AFFORDABLE QUANTUM COMMUNICATION FOR EVERYONE: REVOLUTIONIZING THE QUANTUM ECOSYSTEM FROM FABRICATION TO APPLICATION

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Affordable Quantum Communication for Everyone: Revolutionizing the Ecosystem from Fabrication to Application

UNIQORN
Affordable Quantum Communication for Everyone

Call: H2020-FETFLAG-2018-03 (QComm.), RIA

Project nº: 820474

Countries: AT (Coord.), DE, DK, NL, IL, EL, IT, UK, BE

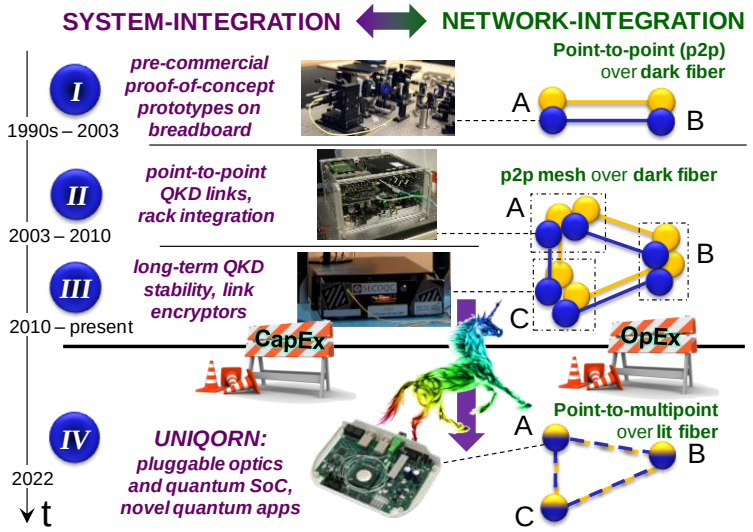
Partners: 17 (with 8 Univ., 3 RTO, 3 SME, 3 Lrg.Ent.)

Funding: 10 M€ over duration of 36M

Focus: Ubiquitous Quantum Communication

- ✓ **Quantum-enhanced communication protocols:** information-theoretically secure key exchange, quantum random number generation and secure multiparty computation

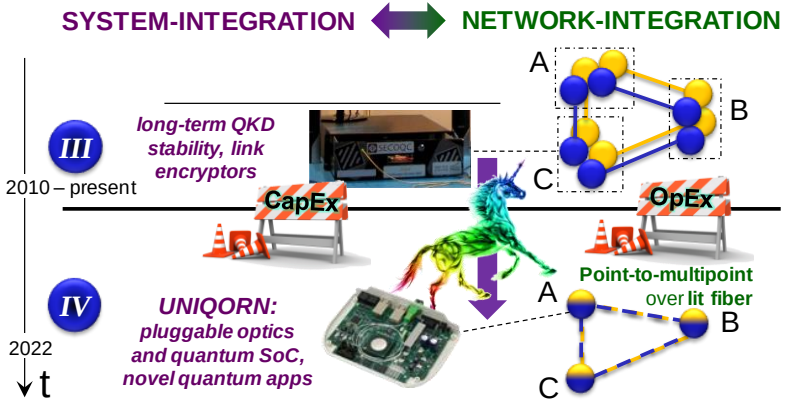
- ✓ **High technological readiness** at the device level: Achieve cost-effectiveness through integrated, deployable quantum-photonic solutions

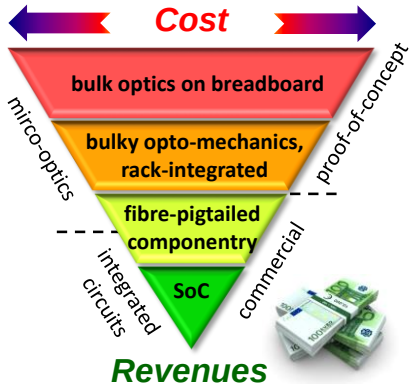


Drivers: The Challenges for Practical Deployment

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”).

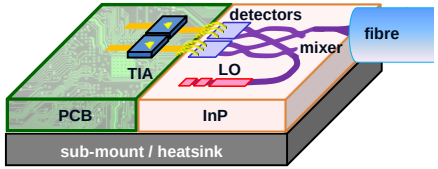
2. ***Powerful quantum applications need powerful yet cost-effective components.***
   The Second Quantum Revolution is only possible when it follows a success story such as that of microelectronics, which led to the Information Age.



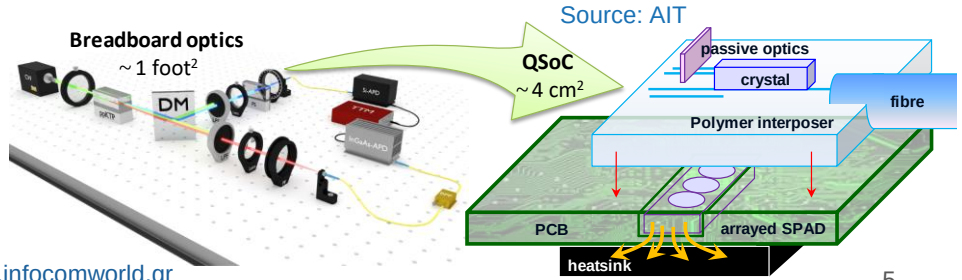


Project Objectives (1/5)

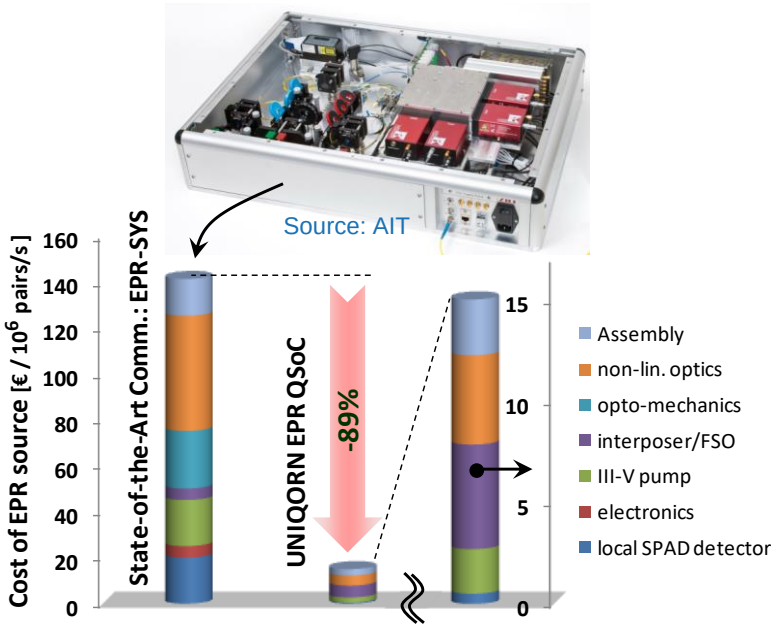
1. **Develop value-added InP, CMOS and polymer quantum-optic communication component technology with reproducible performance.**
   - Quantum-grade monolithic InP integration
   - High-efficiency single photon detection
   - Low-cost industry-qualified planar polymer lightwave circuits



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



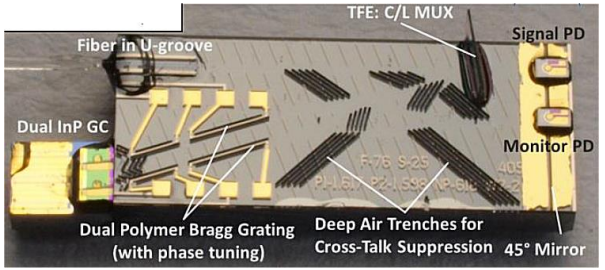
Project Objectives (2/5)



UNIQORN expects an up to 89% cost improvement with respect to state-of-the-art commercial products through a well-orchestrated methodology and process flow used for QSoC fabrication, which drives higher production through-put at lower cost.

Objectives (2/5)

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



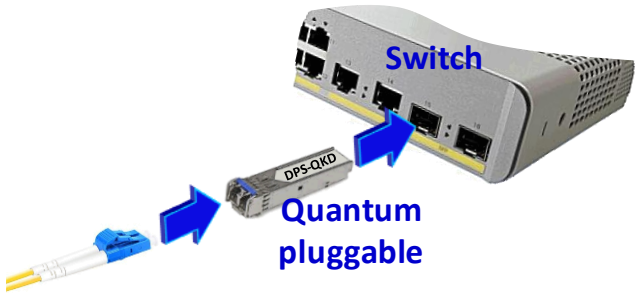
Source: Fraunhofer/HHI

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 (4/5)

4. **Deployable system performance and novel network functionalities.**
   - **System integration**, e.g. secure key rate >1 kb/s using pluggable QKD components
   - **Network integration**

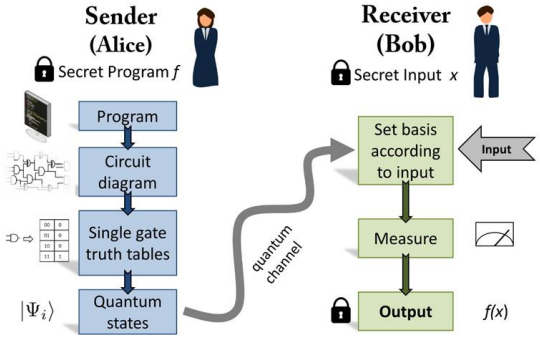
     - introduction of space as a new dimension of multiplexing
     - software defined impairment mitigation and resource optimization
     - programmable Quantum Whitebox



Source: Univ. Bristol

Objectives (5/5)

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



Source: Univ. Vienna

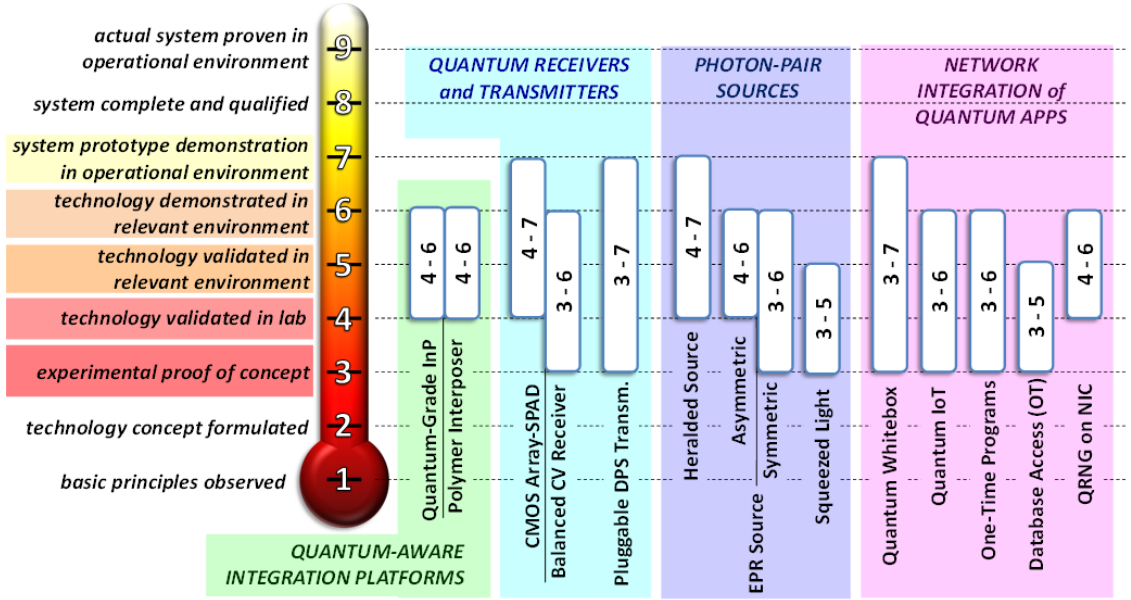
The tight integration of quantum protocols in commercial network equipment and the network-oriented investigation of applicability aspects provides the credentials to generate exploitable assets.

Multi-Disciplinarity is Key to Success!

- Quantum engineers 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

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

Thank you!

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