QUANTUM FLAGSHIP

UNIQORN

Affordable Quantum Communication for Everyone

EU Horizon-2020 Project **UNIQORN**

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

EU Horizon-2020, FET Flagship on Quantum Technologies
Grant Agreement nº 820474

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1.1	Factsheet and presentation	A.Karyda	27/11/2018
1.2	Adressing reviewers comments	A.Karyda	28/11/2018
1.3	Final updates and preparation for submission	A.Karyda	29/11/2018

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Copyright Statement

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Executive Summary

This deliverable presents the UNIQORN factsheet and the project's overview presentation. The project factsheet contains information about the project idea and the project participants and will be distributed in various scientific and industry events where the project partners are planning to participate. The project presentation gives a high-level overview of the project and will be enhanced with relevant information through the project's lifetime. It will also be used by the members of the consortium to present the project in various events. Moreover, they contain information about the EU funding incluging the EU emblem to comply with the Grant Agreement Article 29.4. Finally, both dissemination material have been designed to comply with the project's visual identity, such as the project logo and the color palette.

1 Introduction

1.1 Purpose and scope of the document

The purpose of the document is to present the project factsheet and general presentation, which have been designed to reach a diverse audience. These dissemination tools will be updated throughout the project to meet the dissemination needs for each stage of the project.

1.2 Relation to other project work

The deliverable is prepared within Task 8.3 “Dissemination of foreground knowledge and communication activities”, which describes the activities that will be taken by the consortium to promote the project’s results. D8.1 is related to the following WP8 deliverables:

- D8.2 **“Website development and creation of social accounts”** [M02] It focuses on the web presence of the project and gives a brief overview of the website design and social media accounts.
- D8.3 **“Press Release and Communication Kit”** [M03]: It will contain the 1st project press release in English and the communication kit, which will consists of the project’s dissemination material with copyright clearance which the EC can use to further disseminate the project results.
- D8.4 **“Promotion video availability”** [M10]: This deliverable will contain the design and script of the project video.
- D8.5 **“First period exploitation plans and project dissemination”** [M18]: It will contain the dissemination and communication strategies of the project partners individually and the consortium as a whole and will report on the dissemination and communication activities undertaken in the first 18 months of the project.
- D8.9 **“Final Press Release”** [M36]: It will contain all necessary information about the projects final results.

1.3 Structure of the document

The document is structured in the following way:

- In chapter 2 we present the first UNIQORN Factsheet.
- In chapter 3 we include the slides of the project’s general presentation.

2 Factsheet

The UNIQORN factsheet describes the goals and innovations of the project and the areas of quantum communication, which will be addressed during the project's lifetime. Moreover, it contains the list of project partners, contact details as well as, the website address and social media accounts, and information about the EU funding. The factsheet is available at the project's website and it will also be distributed in relevant scientific and industry events.

UNIQORN

Affordable Quantum Communication for Everyone

The second Quantum Revolution will only happen when it follows a similar road to success as pioneered by the miniaturisation and integration of electronics. UNIQORN's mission is therefore to provide the enabling photonic technology to accommodate quantum communications, by integrating complex systems, which are presently found on metre-size breadboards, into millimetre-size chips. These systems will not only reduce size and cost but will also bring improvements in terms of robustness and reproducibility. This is not possible without:

REVOLUTIONIZING THE QUANTUM ECOSYSTEM FROM FABRICATION TO APPLICATION

Starting with advanced components optimized for quantum applications, UNIQORN will shoehorn entire quantum-optic systems into system-on-chip (SoC) realizations, leading to highly miniaturized solutions for further system- and network-level integration. Selected quantum applications beyond quantum key distribution will build on UNIQORN's highly integrated and yet cost-effective technology and will be evaluated in lab and field.

THE CONSORTIUM

- AIT Austrian Institute of Technology
- Paderborn University
- Technical University of Denmark
- SMART Photonics BV
- University of Vienna
- Mellanox Technologies Ltd
- Fraunhofer - Heinrich Hertz Institute
- Institute of Communications & Computer Systems, National Technical University of Athens
- University of Innsbruck
- Micro Photon Devices S.r.l.
- Eindhoven University of Technology
- VPIphotonics GmbH
- Politecnico di Milano
- University of Bristol
- COSMOTE Mobile Telecommunications S.A.
- imec - Interuniversity Microelectronics Centre
- Cordon Electronics Italia Srl

PROJECT METADATA

Topic: FET Flagship on Quantum Technologies
Type of Action: Research and Innovation Action
Start Date: 01/10/2018
Duration: 36 months
EU Contribution: 9,979,905 €

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UNIQORN Quantum

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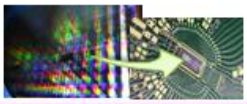
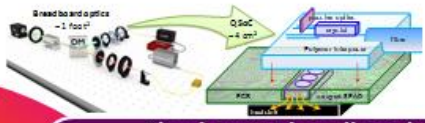
5 Objectives that drive innovation along the value chain



I. Develop value-added InP, CMOS and polymer quantum-optic communication components.

Quantum Fab

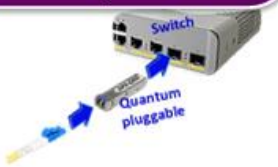


II. Shoehorning breadboards into chips – Develop a quantum System-on-Chip methodology.

Quantum App

V. Demonstration of low-cost quantum links and novel end-user quantum applications beyond QKD in lab and field.

III. Demonstrate the power of the technological food-chain: Realize feature-rich, scalable key sub-systems for quantum comms.



IV. Deployable system performance and novel network functionalities.

UNIQORN addresses 4 levels of quantum communication, covering the entire value chain

Components

- Differential Phase Shift DV Transmitter
- Homo-/Heterodyne CV Receiver

Quantum System-on-Chips

- Quantum Random Number Generator
- Heralded and polarization / time-bin entangled photon pair sources
- 1550 nm up-conversion receiver
- Entangled squeezed light source

Quantum Protocols and Applications

- One-Time Programs for cloud-based quantum processing
- Oblivious Transfer securing data base access
- QRNG as seed for NIC-integrated randomness engine
- Quantum-Secured IoT for Smart City and 5G

System Integration

- Low-Cost DPS QKD
- Quantum FPGA
- Programmable EPR Node
- Quantum ROADM

Network Integration

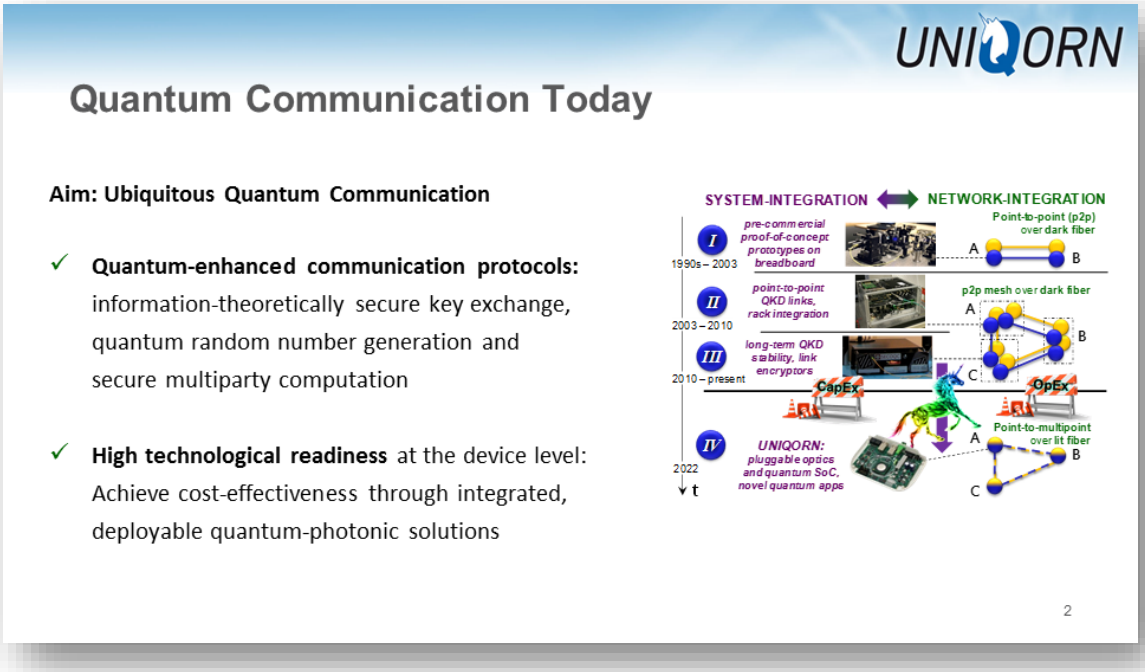
- Co-Existence:
  - Exploit the spectrally clean O-band
  - Electrically duplexed quantum signals
  - Machine-learning assisted allocations
  - Isolation through spatial multiplexing
- Quantum Networking:
  - Reconfigurable quantum overlay: the Quantum Whitebox
  - Quantum-aware SDN platform
  - Programmable EPR

QUANTUM Communication

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820474.

3 Project Presentation

The project presentation gives an overview about the UNIQORN project. In particular, it contains information about the project's objectives, the position of the project within the Quantum Flagship and the TRL of the results expected at the end of the project. This presentation will be enhanced with relevant information during the project's lifetime and it is available at the project's website.The project partners will tailor the level of detail presented according to the background of the audience targeted in every event.

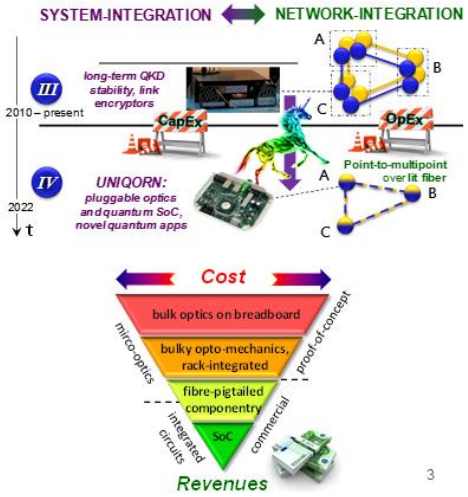


Quantum Communication Today

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.



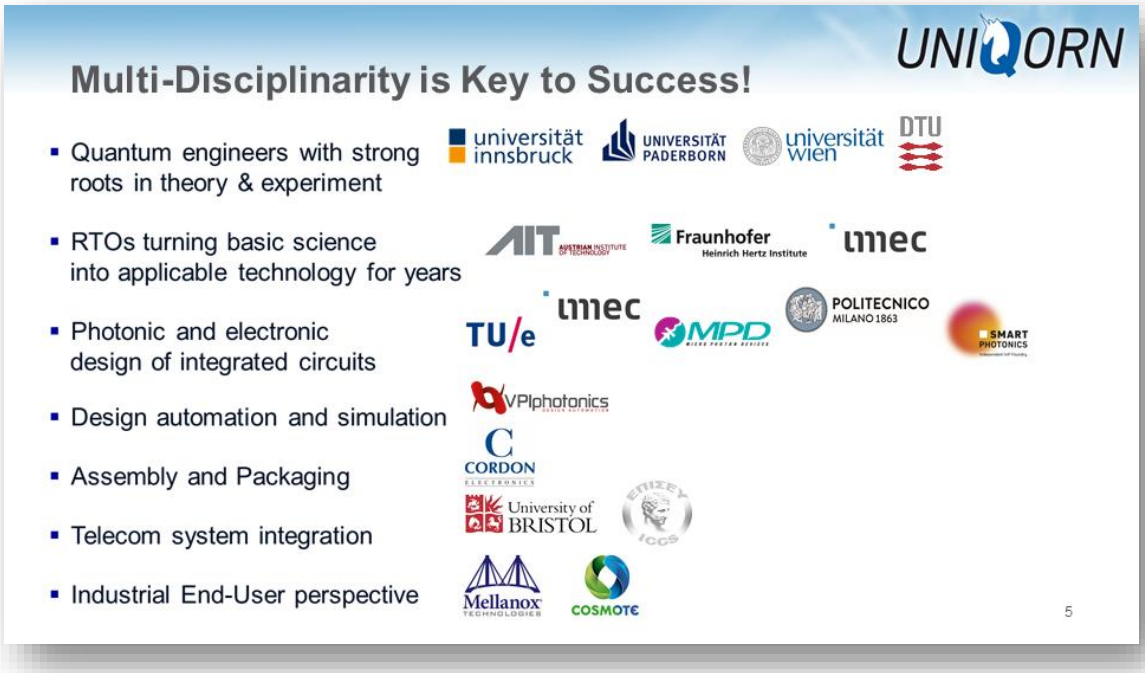
3

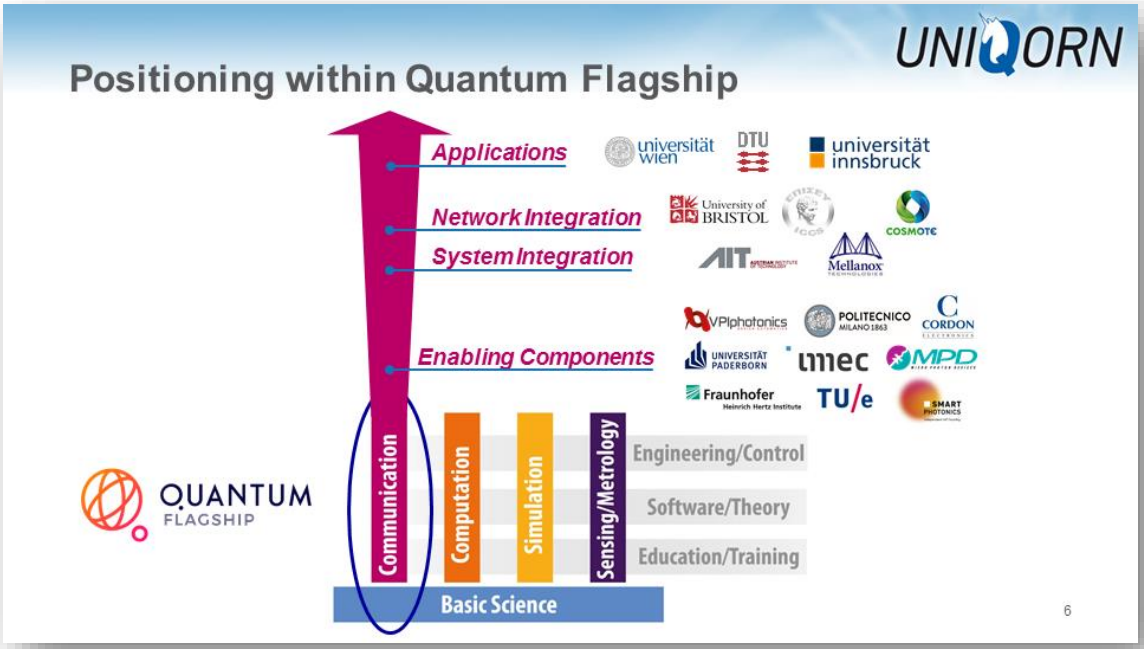
Affordable Quantum Communication for Everyone: Revolutionizing the Ecosystem from Fabrication to Application

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

4


UNIQORN
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
universität innsbruck
UNIVERSITÄT PADERBORN
universität wien
DTU
AIT
Fraunhofer Heinrich Hertz Institute
imec
TU/e
MPD
POLITECNICO MILANO 1863
SMART PHOTONICS
VPIphotonics
CORDON ELECTRONICS
University of BRISTOL
Mellanox
COSMOTE
5


UNIQORN
Positioning within Quantum Flagship
Applications
Network Integration
System Integration
Enabling Components
QUANTUM FLAGSHIP
Communication
Computation
Simulation
Sensing/Metrology
Engineering/Control
Software/Theory
Education/Training
Basic Science
universität wien
DTU
universität innsbruck
University of BRISTOL
COSMOTE
AIT
Mellanox
VPIphotonics
POLITECNICO MILANO 1863
CORDON ELECTRONICS
UNIVERSITÄT PADERBORN
imec
MPD
Fraunhofer Heinrich Hertz Institute
TU/e
SMART PHOTONICS
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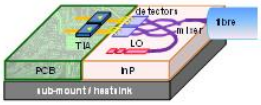
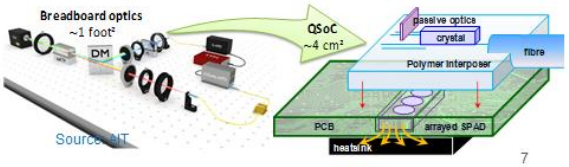
Objectives

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



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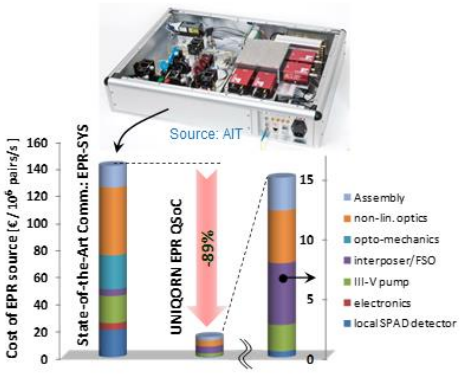
Objectives



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.

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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

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.

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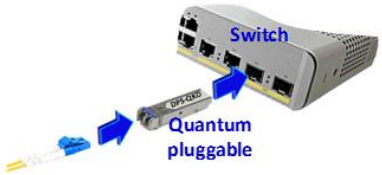
Objectives

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




Source: Univ. Bristol

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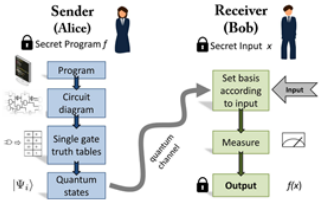
Objectives

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



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.

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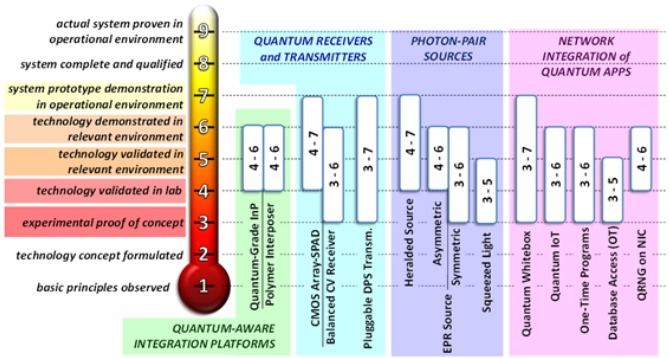
TRL Positioning and Time-to-Market

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

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This set of slides will be updated periodically with the new results as the project advances and will be adapted to meet the events' specific scopes and audiences.