enabled the generation of this enormous amount of data in this conventional optical fibre."

Eggleton says the research addresses two fundamental problems: how to provide capacity for the global telecommunications backbone, and how to do that energy efficiently.

"Increase in the capacity of the backbone is basically doubling every 18 months, because we're using the internet more frequently and we're using more sophisticated tools," says Eggleton.

"In the context of the National Broadband Network (NBN) we're talking about 100 megabits per user. In five to ten years that will be a gigabit per user and there's no sense that that will be enough either."

To deliver those capacities the NBN backbone will need "tens of terabits per second to link the major cities and regional centres of Australia."

But not only do we have increased bandwidth demands, Eggleton says the internet consumes vast amounts of energy — eating up about 2 per cent of Australia's energy budget.

"[Energy consumption] is growing at the same rate that internet traffic is growing. It's doubling every 18 months, which means that in 10 years we've got a real crisis."

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