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Laser puts record data rate through fibre

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Researchers have set a new record for the rate of data transfer using a single laser: 26 terabits per second.

At those speeds, the contents of nearly 1,000 high-definition DVDs could be sent down an optical fibre in a second.

The trick is to use what is known as a "fast Fourier transform" to unpick more than 300 separate colours of light in a laser beam, each encoded with its own string of information.

The technique is described in the journal **Nature Photonics**.

The push for higher data rates in light-based telecommunications technologies has seen a number of significant leaps in recent years.

While the earliest optical fibre technologies encoded a string of data as "wiggles" within a single colour of light sent down a fibre, newer approaches have used a number of tricks to increase data rates.

Among them is what is known as "orthogonal frequency division multiplexing", which uses a number of lasers to encode different strings of data on different colours of light, all sent through the fibre together.

At the receiving end, another set of laser oscillators can be used to pick up these light signals, reversing the process.

Check the pulse

While the total data rate possible using such schemes is limited only by the number of lasers available, there are costs, says Wolfgang Freude, a co-author of the current paper from the Karlsruhe Institute of Technology in Germany.

"Already a 100 terabits per second experiment has been demonstrated," he told BBC News.

"The problem was they didn't have just one laser, they had something like 370 lasers, which is an incredibly expensive thing. If you can imagine 370 lasers, they fill racks and consume several kilowatts of power."

Professor Freude and his colleagues have instead worked out how to create comparable data rates using just one laser with exceedingly short pulses.

Within these pulses are a number of discrete colours of light in what is known as a "frequency comb".

When these pulses are sent into an optical fibre, the different colours can mix together and create 325 different colours in total, each of which can be encoded with its own data stream.

Last year, Professor Freude and his collaborators **first demonstrated** how to use a smaller number of these colours to transmit over 10 terabits per second.

At the receiving end, traditional methods to separate the different colours will not work. In the current experiment, the team sent their signals down 50km of optical fibre and then implemented what is known as an optical fast Fourier transform to unpick the data streams.

Colours everywhere

The Fourier transform is a well-known mathematical trick that can in essence extract the different colours from an input beam, based solely on the times that the different parts of the beam arrive, and at what intensity.

The team does this optically - rather than mathematically, which at these data rates would be impossible - by splitting the incoming beam into different paths that arrive at different times.

In this way, stringing together all the data in the different colours turns into the simpler problem of organising data that essentially arrive at different times.

Professor Freude said that the current design outperforms earlier approaches simply by moving all the time delays further apart, and that it is a technology that could be integrated onto a silicon chip - making it a better candidate for scaling up to commercial use.

He concedes that the idea is a complex one, but is convinced that it will come into its own as the demand for ever-higher data rates drives innovation.

"Think of all the tremendous progress in silicon photonics," he said. "Nobody could have imagined 10 years ago that nowadays it would be so common to integrate relatively complicated optical circuits on to a silicon chip."

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