All you need to know about...

UNIQORN

Affordable Quantum Communication for Everyone

Revolutionizing the Quantum Ecosystem from Fabrication to Application

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EQTC 2019, Grenoble

QUANTUM FLAGSHIP

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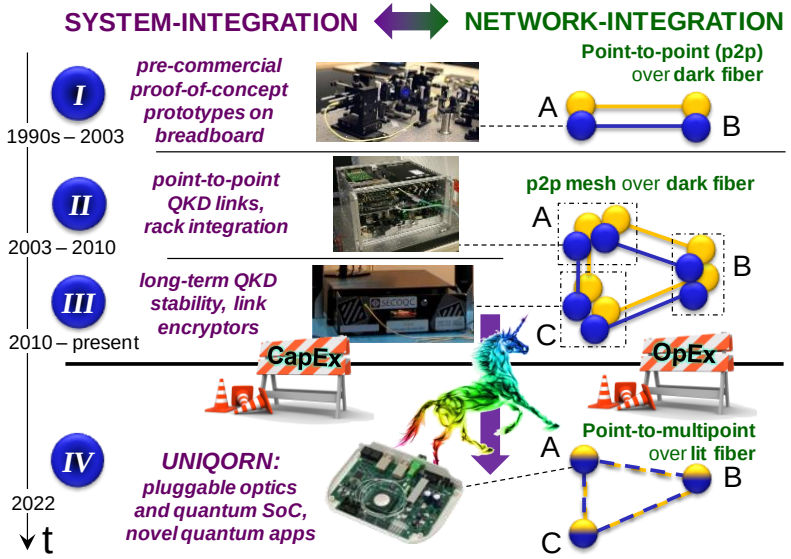
Quantum Communication Today

Aim: Information-theoretic Security (ITS)

- ✓ **Quantum Key Distribution (QKD)**:
  security based on the laws of nature,
  therefore “quantum-safe”
  early demonstrations (Vienna, Tokyo, Battelle)

- ✗ Classical **Post-Quantum** algorithms:
  computationally hard problems, no guarantee
  for ITS as quantum algorithms evolve

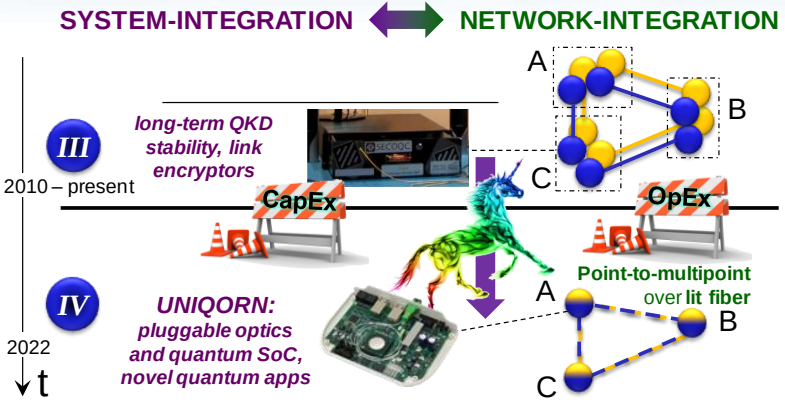


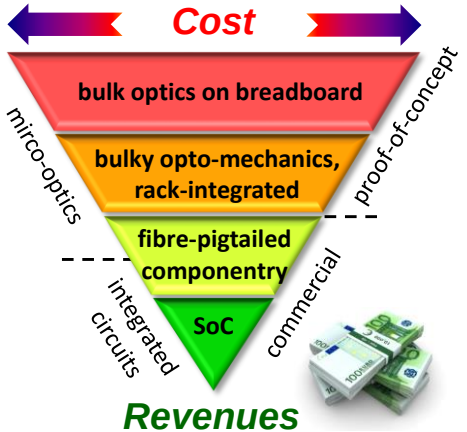
Quantum Communication Today

Current Roadblocks for a Practical Introduction:

1.) ***ICT infrastructure will not change to accommodate quantum network functions.***
Need to merge the striking benefits of quantum technology with highly advanced telecom technologies (“co-existence”).

2.) ***Powerful quantum applications need powerful yet cost-effective components.***
The Second Quantum Revolution is only possible when it follows a success story such as that of microelectronics, which lead to the Information Age.





Positioning within Quantum Flagship

UNIQORN

Applications

Network Integration

System Integration

Enabling Components

Communication

Computation

Simulation

Sensing/Metrology

Engineering/Control

Software/Theory

Education/Training

Basic Science

QUANTUM Communication

Multi-Disciplinarity is Key to Success!

UNIQORN

- Quantum scientists with strong roots in theory & experiment
- RTOs turning basic science into applicable technology for years
- Photonic and electronic design of integrated circuits
- Design automation and simulation
- Assembly and Packaging
- Telecom system integration
- Industrial End-User perspective

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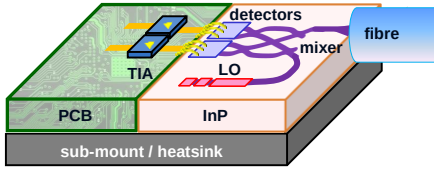
DTU
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY
Fraunhofer Heinrich Hertz Institute
imec
TU/e
MPD MICRO PHOTON DEVICES
POLITECNICO MILANO 1863
SMART PHOTONICS Independent InP Foundry
VPIphotonics DESIGN AUTOMATION
CORDON ELECTRONICS
University of BRISTOL
ICCS
Mellanox TECHNOLOGIES
COSMOTE

Objectives

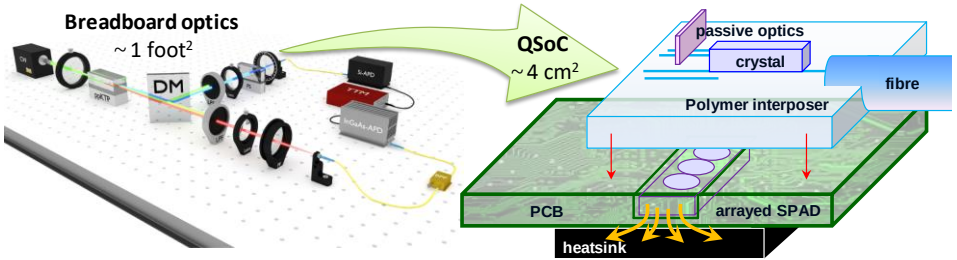
1.) **Develop value-added InP, CMOS and polymer quantum-optic communication component technology with reproducible performance.**

- Quantum-grade monolithic InP integration
- High-efficiency silicon photon detection
- Low-cost industry-qualified planar polymer lightwave circuits



2.) **Shoehorning breadboards into chips – Develop a quantum System-on-Chip (QSoC) methodology that enables low-cost assembly and packaging.**

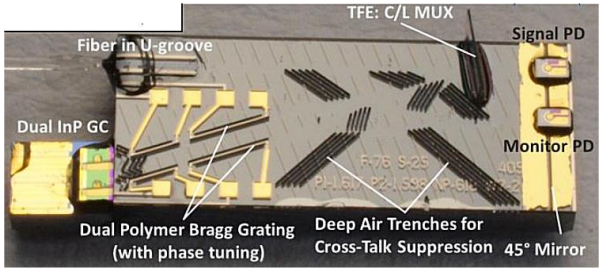
- Hybrid integration of “best-of-breed” components
- Efficient interposer-to-fiber interfaces
- Pump source integration
- RF and thermal features



Objectives

3.) Demonstrate the power of the technological food-chain through realization of feature-rich, scalable key sub-systems for optical quantum communications.

- Heralded and polarization / time-bin entangled photon pair sources
- 1550 nm up-conversion DV receiver
- Differential Phase Shift DV transmitter
- Entangled squeezed light source and homo-/heterodyne CV receiver
- Quantum random number generator (QRNG)
- Programmable Einstein-Podolsky-Rosen (EPR) node



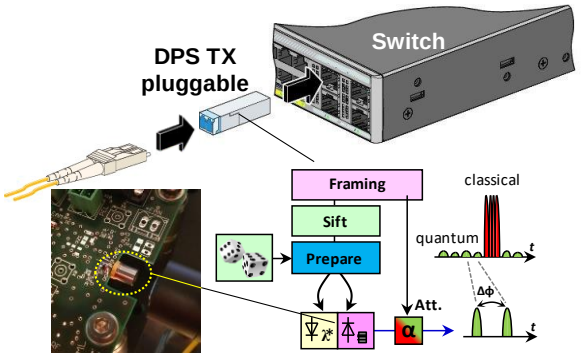
The demonstration of **feature-rich and scalable quantum circuits** in the form of QSoC is a significant step forward in the fabrication of a broad range of DV and CV quantum communication sub-systems with reduced size and cost – following the same paradigm of integrated microelectronics during the late 20th century.

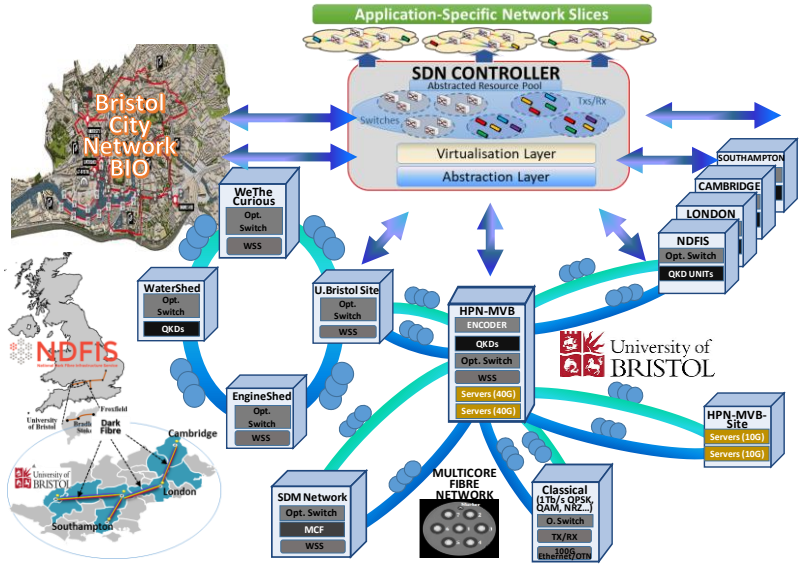
Objectives

4.) Deployable system performance and novel network functionalities.

- **System integration**, e.g. secure key rate >1 kb/s using pluggable QKD optics
- **Network integration**

  - introduction of space as a new dimension of multiplexing
  - software defined impairment mitigation and resource optimization
  - programmable Quantum Whitebox

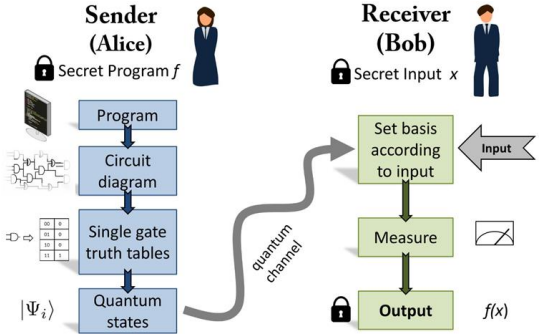




Objectives

5.) From quantum *fab* to quantum *app*:
Demonstration of low-cost quantum links and novel end-user quantum applications beyond QKD in lab evaluation and field scenarios.

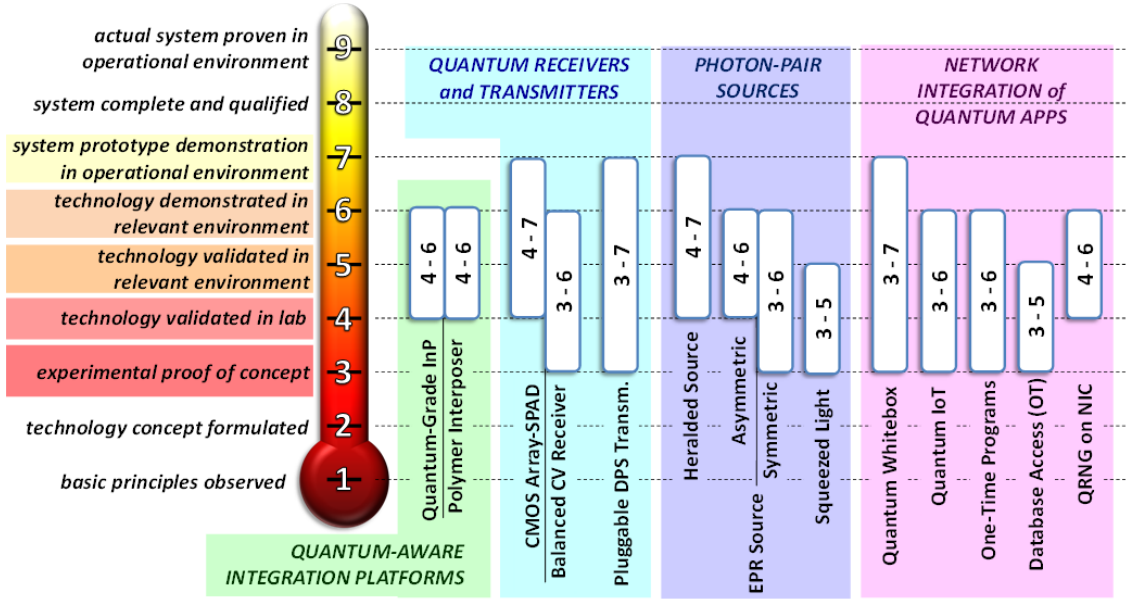
- Quantum-secured Internet-of-Things (QIoT)
- One-time programs for cloud-based quantum processing
- Secure database access through oblivious transfer
- QRNG as a seed for NIC-integrated randomness engine



The tight integration of quantum protocols in commercial network equipment and the network-oriented investigation of applicability aspects provides the credential to generate exploitable assets.

TRL Positioning and Time-to-Market

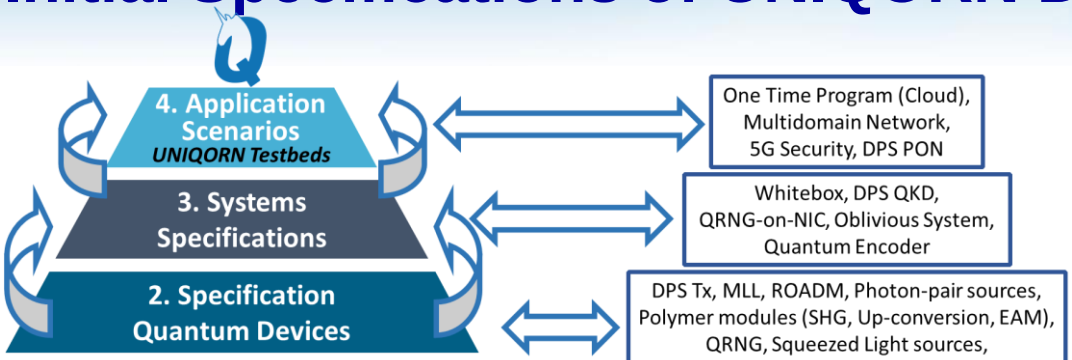
UNIQORN relies on the integration of innovative quantum-optical building blocks (sources, transmitters, detectors) that are based on well-established InP/polymer/CMOS technologies, offering the optimum balance between innovation and risk/maturity/time-to-market: **quantum revolution through technological evolution**.



Commercialization Path:

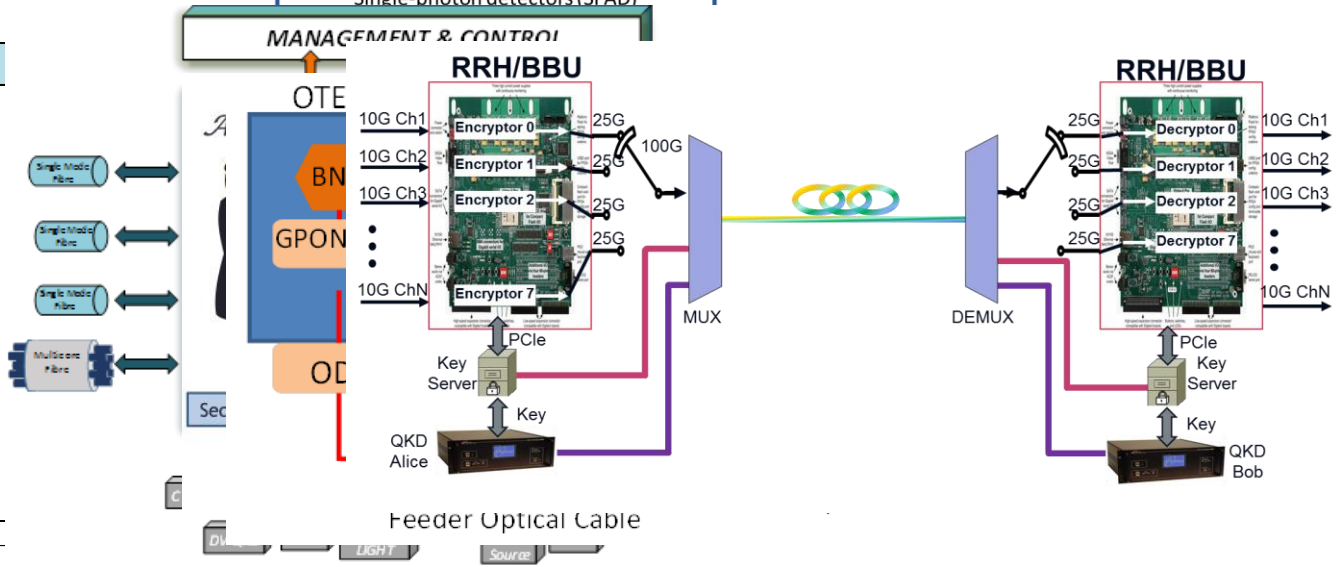
- Early adoptions of services and components, e.g.:
  - quantum-grade PIC foundry
  - EDA tools for quantum tech
  - CMOS SPADs
- 2-3 years after project end: first qSoC solutions

Initial Specifications of UNIQORN Devices



I. Photon pair
Parameters
Wavelength p
Pump Power
Wavelength s
Wavelength i
PDC bandwidt
Coupling loss polymer (sign
Coupling loss single mo (signal, idler)
Long-pass fi pump light
Source bright

I. QRNG
Parameters
Wavelength
Repetition rate
Fixed attenuators
Adjustable attenuator
Beamsplitter splitting ratio
Number of Channels



Events

October: Kick-off meeting at NTUA (Athens)
December : ICT2018 (Vienna)
January: 1st technical meeting at HHI (Berlin)

Thank you for your attention!

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