Danmarks Grundforskningsfond
Danish National Research Foundation

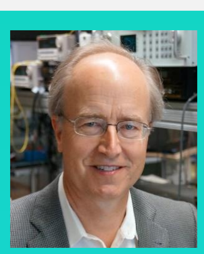
Centre for Silicon Photonics for Optical Communications

SPOC
CENTRE FOR SILICON PHOTONICS FOR OPTICAL COMMUNICATIONS

Centre leader	Location	Period	Grant
Professor Leif Katsuo Oxenløwe	Technical University of Denmark	2015-2021	59 mio DKK

International partners:


USYD
Prof. Eggleton


UCSB
Prof. Bowers


Uni. Ghent
Prof. Baets


Boston Uni.
Prof. Ramachandran


Uni.Bristol
Prof. Siyuan Yu


TU München
Prof. G.Kramer


Appl. Comm. Sci.
Dr. Colin McKinstrie

DTU

UNIVERSITY OF COPENHAGEN

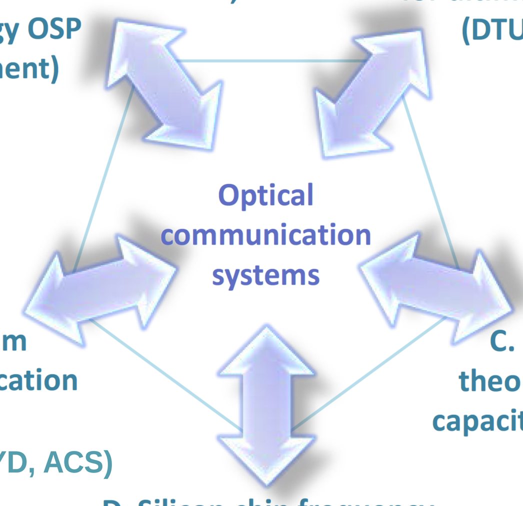
Research Flagship Themes:


Kresten Yvind,
Assoc. Professor, DTU Fotonik

A. Nonlinear silicon wires:
ultra-fast, ultra-broadband,
low-energy OSP
(DTU, Ughent)

B. Advanced multiplexing
for ultimate capacity
(DTU, BU, UBris)


Toshio Morioka,
Professor,
DTU Fotonik




Karsten Rottwit
Professor,
DTU Fotonik

E. Quantum
communication
sources
(DTU, USYD, ACS)

C. Information
theory & coding:
capacity limits and
beyond
(DTU, TUM)


Søren
Forchhammer,
Professor,
DTU Fotonik

D. Silicon chip frequency
comb and light sources
(DTU, KU, UCSB)


Jan W. Thomsen,
Assoc. Professor,
Niels Bohr Institute

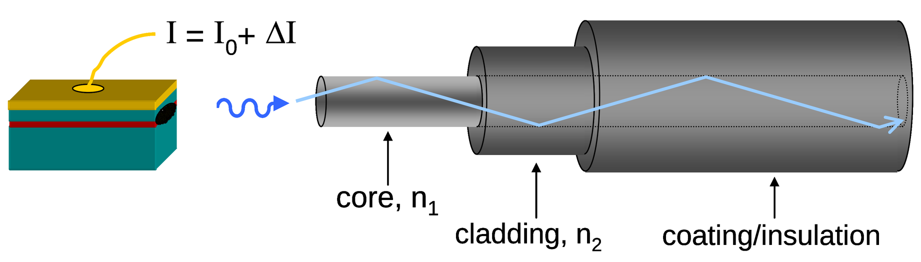
Motivation

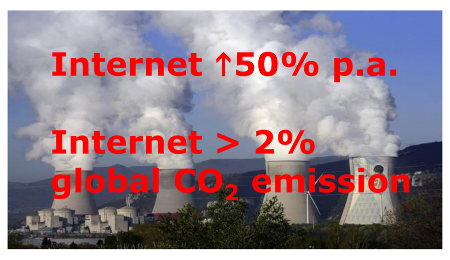
Information Age:
Societal transformation in work, communications, interactions

2.4 billion people online
(34% world population)

Each day: generate and transmit as much data as dawn of time to y2000

Based on optical breakthrough developments: Laser and optical fiber





15 Nobel Prizes to laser science, including optical fiber

Urgent: Must reduce energy consumption of communications

SPOC's aim: investigate silicon devices for advanced optical communications, yielding increased capacity and energy efficiency

SPOC will:

- Control light by light: Ultra-broadband, ultra-fast for energy-efficiency
- New information and coding theory: joint optimium spectral and energy efficiency
- Spatial super-channels: orders of magnitude higher data densities
- Frequency combs: multiple colours as data sources, for ultra-precise optical clocks and frequency references
- Single-photon sources for secure practical quantum communications

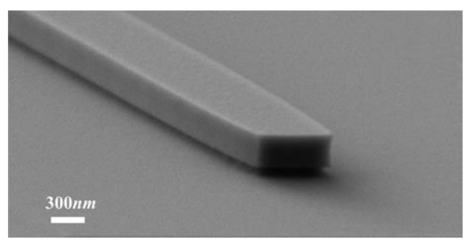
Goals

This research centre addresses the optical communication infrastructures of the future. In an interdisciplinary approach, relying on physics, nonlinear optics, photonic communication technologies, information theory and advanced coding, we aim to find solutions to the major challenges of communication systems—the energy consumption and potential capacity.

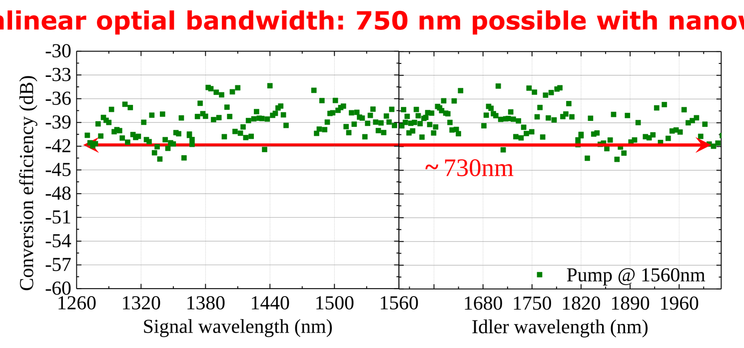
We will explore optical signal processing in photonic wires for orders of magnitude improvements in bandwidth and energy efficiency, and conduct fundamental research on optical silicon chips and integration technologies addressing ultimate-capacity optical communications. We will explore spatially distributed data transmission for orders of magnitude higher data densities. We will explore information and coding theory for optimum spectral-efficiency. We will explore frequency comb generation for light sources and for unprecedented ultra-precise optical clocks and frequency references, and we will explore future quantum communication channels with impenetrable security."

SPOC's key technologies

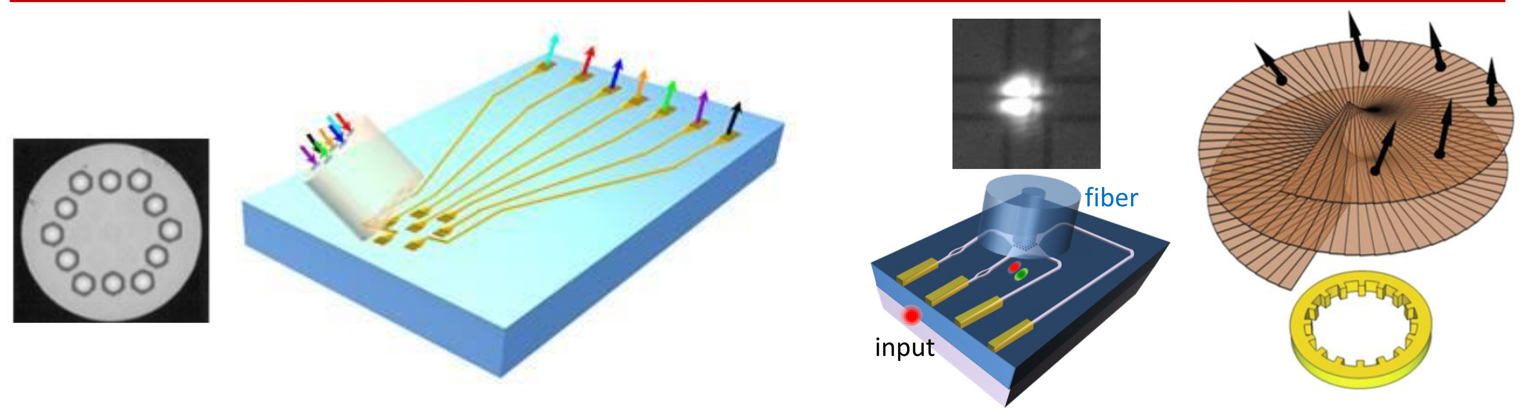
A. Nonlinear nanowires for ultra-broadband optical signal processing – enabling energy-efficiency



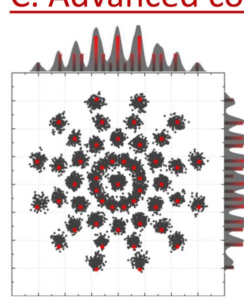
Nonlinear optical bandwidth: 750 nm possible with nanowire



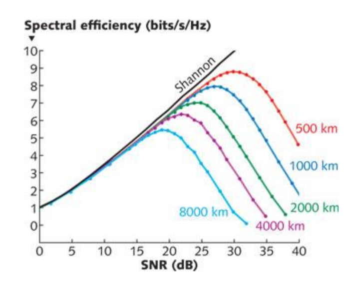
B. Advanced multiplexing components and systems – multi-core, multi-mode, higher-order mode



C. Advanced coding and regenerative transmission for increased transmission reach

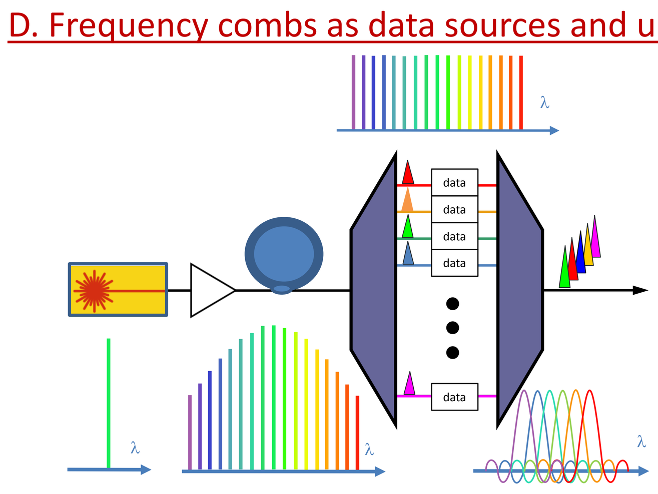


Constellation shaping by advanced data coding reducing nonlinear transmission impairments

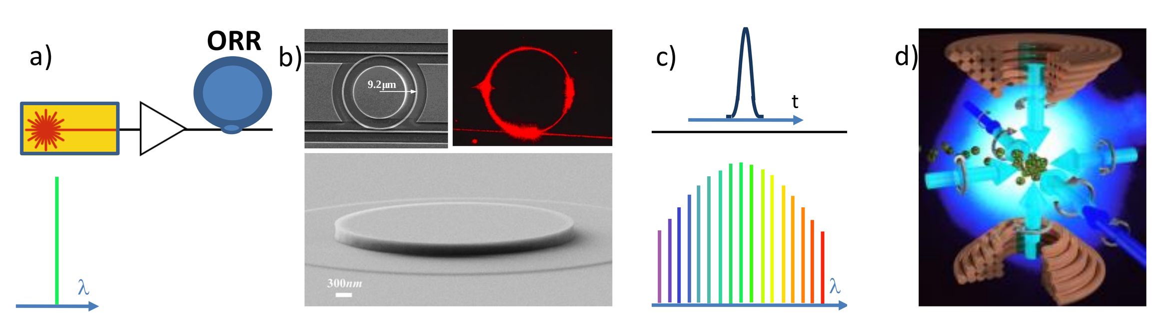


Breaching nonlinear Shannon limit requires regeneration

D. Frequency combs as data sources and ultra-precise optical clocks

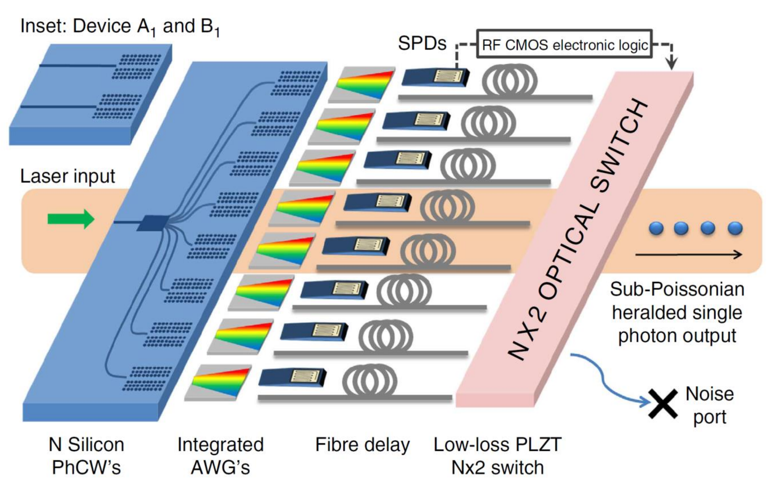


Frequency combs generated by ring resonator as source for multiple wavelengths for e.g. highly specrally efficient data signals like orthogonal frequency division multiplexed (OFDM) data.



Frequency comb locked to atomic transition for e.g. frequency reference or ultra-stable clock.

E. Si-based integrated heralded single-photon source for quantum communications




ARTICLE
Integrated spatial multiplexing of heralded single-photon sources

- Integrated spontaneous FWM emitters of heralded single photons.
- M-ary (spatial mode) quantum keys

All 5 flagships have world leading international partners

DTU Fotonik
Department of Photonics Engineering

Niels Bohr Institutet

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