Digitalization found to be an important climate tool

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Carbon emissions from the internet are on a par with emissions from the aerospace industry, but at the same time digital technologies are crucial to winning the battle against climate change.

The internet is not just a climate sinner. According to Professor Leif Oxenløwe from DTU Fotonik, it is time we started focusing on optimizing the technologies behind the internet. In this way, digitalization can become a crucial tool in the battle against climate change.

Today, the internet is responsible for 10 percent of the world's electricity consumption, and consumption is increasing—both for entertainment and as a result of the general digitalization of society. To prevent the percentage from increasing to 20 percent by 2030, we need to turbocharge the development of our communication infrastructure and the way we send data, says Professor Leif Oxenløwe, DTU Fotonik.

"We need new technology that can send as much data as possible using the least possible amount of energy, because there are huge potentials in an efficient internet. For every kilogram of CO_2 ascribable to internet use, you save 1.5 kg of CO_2 elsewhere in society because of smart digital solutions. And by making our communication processes even more efficient, we expect to see a ten-factor increase," says Leif Oxenløwe.

Digital solutions require sufficient capacity

The World Economic Forum (WEF) estimates that digital technologies alone can reduce global carbon emissions by 15 percent, and the International Energy Agency (IEA) has identified significant energy savings from the digitalization of sectors such as transport, agriculture, construction, energy, and manufacturing. WEF and IEA both point out that digitalization is crucial to realizing the goal of a sustainable society based on smart cities, smart transport, smart buildings, smart lighting, and smarter communication.

However, the potential energy savings depend on the speed at which we are able to maximize the energy efficiency of the communication

infrastructure.

"To reap the expected energy savings, communication networks need ample capacity to support new smart initiatives and ensure the reliability and safety of time-critical data services such as driverless vehicles and vessels. If we can achieve this, we'll be able to create a greener society and support more of the UN's Sustainable Development Goals," says Leif Oxenløwe.

New core technology urgently needed

But time is of the essence because we are looking at major challenges. One of the challenges has to do with 'Moore's Law', according to which the number of transistors and electrical components in an integrated circuit doubles every 18 months. The law has held true for the past 50 years, during which electronic chips have developed into smaller, faster, and more energy-efficient microchips. However, Moore's Law is stagnating as we are reaching the physical limit to how small a classic microchip can be. And that is now slowing down the pace of chip technology advances. Today, microchips are produced using a technology whereby the smallest parts measure only few nanometres.

"We're going to need new core technologies within the next two to three years if we are to stand a chance of keeping up with the expected 30 percent annual growth in internet traffic. What we need is a technological paradigm shift, moving away from the current increase in energy-consuming equipment in order to achieve greater data capacity. Instead, we're going to need technologies that do not result in increased energy consumption when capacity increases," says Leif Oxenløwe, and continues:

"It's imperative that the communication infrastructure is improved significantly and urgently if we are to achieve the potential energy

savings and reductions in emissions. The communication infrastructure must be able to accommodate the increase in digitalization that is one of the keys to saving the climate."

At DTU's SPOC center, which is funded by the Danish National Research Foundation (DNRF), Leif Oxenløwe and other researchers have already thrown themselves into developing new technologies capable to transmitting more data using less energy. For example, they have demonstrated that a single optical chip can generate enough light to carry more than twice the total global internet traffic. Such a chip could, for example, replace many parallel lasers, each of which would require energy. The chip has been made at DTU, but quite a lot of development will be needed before it is ready for use and mass production.

Need for interdisciplinary collaboration

The EU is referring to the 2020s as a Digital Decade, which will be focused on creating green and sustainable solutions while digitalizing Europe as part of a so-called 'Green Deal', and according to Oxenløwe, collaboration will be crucial to achieving the goal.

"We need large-scale, coordinated, cross-border action to develop communication technologies based on a green mindset. The work must embrace all the different network layers (including hardware, network, and software). The components—like, for instance, an optical chip—must be implemented in a network that maximizes use of the physical structure, while requiring as little energy as possible to deliver the digital service," says Leif Oxenløwe.

He believes that Denmark should show the way and points out that an infrastructure must be developed consisting of more energy-efficient communication technologies operating according to an energy-efficient network protocol, and which offers even more capacity than today. In

addition, the infrastructure must be more secure than current networks and offer the best availability and encryption. The infrastructure must support time-critical functions such as driverless means of transport and secure digital solutions that ensure optimal use of renewable energy.

Finally, he points out that we need to create a tool that will enable us to distinguish between different internet services and to objectively identify the greenest and most energy-efficient ones—when it comes to hardware and software as well as installations and internet services.

"A sort of certificate or energy label may prove extremely useful in the very near future from the point of view of investments in new technology, and should therefore be developed as quickly as possible," says Leif Oxenløwe.

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