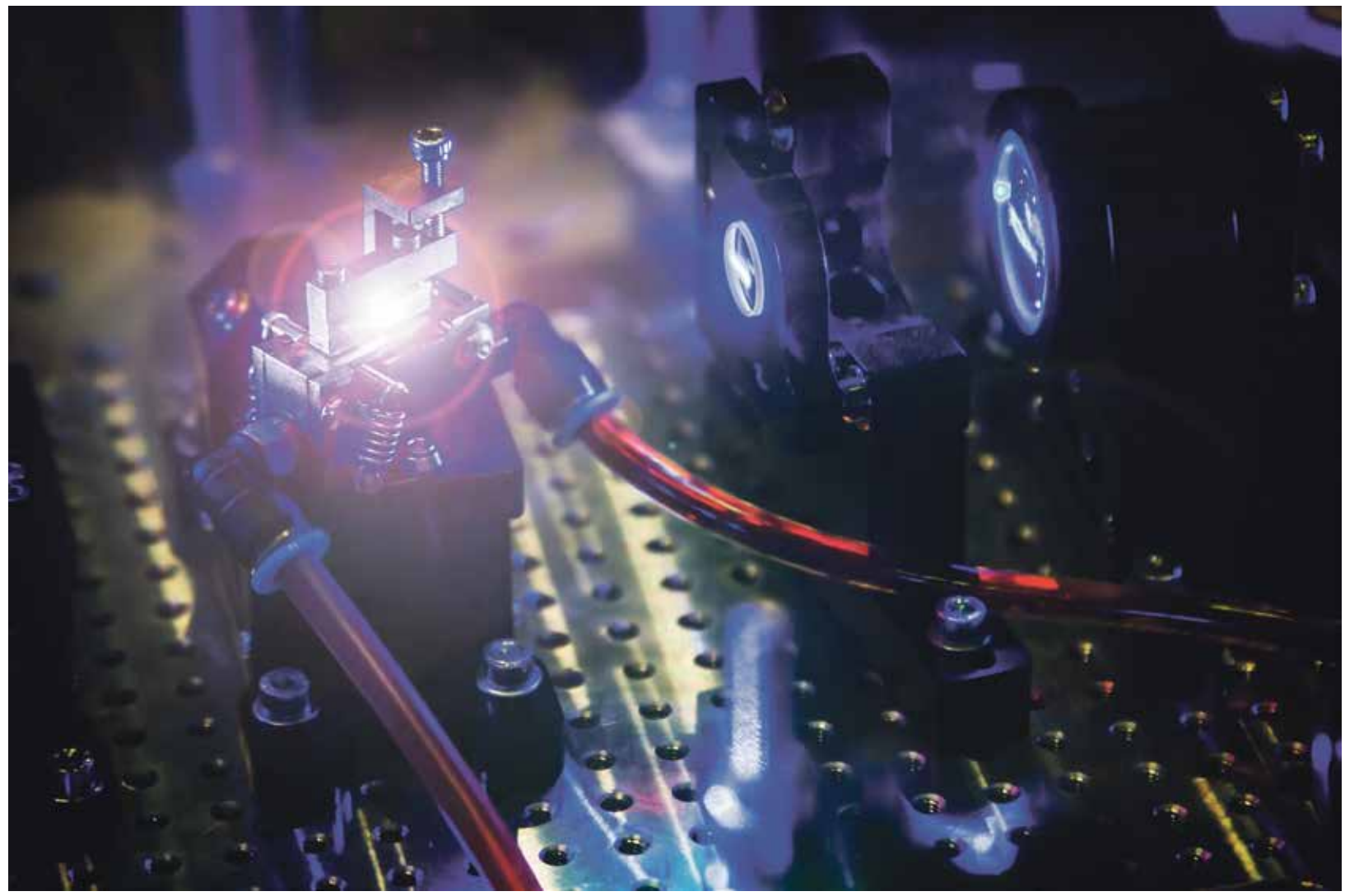
The next optical revolution is green

Keeping the internet's runaway energy consumption at sustainable levels is a key challenge. The Danish Communication cluster is ready for the challenge.

By Morten Andersen



Optical technology promises more efficient transmission of data, lowering both economic costs and energy consumption significantly. Photo credit: Colourbox.

On any given day, we transmit more data than was generated from the dawn of time up until the year 2000. This translates into a huge energy consumption. The internet alone accounts for 8-9 per cent of global power consumption and the level continues to grow. This will be all good if the supply is green electricity, but that is unfortunately not always the case.

"In other words, the current trend is not sustainable. But the solution is not a ban on playing Fortnite or on streaming movies. Research has demonstrated, how a manifold increase in transmission rates is possible by improved use of optical fibres. What we need to do is to develop these technologies further and implement them into industrial products," says Niels Hersoug, senior project head at DTU Fotonik. He heads the joint industry project INCOM (INnovative solutions for next generation COMmunications infrastructure). In the project, research groups at DTU and Aarhus University have teamed up with 12 industrial partners.

Internet of Things (IoT), 5th generation telecommunication networks (5G), Industry 4.0, and advanced cloud solutions are developments likely to challenge the power consumption and threaten sustainability further. This is not least the case in Denmark, where several global tech companies have chosen to place many large-scale data centers.

Fortunately, Denmark is well positioned to become part of the solution, Hersoug notes:

"Not least due to the portfolio of innovative companies sprung out from the NKT Group since the mid-1980'ies, Denmark is a home for an internationally leading photonics and communication cluster. This puts us in a unique position to tackle this important societal challenge."

Plenty of head space for higher efficiency

As is often the case, strong industrial interest in a field is fostered by academic strongholds. One of these resulted in a world record as a group at DTU Fotonik was able to transmit 661 Tbit through a single fibre only employing a single laser.

"This equal transmitting the entire global traffic on the internet through a single fibre. Obviously, this is not what we want to do in practice, but it shows the potential of optical technology. There is plenty of head space for more efficient transmission, lowering both economic costs and energy consumption significantly. And this is just an example from the optical domain. Technologies for harvesting more efficiency is also known in other domains," Niels Hersoug comments.

Of the total budget for the INCOM project of 100 million DKK, the partners will jointly provide 40 million, and Innovation Fund Denmark 60 million.

"All aspects of the project obviously have clear commercial potential, still we could not have built this type of cooperation without public funding. It is generally difficult for individual companies to get a return of investment for costs associated with reaching out to other companies and employing into maturing early stage technologies. Therefore, it makes good sense that creating the right framework is a public task. Especially, since the solutions will be of benefit to global environment and climate protection and resonates very well with the Danish Digital Agenda and the UN Global Goals. Also, the economic growth and workplaces to be created will add value to the Danish society," says Niels Hersoug.

Strong focus on entrepreneurship

The INCOM project officially began October 2018 and is scheduled to run for three years. According to a survey among the 12 industrial participants, they all are rather ambitious and expect a significant growth based on innovation springing from the project.

"The fact that participating industry hope to generate turnover is a good thing itself. We have already initiated several proof of concept projects. Still, at this early stage a lot of the industry input is rooted in general enthusiasm related to the technological interest and the good cause," says Niels Hersoug, adding that growth will not be limited to the 12 current partner companies:

"We have a clear ambition of establishing fresh start-up companies from the project. The potential is huge."

The entrepreneurship perspective is yet another reason for the strong engagement of the INCOM partners at High Tech Summit 2019:

"Over the past years, DTU has created a great environment for entrepreneurship. The focus is not only on technology, but also very much on the commercial side. Provided the young entrepreneurs do their homework properly, they will actually stand a good chance to achieve the necessary funding for a good idea," Niels Hersoug concludes.

WORLD RECORD IN OPTICAL TRANSMISSION

In 2012, a group led by professor Leif Oxenløwe, DTU Fotonik, was able to transmit 661 Tbit per second through a single fibre. Tbit means Terabit, 1012 bit, or 1.000.000.000.000 bit. As an illustration of the scale, 100 Mbit, which is 10^8 bit, so 100.000.000 bit, is generally sold to consumers as "fast" internet.

The record was set by application of a combination of different methods. The core technology is known as space-division multiplexing (SDM). Here, the signal power is distributed over several spatial channels, thus lowering the intensity per channel and allowing for increased data throughput. SDM fibres allow for orders of magnitude higher capacity through a single fibre, whilst keeping the fibre diameter on a scale that does not compromise the mechanical reliability. In each spatial separated channel, more traditional wavelength division multiplexing (WDM) was employed, however with the novelty that each "colour" of the light was not generated by one laser per wavelength but by a single laser in combination with a nonlinear element forming a so-called laser comb.

In 2016, the DTU-based Centre of Excellence SPOC (Centre for Silicon Photonics for Optical Communications) received the prestigious Horizon 2020 prize, awarded by the EU Commission, based on the center's work on optical transmission.

THE INCOM PROJECT

INnovative solutions for next generation COMmunications infrastructure (INCOM) is a joint industry project funded by 60 million DKK from Innovation Fund Denmark, and 40 million DKK from the partners, which are DTU Fotonik and Elektro, University of Aarhus, Accelink Denmark, Bifrost Communications, Chocolate Cloud, Comcores, Danish Optical Fiber Innovation, Develco Products, Mellanox Technologies Denmark, Napatech, NKT Photonics, OFS Fitel Denmark, Telia Denmark, and Zeuxion.