Kan internettet gøre verden grønnere?

Leif Katsuo Oxenløwe,

Professor, Centerleder

DTU Fotonik

SPOC
Centre for Silicon Photonics for Optical Communications

Danmarks Grundforskningsfond
Danish National Research Foundation

IS STAYING ONLINE COSTING THE EARTH?

policy connect

GreenCOM

Internet: The *key* for climate improvements

- **Internet compensates own weight in CO2 1.5x (~10x in 2030)**
- **Autonomous cars and digitalisation can cut 60%** of energy consumption in **transport sector**
- **Buildings: 10%** energy saved by better temperature control
- **Lighting: 20% electricity with smart-light**
- **Digital technologies can cut global emissions by 15%**

GeSI GLOBAL ENABLING SUSTAINABILITY INITIATIVE

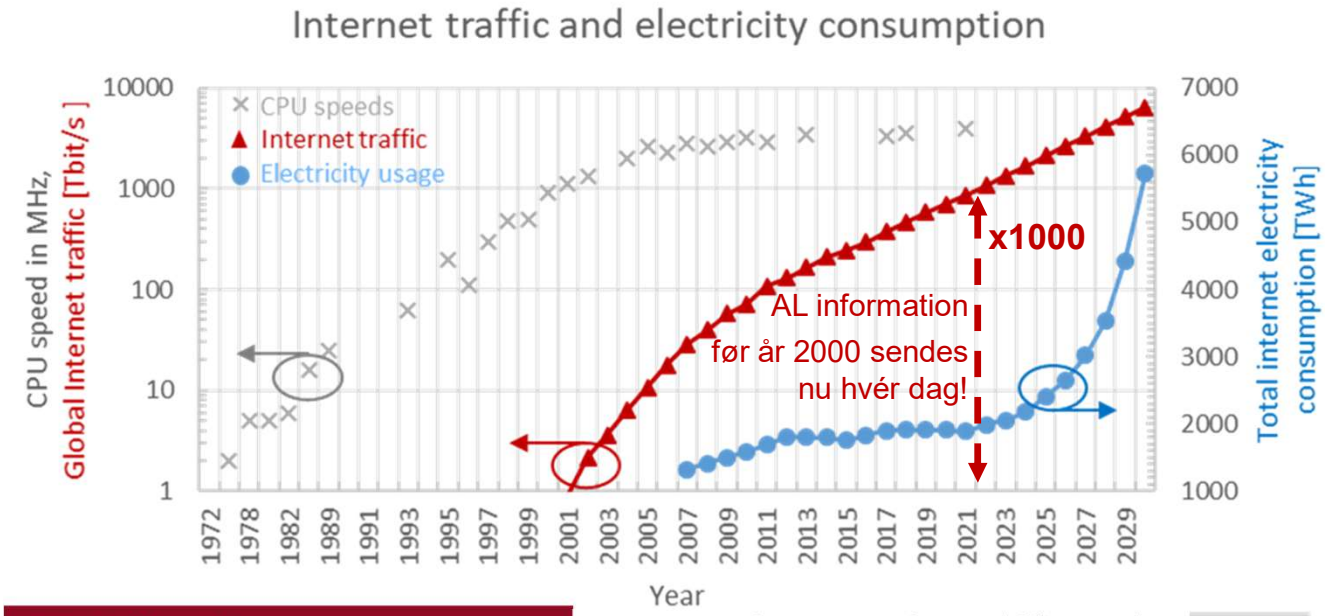
iea International Energy Agency Secure Sustainable Together

Digitalization & Energy

WORLD ECONOMIC FORUM

Only possible if internet doesn't use more energy than it saves

Background: Internet growth and energy consumption



nature
International journal of science

NEWS FEATURE · 12 SEPTEMBER 2018 · CORRECTION 13 SEPTEMBER 2018

How to stop data centres from gobbling up the world's electricity

Nicola Jones

The Register
Biting the hand that feeds IT

DATA CENTRE SOFTWARE SECURITY DEVOPS BUSINESS PERSONAL TECH SCIENCE EMERGENT TECH BOOTNOTES LECTURES

< Death notice: Moore's Law. 19 April 1965 – 2 January 2018

GreenCOM consortium:

- Energi-efficient technologies
- ICT with higher capacity
- Increased accessability
- Critical functionalities
- Green secure IoT solutions
- Green internet protocols
- Green certificate

Science AAAS

"We will need new more energy-efficient technologies in 3-4 years from now!"

Masanet, Koomey et al, Science 2020,
"Recalibrating global data center energy-use estimates"

Popular time- and energy usages

POLITIKEN Mandag

4 friends for 2 hours:

140 Wh, 24 g CO_2 ~ boil 1.2 litres water.

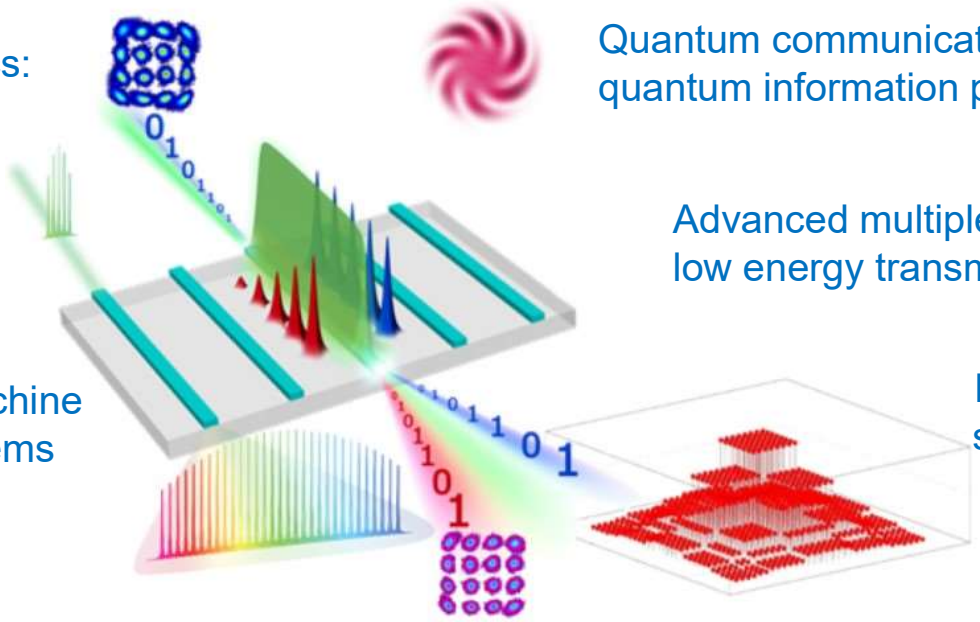
125 millioner gamers worldwide 1 year:

14 TWh, (50%DK electricity), 2.5 million tons CO_2 (5 pct. DK total GHG emission), ~ boil 125 billion litres water ~**Lake Arresø** or / all lakes in **Lake District in UK**

SPOC – Silicon Photonics for Optical Communications

Danish National Research Foundation (DNRF) Centre of Excellence (CoE) (www.spoc.dtu.dk

Integrated nonlinear photonics: Ultra-fast, ultra-broadband, low-energy



Quantum communications, quantum information processing

Advanced multiplexing, high capacity, low energy transmission systems

Microwave photonics, machine learning for photonic systems

Information theory, advanced signal processing and coding

10 years funding for basic research in Optical Communications
100 mio DKK, 25 PhD students, 12 postdocs, 2015-2025

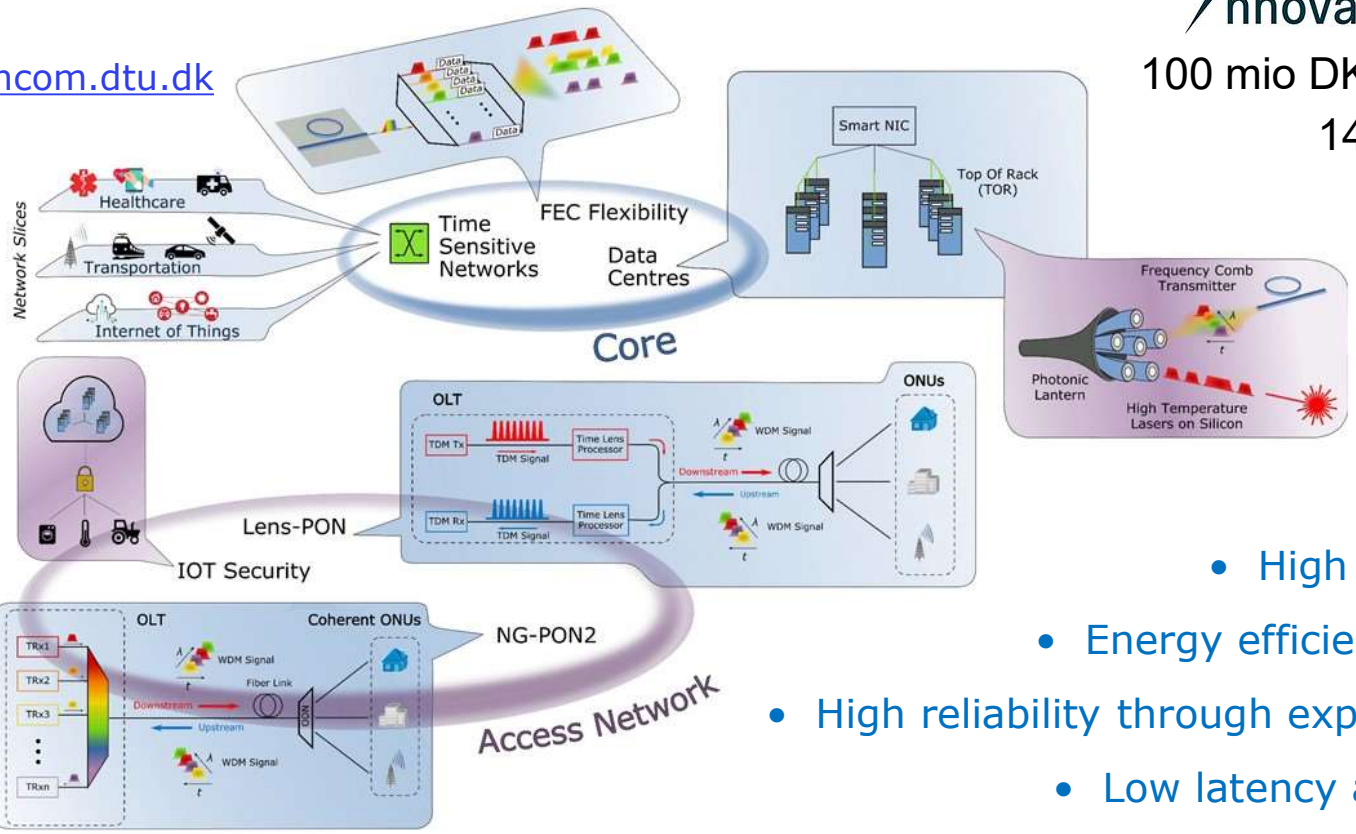
With: Nanophot.Dev., Coding, Nonlinear Fiber Optics, Machine Learning groups at DTU Fotonik & Q. Metrology group at NBI-KU

Energy, capacity, flexibility – cross-network-layer

INCOM
INnovative solutions for next generation
COMmunications infrastructure

www.incom.dtu.dk

Innovation Fund Denmark
100 mio DKK –60M IFD + 40M partners,
14 partners: 2xUni, 12xindustry
3 years 2018-2021



- Optical frequency combs
- High capacity through new fibres
- Energy efficient optical time lens systems
- High reliability through expanded capacity and security
- Low latency and time sensitive switching

A single chip capable of feeding the whole internet

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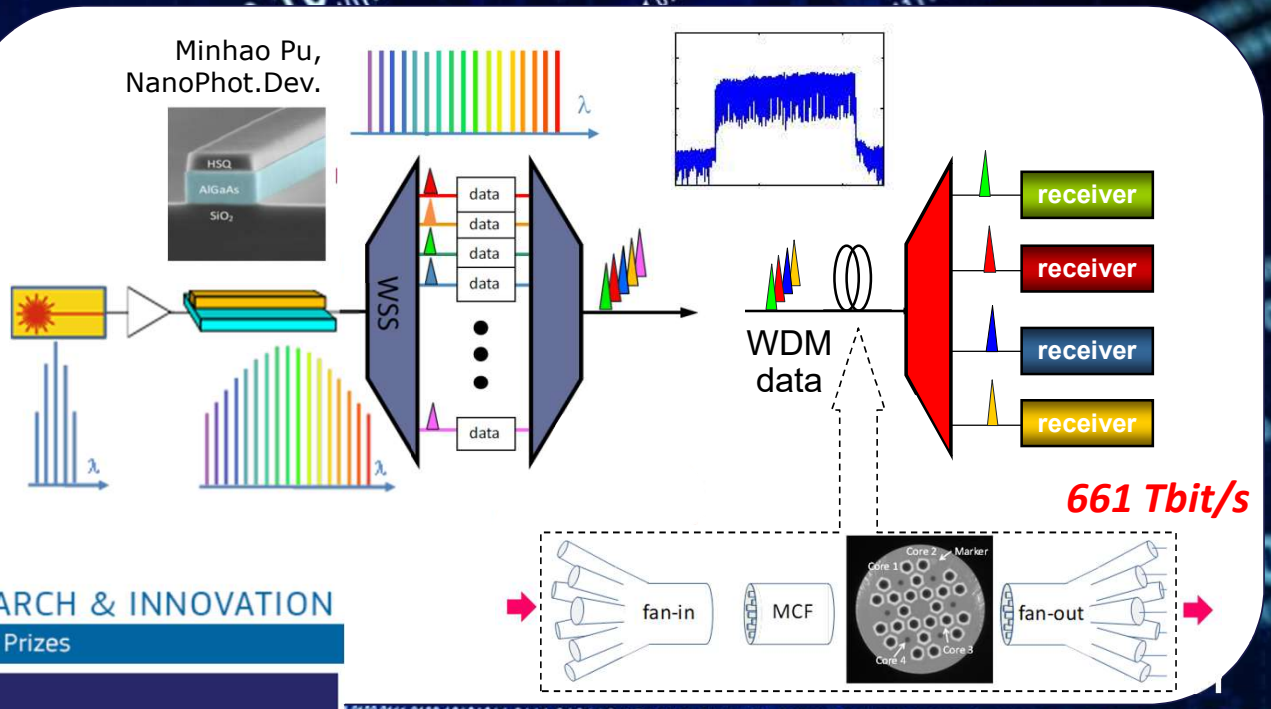


RESEARCH & INNOVATION
European Commission
Horizon Prizes

Horizon **Prize**
BREAKING THE OPTICAL TRANSMISSION BARRIERS

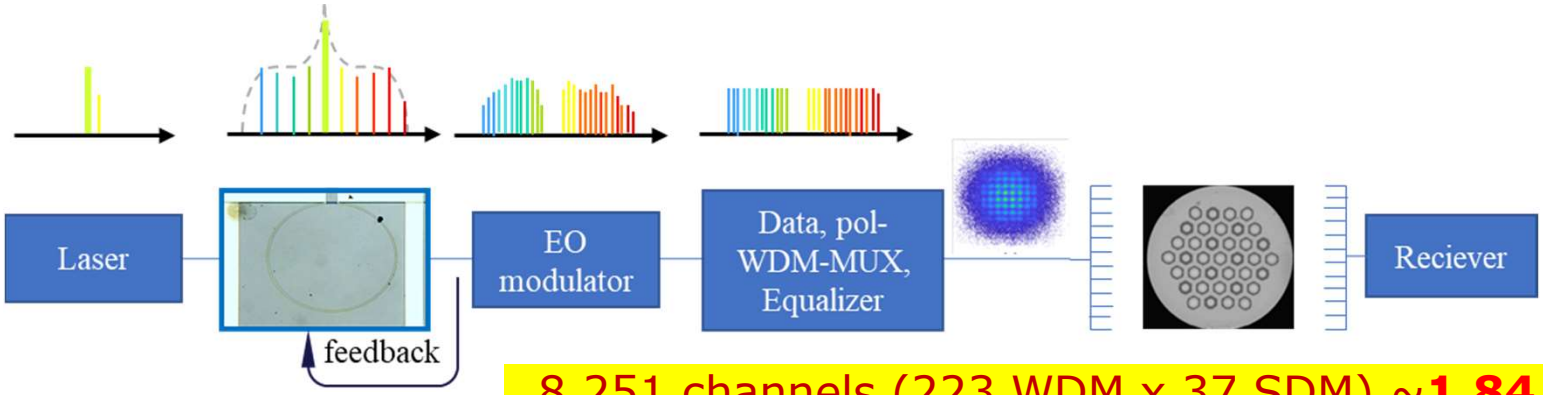
PHOTONMAP
cracked the optical transmission **challenge** and **won** the prize
Team led by Technical University of Denmark

661 Tbit/s: more than 2x global internet traffic!
All on the light from a single optical chip
Won EU competition

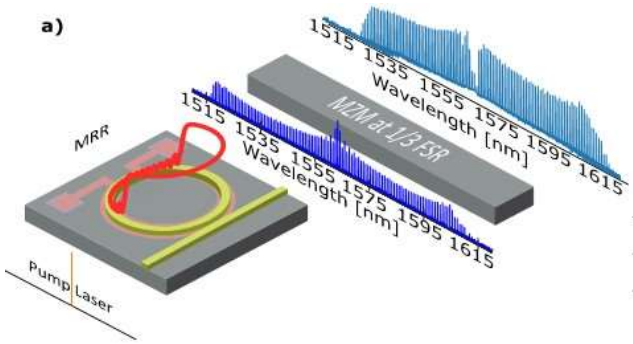
2020 – into the Pbit/s regime for single chips

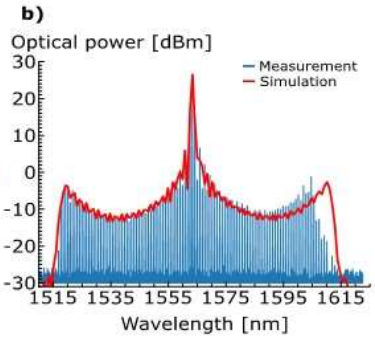
- Hot topic paper @ CLEO 2020

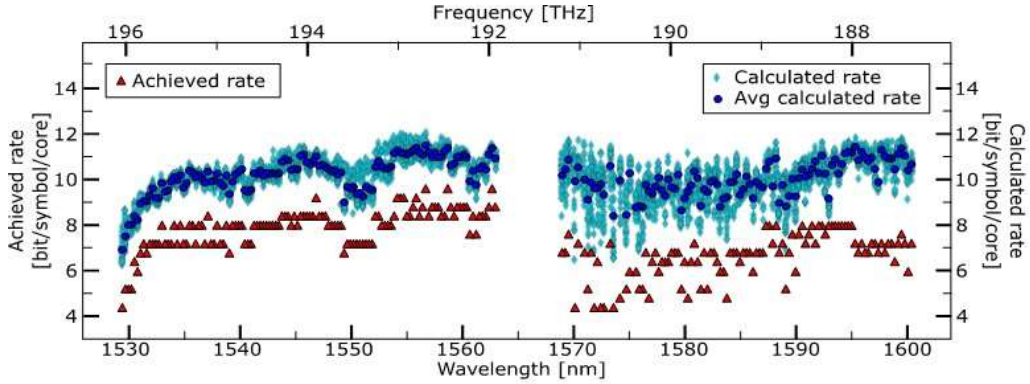
- ""Single Dark-Pulse Kerr Comb Supporting 1.84 Pbit/s Transmission over 37-Core Fiber." (SPOC, FORCE (Chalmers), Fujikura)



8.251 channels (223 WDM x 37 SDM) ~**1.84 Pbit/s**







Need for international ”green ICT-certificat”

Energy/climate-certificate must be international **standard**.

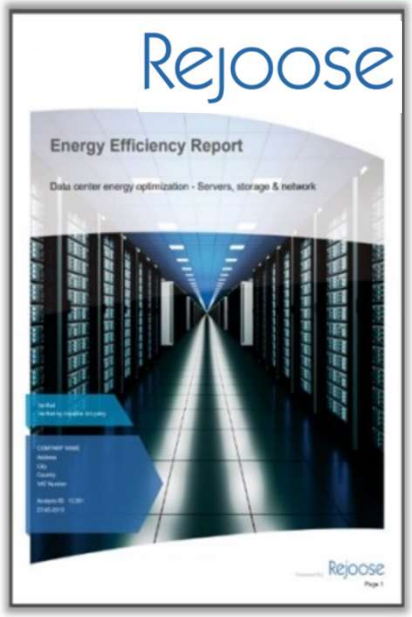
Like our CO2-model, it must contain:

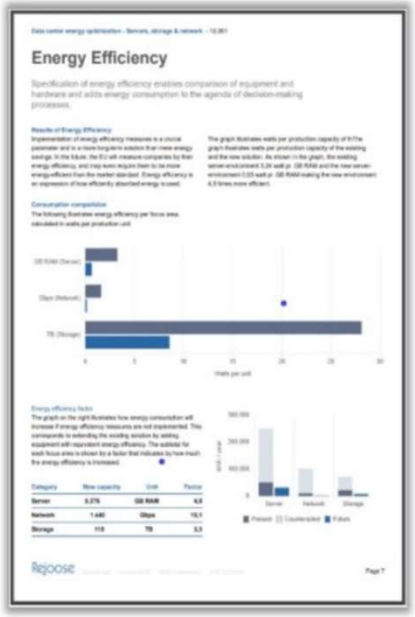
- **Energy-efficiency** [Wh/GB]
- **Total energy** consumption
- **Share of green energy**
- **e.g. green compensation**

Danish example Rejoose: maps directly e.g. server room hardware

Video Streaming

	Final Grade	Clean Energy Index	Natural Gas	Coal	Nuclear	Energy Transparency	Renewable Energy Commitment & Siting Policy	Energy Efficiency & Mitigation	Renewable Procurement	Advocacy
Company	F	2%	19%	39%	31%	F	F	F	F	F
Company	C	17%	24%	30%	26%	F	D	C	C	B
Company	D	22%	20%	25%	25%	D	F	F	F	F





OUTPUT | GREEN TRANSITION PLAN

CLIMATE CONFERENCE AAU-CPH 2019

PANEL: ENERGY CONSUMPTION OF GROWING INTERNET (REPS FROM DTU, DANSK ENERGI, TELIA, GREENPEACE, HUAWEI)

THE PANEL AGREED ON:

- **ENERGY EFFICIENCY** IN ICT IS **VERY IMPORTANT** – AND **RELEVANT FOR POLICY MAKERS** TO ADDRESS.
- POLICY MAKERS SHOULD INTRODUCE AN **ENERGY-EFFICIENCY CRITERION** ON ALL NEW ICT EQUIPMENT, BEFORE DEPLOYMENT IS ALLOWED, AND INSIST ON **PHASING OUT OLD** INEFFICIENT EQUIPMENT AND NETWORKS. EXISITING **PARALLEL NETWORK** INFRASTRUCTURE SHOULD ALSO BE **QUESTIONED**
- **REGULATE** ICT-ENERGY-CONSUMPTION BY THE **PRICE ON ELECTRICITY** – COMPANIES SHOULD PAY THE FULL COST OF ENERGY PRODUCTION AS A MINIMUM
- **PUBLIC INSTITUTIONS** SHOULD **ONLY USE GREEN ICT** SOLUTIONS, SUCH AS ONLY USE GREEN CLOUD SOLUTIONS (GREEN DATA CENTRES)

Summary

- ICT is good for the climate – challenge: energy-efficient ICT
- Optical technologies have enormous power:
  - 1 chip can carry 2x internet traffic – 1.8 Pbit/s record today
- Certificate to evaluate services to choose the green one necessary
- Public-private collaborations required

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