

ANNUAL HIGHLIGHTS

2023 has been a good and solid work-year for SPOC. All PhD students are well on their way on their second year, and good results are being hatched. Thus, SPOC has contributed with a number of *peer selected* papers for important conferences, while bigger full journal papers are being prepared. Solid steps have been taken in 2023 w.r.t. the main goal of SPOC, to develop energy-efficient communication technologies: SPOC's concept, "dual-fiber", is now fully verified experimentally, numerically and theoretically to offer savings of up to 40% of amplifier units in trans-oceanic fibre cables, and the results are written into a submitted article. There are new designs made for spatially efficient fibres with robustness to high light intensity, paving the way for more efficient data transmission. New frequency comb sources have been developed in the materials of AlGaAs (aluminium gallium arsenide) and SiC (silicon carbide), that are able to produce useful frequency combs, with the potential of saving hundreds of lasers. In order to transmit data with limited signal-to-noise ratio, SPOC's developed adaptable *probabilistic shaping* code has shown itself extremely useful. SPOC's codes for error correction and bit processing have also been developed to handle quantum encrypted signals, and even to increase the efficiency by use of high-dimensional quantum bits. It simply looks very promising.

The annual SPOC Workshop was held with several international partners from Sweden, Belgium, Germany, Italy, Japan and Australia. It remains a highlight of the year and produces the most inspiring and useful discussions and ideas. *The Australian Research Council* started a sister-centre to SPOC in 2023, COMBS, on the initiative of SPOC's long lasting partners David Moss and Bill Corcoran. David Moss has been selected an honorary doctorate at DTU (TBA at DTUs Annual Party 2024), for his many years of collaborating with SPOC a.o.. Centre leader Leif Oxenløwe is a *partner investigator* in COMBS.

Based on the spectacular SPOC results in 2022, 2023 has witnessed a large number of invitations to give presentations at important conferences and other relevant meetings and contribute to popular media through numerous interviews and explanations of our results and their significance. We have thus given invited talks in Japan, Australia, The US, The Netherlands, Germany, France China and South Korea a.o.. Additionally, in particular the centre leader has had a busy outreach program with podcasts (KDVS, Huxi Bach), video-explainers with Influencer/Science-communicator Martin Thorning, talks on the energy use of the internet on the KDVS climate seminar, at IDA Driving IT, IDA Industri4.0, Dig.Tech Summit, TDC Net University, DI Digital Webinar, and not least at the exclusive meeting, *Designing Storage Architectures*, at the *Library of Congress* in Washington-DC. The centre leader has talked on secure quantum encryption to the parliament's IT-department, to a NATO Panel Meeting, to a quantum investor meeting, at QIT Nordics a.o., and SPOC has made a live demonstration at the Culture Night in the Enigma museum, and is working on making it part of a permanent exhibition.

SPOC' paper on the internet's energy consumption from 2023 is now forming the basis for the development of a standard for energy evaluation with ICT companies and industrial associations (DI Digital and IT-B Branchen) targeting to initiate a shift from dollars-per-bit to kWh-per-bit.

SPOC, in collaboration with D NRF-CoE Hy-Q, was awarded the *IDA Connect Prisen 2023* for our work on a quantum encrypted deployed link, and our paper "*Deploying an Inter-European Quantum Network*" in *J.Adv.Q.Technol.* received the prize for *Most Downloaded Article* in 2023, while SPOC scientific coordinator Michael Galili was awarded the AEG Elektronprisen 2023. SPOC co-Pis received several grants, e.g. a Villum Investigator for Darko Zibar, a DFF project (MEMORY) for Toshio Morioka, and a Marie Skłodowska-Curie EU Doctoral Network project (MicrocombSys) for LKOX and Minhao Pu.