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

Document:	**Deliverable**	
Type:	Report	
Dissemination Level:	Public	
Title:	**First period exploitation plans and project dissemination**	
Work-Package / Task(s):	WP8 / T8.1, T8.2, T8.3, T8.4, T8.5	
Document number:	**D8.5**	Latest Revision: V3_Final
Delivery Date Planned:	M18 / March 2020	Pages: 44
Document Owner:	P. Bakopoulos – MLNX	Label: UNIQORN-D8.5 First period exploitation plans and project dissemination_v3.docx
Contributors:	AIT, MLNX, COSMOTE	
Abstract:	Initial plan for exploitation and dissemination of results and overview of period 1 activities.	
Key words:	Exploitation, dissemination, communication	

Revision History

Version	Revision points	Version Author(s)	Date
1.0	Dissemination part	Agi Karyda	16 March 2020
1.1	Exploitation part	Paraskevas Bakopoulos	25 March 2020
1.2	Exploitable outcome description	Hannes Hübel	1 April 2020

Author List

Organisation	Name	Email
AIT	Agi Karyda	agi.karyda@ait.ac.at
MLNX	Paraskevas Bakopoulos	paraskevasb@mellanox.com
COSM	Fotini Setaki	fsetaki@cosmote.gr

Reviewer List

Organisation	Name	Email
POLIMI	Franco Zappa	franco.zappa@polimi.it
SPH	Antonio Bonardi	antonio.bonardi@smartphotonics.nl

Copyright Statement

Funding Acknowledgement:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820474: UNIQORN quantum-uniqorn.eu

Table of contents

List of Figures

List of Tables

Executive Summary

UNIQORN project aims at delivering the enabling photonic technology to commoditize quantum communications. UNIQORN relies on photonic integration to miniaturize quantum systems from their current lab bench dimensions into millimetre chips, and to dramatically reduce their cost and improve their robustness. Starting with advanced components optimised 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 simple quantum key distribution will build on UNIQORN's highly integrated and yet cost-effective technology and will be evaluated in lab and field.

Work Package 8 "Dissemination and exploitation activities, manufacturability studies and roadmapping" plays a vital role in the project as it aims to link the project's technical activities with tangible target outcomes for the consortium partners. The present deliverable report D8.5 "First period exploitation plans and project dissemination" describes the consortium's methodology for exploiting project outcomes as well as its strategy for communication and dissemination of results.

The main exploitable outcomes of UNIQORN are identified and the main players and potential exploitation paths are highlighted. To facilitate further processing, the exploitable outcomes are listed in sub-categories: (a) software design and fabrication of quantum enhanced PICs; (b) integrated components for quantum comm devices; (c) tools for quantum networks; (d) quantum comm devices; and (e) applications. Parallel to the exploitable outcomes of the project as a whole, individual exploitation directions are provided by the project partners.

The communication and dissemination strategy of UNIQORN is described, elaborating on target audience, key messages, objectives of the relevant activities and means to achieve them. The main mechanisms for communication and dissemination has been setup since the early stages of the project and includes the project website, social media accounts, graphical identity, flyers and animation video. Several activities have been carried out during the first 18 months of the project such as scientific publications, conference and workshop presentations, preparations of lectures and theses and collaborations with other projects.

1 Introduction

The second Quantum Revolution will only happen when it follows a success story such as microelectronics' one. UNIQORN's mission is to provide the enabling photonic technology to accommodate quantum communications, by shoehorning entire quantum-optic systems, which are presently found on metre-size breadboards, into millimetre-size system-on-chip (SoC) implementations. These systems will not only reduce size and cost, but will also bring improvements in terms of robustness and reproducibility. Selected quantum applications beyond simple quantum key distribution will build on UNIQORN's highly integrated and yet cost-effective technology and will be evaluated in lab and field.

It is thus evident that the exploitable opportunities that arise from the project's results are manifold and span in various categories: chips, systems, algorithms, applications, as well as end-to-end service solutions and use cases. As these results are generated by many partners of versatile interests and strategic (profitable or non-profitable) goals, it is important to devise an all-encompassing exploitation strategy methodology that shall capture and classify all possible prospects and partners' interests.

1.1 Purpose and scope of the document

Purpose of this document is twofold: First, it lays the foundations of the exploitation activities by delineating the methodology and identifying the main exploitable outcomes expected to come out by the end of the project. Second, it lays out the consortium's strategy for project Communication and Dissemination and exposes the mechanisms that have been set up to facilitate it.

1.2 Target audience

This report is intended for the European Commission and reviewers, to review and assess the activities have been done so far in the UNIQORN project. It is also intended for the project's stakeholders and provides an overview of project's activities and results.

1.3 Relation to other project work

Exploitation, Communication and Dissemination of the project's results are closely interrelated with the technical work carried out in the project. The success of UNIQORN's exploitation, Communication and Dissemination activities relies on the very same elements that make the project a strong candidate for putting the European industry in the driver's seat of the QTs commercialization path. The innovative solutions proposed in UNIQORN, which answer directly to market needs and future roadmaps, and the strong commitment of the consortium's industrial members are the key elements of UNIQORN quest for success. The work reported in this deliverable is set to provide the means towards maximizing the project's exploitation and innovation potential.

1.4 Structure of the document

This document sets out to define the appropriate UNIQORN exploitation strategy methodology in Section 2, capture the related input per partner and set the scene for further studies towards defining the overall project's value proposition in Section 3. As a next step in a later phase, this value proposition shall be market analysed and maturity assessed. Furthermore, the document outlines the exploitation directions of each individual partner in Section 4.

The document follows on to describe UNIQORN's Communication and Dissemination Strategy in Section 5 including target audience, key messages, objectives of the relevant activities and means to achieve them. Section 6 describes Communication and Dissemination tools and activities carried so far.

2 Exploitation Strategy Methodology

This Section explains the methodology followed to define the project's exploitation strategy. It starts by clarifying the definition of an exploitable outcome in 2.1.1 and the proposition of a generic classification of the project's results in 2.1.2. Building on these constructs, it then introduces in 2.2.1 the methodology to identify exploitation opportunities and challenges by formalising a value proposition canvas, and through the lean canvas methodology of 2.2.2 to support the business case development for mature direct exploitable assets.

2.1 Exploitation Potentials & Project Results

This section clarifies the types of exploitable outcomes and proposes a classification of project results. These are the basic constructs upon which the exploitation methodology presented subsequently is based.

2.1.1 Types of Exploitable Outcome

Various types of partners may participate in a R&D EU funded project -universities, research centres, commercial companies and SMEs-, and depending on their expertise and areas of interest, the exploitation strategy and activities vary accordingly. Universities and Research Centres focus on exploitation activities regarding research items, while commercial companies and SMEs are mainly involved with the exploitation of commercially oriented products. In the light of this diversity, we can identify five major categories of exploitable outcomes:

- **Product development**, which includes the introduction of new products/features (together with a roadmap definition) and the product validation that increases the technology readiness level (TRL) towards a successful deployment. This outcome category is related mostly to commercial companies and SMEs.
- **Business development**, which includes enhancement of existing processes/services and/or the creation of new services/activities. This outcome category is also related mostly to commercial companies and SMEs.
- **Standardization**, a process through which the commercialization and sustainability of a project's results can be supported. Partners that are actively involved in standardization and regulatory activities may promote project results to provide technical contributions to relevant standards bodies.
- **Research achievements**, including publications, IPRs and prototypes and can be produced by all partners.
- **Start-Up companies**, which can be established mainly by Universities and Research Centres in order to exploit one or more project's outcomes and to pursuit Product developments.

The exploitable outcome categorisation is graphically depicted in figure below.

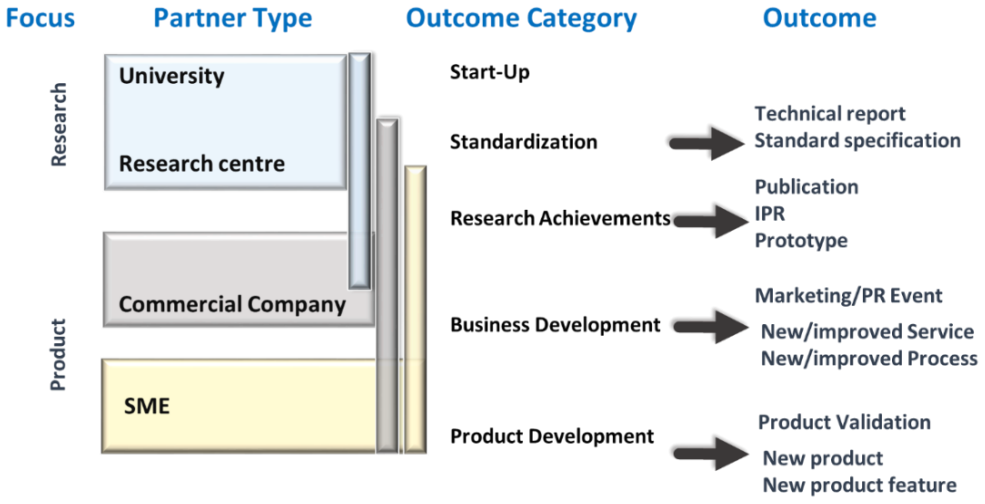

Figure 1: Partner Type and Related Exploitation Types and Outcomes.

2.1.2 Categories of Project's Results

UNIQORN, as a European-funded research project with contributions from partners of varying focus and type, is considered to deliver results that span across the following categories:

- **Demonstrators** – of one or more UNIQORN results/products in the field or in lab environment; either as Proof of Concept (PoC) or as Solutions addressing specific end-user needs. Demonstrators are usually joint results of more than one partners and partner types.
- **Prototypes** – stand-alone, modular products which have been either developed or enhanced in the context of the project. Prototypes may be developed by commercial companies and SMEs or by academic or research initiatives with no direct commercialization capability.
- **Validation Activities** – aiming at validating the functionalities of specific products; these can be considered as exploitation activities aiming at increasing the technology readiness level of the associated products.
- **Contributions to standardization and publications** – indirectly exploitable results delivered to the industry through standardization and dissemination paths.
- **Other Achievements** – activities/tools aiming at enhancing processes/services related to the introduction/deployment of the project results (ex. studies, algorithms, techno-economical tools, knowledge transfer etc.).

2.2 Exploitation Methodology

There are two prevailing models in the market for customer-centric identification of the exploitable potentials for a given product/result: the Value Proposition Canvas that is presented in Section 2.2.1 and the Lean Canvas in Section 2.2.2 for more mature propositions.

The process to be followed encompasses the following steps:

1. As a first step each project member provides input towards the potential exploitable outcomes that s/he contributes to. This is a structured information associating the Outcome with the Result Category, an Exploitation Type and the target Customer Segment. This is assessed and aligned across the project to offer a concrete final list.
2. For each Exploitable Outcome and Customer Segment, the Value Proposition Canvas is filled in. Through the identification of gains, pains and opportunities a clear and structured value proposition statement for the outcome is provided.
3. For the Outcomes with promising Value Propositions, the Lean Canvas methodology is used to further analyse the exploitation potential and identify the key parameters to build the business case.

2.2.1 Value Proposition Canvas Methodology

The Value Proposition Canvas [1] has two sides, the Customer Profile (on the right) and the Value Proposition (on the left) and is graphically depicted in Figure 2.

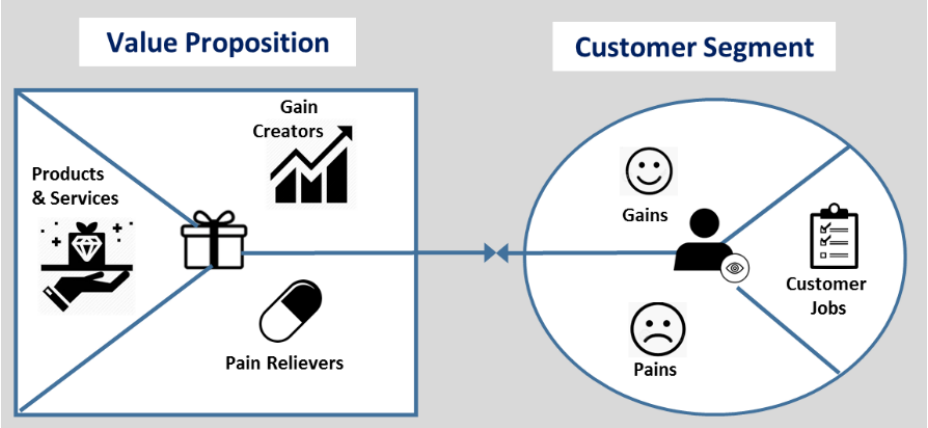

Figure 2: Value Proposition Canvas.

The Value Proposition part is used to depict and identify information regarding the features of a product or service targeting a specific Customer. The Value Proposition is broken down into:

- **Products and services**: the list of UNIQORN products and services targeting the value proposition to a specific customer segment.
- **Pain relievers**: the ways in which these product and services will alleviate specific Customer Pains.
- **Gain creators**: the ways in which these products and services can create gains for the Customer.

The Customer Segment describes the target customer profile and relevant key information to understand the expected value to be provided by UNIQORN results:

- **Customer Jobs**: the existing customer jobs and business processes executed by the prospect (corporate) users that are relevant to each UNIQORN product.
- **Pains**: the risks, obstacles, problems related with the existing way (without the UNIQORN product) of performing the Customer Jobs.
- **Gains**: the outcome customers want to achieve or concrete benefits they are seeking from their Jobs.

2.2.2 Lean Canvas Methodology

The Lean Canvas Model is a business-case development method that is based on the graphic representation of a number of variables, which show the values of a business and/or organisation. Lean Canvas is adapted from The Business Model Canvas [2][3] and can be applied at for direct exploitable assets of a commercial initiative. The Canvas is presented in the table below.

Table 1: Lean Canvas Model.

<table>
<tr><th>PROBLEM</th><th>SOLUTION</th><th rowspan="2">UNIQUE VALUE PROPOSITION</th><th>UNFAIR ADVANTAGE</th><th rowspan="2">CUSTOMER SEGMENTS</th></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="2"></td><td>KEY METRICS</td><td>CHANNELS</td></tr>
<tr><td>EXISTING ALTERNATIVES</td><td></td><td></td><td>EARLY ADOPTERS</td></tr>
<tr><td colspan="3">COST STRUCTURE</td><td colspan="2">REVENUE STREAMS</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td></tr>
</table>

The key parameters foreseen in the Lean Canvas Model are explained in detail as follows:

- **Problem**: The top problems that can be addressed from the product/service, addressing the jobs that are affected, why, how and who is concerned.
- **Existing Alternatives**: Other solutions currently solving the same or similar problem.
- **Solution**: A brief description of what the solution does and how, with special focus on the main features that differentiate it from the alternatives.
- **Key Metrics**: Key activities that will be measured to track the success (e.g., units sold, users registered)

- **Unique Value Proposition**: The critical success factors of UNIQORN's product proposition towards satisfying customers' needs especially in comparison to the alternatives. The statement should underline the product's uniqueness and provide numbers to explain performance gains.
- **Unfair Advantage**: Identify advantages compared to the competition, such as acquisition, switching and maintenance costs
- **Channels**: Detail the channels to be used to contact customers, promote and deliver the value promised.
- **Customer Segment**: The customer segment in focus, who has the problem and would be interested in buying the solution. The customer segment can be split in vertical segments to identify the strongest vertical to target for.
- **Early Adopters**: A small niche that is having the biggest problem, the ones who suffer the most and could become early adopters. In the process of identifying early adopters, geographic location, industry and connection to the problem are important aspects.
- **Cost Structure**: The main costs as soon as the solution is ready for the market (e.g., customer acquisition costs, distribution costs, hosting, human resources costs, etc.). To build a subtle business case the costs should be estimated in the short term (six months) and longer-term (three years). In the case of research projects like UNIQORN that are not aiming to release a product within their duration, the target is to identify the factors affecting the final cost structure and revenue streams.
- **Revenue Streams**: The main revenue streams when the solution is ready for the market in the short-term (six months) and longer-term (three years).

3 Identification and Classification of UNIQORN Exploitable Outcomes

Based on the methodology defined above, the exploitable UNIQORN project results are depicted in the table below, listed in the following sub-categories:

a) software design and fabrication of quantum enhanced PICs;
b) integrated components for quantum comm devices;
c) tools for quantum networks;
d) quantum comm devices;
e) applications.

A colour code is used in the table to highlight the different project result categories, namely: green (prototype), blue (validation activity), and orange (demonstrator).

Table 2: Project Exploitable Results Identification and Classification.

Title	Description	Exploitable Outcome	Project Result Category	Exploitation Type	Customer	Involved Partner(s)	Individual or project exploitation (product development)
Software design and fabrication of quantum enhanced PICs							
SPAD integration services	The SPAD services include the design and manufacturing of room temperature SPADS as well as the process methodology to integrate them on the photonic PolyBoard platform	SPAD array pigtailing	prototypes	product development	Research Institutes, component/ system vendors	POLIMI, CORDON	individual
		SPAD array with increased efficiency	prototypes	product development	OEM customers working and-or in industry or typical MPD customers working in research institutions and universities	POLIMI, MPD	individual
		SPAD arrays	prototypes	product development	OEM customers working in the quantum communication field	POLIMI	individual
		SPAD readout logic	prototypes	product development	OEM customers working in the quantum communication field	POLIMI	individual
		PolyBoard+SPAD integration	prototypes	Product development	Research Institutes, component/ system vendors	HHI-POLIMI, CORDON	project
Quantum-capable PIC fabrication services	Extension of the current design and fabrication methods	Quantum-capable PIC design and fabrication services	prototype	product development	University, component/ system vendor	HHI, Smart	individual individual

	in well-established photonic integration platforms (InP and PolyBoard)to support quantum communication functionality						
Quantum PIC integration	Demonstrating the feasibility to package Quantum Systems on Chips	Quantum PIC integration and packaging service	prototypes	product development	University, component/ system vendor	CORDON	individual

Integrated components for quantum comm devices

Quantum SoC	Demonstration and evaluation of quantum communication capabilities on InP and PolyBoard integration platforms	time bin entanglement source	validation activity	research achievements	Research Institutes, component/ system vendors	UIBK	project
		pol entangled photon source	validation activity	research achievements	Research Institutes, component/ system vendors	UNIVIE+AIT	project
		QRNG PolyBoard	validation activity	research achievements	Research Institutes, component/ system vendors		project
		heralded photon source	validation activity	research achievements	Research Institutes, component/ system vendors	UPB	project
		modulated coherent states source	validation activity	research achievements	Research Institutes, component/ system vendors	NTUA	project
		1550 nm up-conversion DV receiver	validation activity	research achievements	Research Institutes, component/ system vendors	UPB	Project
		squeezed light source	validation activity	research achievements	Research Institutes, component/ system vendors	HHI, DTU, UPB	Project
		second harmonic generation	validation activity	research achievements	Research Institutes, component/ system vendors	HHI, UPB	project
		photonic cavity on PolyBoard	validation activity	research achievements	Research Institutes, component/ system vendors	HHI	project
High-sensitivity TIAs	Design and manufacturing of amplifiers, based on enhanced CMOS fabrication processes, for CV quantum communication systems	High performance TIA for CV quantum communication	Prototype	product development	University, component vendor	imec	individual

Tools for quantum networks

Entanglement distribution solution	Design and setup of a node consisting of an entangled photon pair source and an active routing device	multi-node entanglement system (demonstrator)	validation activity	research achievements	Research Institutes, component/ system vendors	UNIVBRIS	project
SDN framework for entanglement distribution	Software component to monitor and control the entanglement routing in a multi user network	SDN framework for entanglement distribution	validation activity	research achievements	Research Institutes, system vendors	UNIVBRIS	project
quantum communication emulation SW	Development of software tools used to emulate quantum correlations for various types of quantum communication links	emulation tool for quantum correlation	prototype	product development	Research Institutes, component/system vendors	AIT	individual
QKD system design software	Extension of existing simulation software tools with functions for DV and CV quantum communication	design software for weak-coherent quantum-secure communication systems (CV and DV)	prototype	product development	Research Institutes, component/system vendors	VPI	individual

Quantum comm devices

QRNG appliance	Assembly of QRNG device and design of application for the QRNs	quantum-secured communication protocols on NIC	prototype	product development	OEM customers working in the quantum communication field	MLNX	project
		QRNG device based on quantum SoC	prototype	product development	OEM customers working in the quantum communication field	MPD	project
DPS transmitter	Integration and packaging of a modulated weak coherent-pulse source	DPS transmitter	prototype	product development	OEM customers working in the quantum communication field	AIT, NTUA	project
Programmable EPR node	Integration and packaging of an entangled photon source and active optical switch with WDM capabilities	QROADM	prototype	product development	OEM customers working in the quantum communication field	HHI, AIT, UNIVBRIS, NTUA	project

homo-heterodyne CV receiver	Integration and packaging of a receiver device for CV quantum communication	balanced detector + TIA	Prototype	product development	component system/vendor	smart, TU/e, imec	project

Applications

Data Centre Use Case	Development of application software and demonstration of QKD in a data center use case	QKD in Data Centre Use Case	Demonstrator	Business Development	ICT Provider	MLNX, COSM	shared
MEC Use Case	Development of application software and demonstration of QKD in a MEC use case	QKD in MEC Use Case	Demonstrator	Business Development	Mobile Operator	UNIVBRIS, COSM	shared
FTTH Use Case	Development of application software and demonstration of QKD in a FTTH use case	QKD in FTTH Use Case	Demonstrator	Business Development	Fixed Operator	ICCS, COSM	shared
one-time signatures	Development of application software running a quantum one-time algorithm and field demonstration	message authentication	demonstrator	Product development	Fixed Operator	COSMOTE	shared
		quantum-secured one-time program	demonstrator	Product development	Fixed Operator	UNIVIE	shared
private data retrieval	Development of an application software running quantum OT for private information retrieval	database query	validation activity	research achievement	Research Institutes, component/system vendors	COSMOTE, UNIVIE	project
		quantum oblivious transfer	validation activity	research achievement	Fixed Operator	DTU, AIT	project

Colour code

Green	Prototype
Blue	Validation Activity
Orange	Demonstrator

4 Individual partner exploitation plans

In parallel to the above study, which elaborates on UNIQORN's exploitation opportunities as a whole, the consortium partners have identified their individual exploitation directions. Indeed, UNIQORN presents huge exploitation potentials for its consortium members that the latter have identified from its early stages. Table 3 below outlines the exploitation map of the innovation actions that the industrial partners of UNIQORN have qualified as commercially exploitable. More detailed exploitation plans per project will be provided in internal reports.

Table 3: Exploitation map of UNIQORN technology.

Innovation	**Silicon SPADs at 800 nm**	**InP for Q-PICs**	**Polymer Q-interposer**	**Low-noise electronics**	**Q-system design tool**	**Packaging of Q-SoCs**	**Q-NICs**	**DPS system with pluggables**	**Q-network management**	**Q-cloud and IoT services**
TRL (M01-M36)	2-5	3-7/4-7	3-6	3-6	3-6	4-7	3-7	3-7	3-6	3-6
Involved partner	MPD	Smart	HHI	IMEC	VPI	Cordon	MLNX	MLNX, COSM	UNIVBRIS, COSM	COSM
Type of exploitation after project end	Development of products for next generation quantum systems	Incorporation of quantum-grade structures and components in standard toolbox of the platform	Incorporation of quantum interposer in the standard toolbox of the platform.	Service provision for the design of this type of electronics. Collaboration with component vendors.	Development of relevant tool and incorporation into standard VPI simulation tool portfolio	Service provision for packaging of this type of components.	Incorporation of smart NICs with QRNG and NICs with CV Rx into standard product line	MLNX: Incorporation of DPS systems in product portfolio COSM: adoption of these systems In existing PONs.	UNIVBRIS: Collaboration with system vendors COSM: Incorporation of this type of tools in real networks.	Incorporation of Q-services in standard commercial service portfolio.
CSWR analysis: Competition Strengths Weaknesses Risks	**C:** Solutions at other λs. **S:** Simplicity, no cooling, high efficiency. **W:** Need for nonlinear effects to go to 800 nm **R:** Need for good integration.	**C:** None specific at the moment, in future other InP foundries. **S:** Established foundry with extensive PDK. **W:** None specific. **R:** Not specific Q-activity yet	**C:** None specific at the moment. **S:** Broadband multi-functional, low-cost. **W:** Bigger compared to SOI solutions. **R:** Never tested in Q-framework.	**C:** Other CMOS approaches **S:** Low-cost, superior designs and performance. **W:** None specific R: Never tested in Q-framework and as part of Q-SoCs.	**C:** None specific at the moment. **S:** Long experience with similar tools. **W:** None specific **R:** Not specific modelling of Qcomponents yet.	**C:** None specific, possibly various in the future **S:** Experience with polymer and InP platform. **W:** Not previous experience with Q-SoCs. **R:** As above.	**C:** None specific, possibly various in the future **S:** Large vendor and knowhow. **W:** Non specific. **R:** Not previous experience with Q-graded NICs.	**C:** None specific **S:** Disruptive but realistic, size of system vendor, market penetration potential. **W:** None specific **R:** New type of system, market not established there.	**C:** Various: None specific at the moment **S:** For UNIVBRIS, extensive knowhow. **W:** For COSM, too disruptive concept. **R:** For COSM, network investments will be needed.	**C:** None specific at the moment **S:** Possibility for early entry in these markets **W:** Greece might prove a small market for these services. **R:** As above

Exploitation potential	**Very high:** Vital, and much simpler system for single photon detection.	**Very high:** Given the belief that photonic integration is the only way to make Q-technology go practical.	**Very high:** Given the combination of high compactness but still high performance it can offer.	**High:** Given the absolute need for low-noise amplification at the back-end of Q-coherent Rxs.	**High:** Given that Q-tools similar to standard optical system tools will be needed for academic or industrial use.	**Very High:** Given that compact, low-cost devices will be a pre-requisite for mass Q-system deployments.	**Very High:** Given that development of Q-graded NICs will be needed for practical systems	**Very high:** Given the low cost and the compatibility of this system with standard PON equipment and operation.	**Very high:** Given that the Q-systems will be deployed in a form of a Q-overlay that should be coordinated with classical traffic.	**High:** in first years **Very high:** Later when commercial maturity will be reached.
Conflicting IP	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Time-to-market after project end	<1 year	<1 year	<1 year	<2 years	<2 years	<3 years	<2 years	<2 years	<4 years	<2 years
Targeted market	Q-technologies in general	Q-technologies in general	Q-technologies in general	Q-comm. Systems (CV)	Q-comm. Systems (CV/DV)	Q-technologies in general	Q-comm. Systems (CV/DV)	Q-secured IoT applications	Q-comm. Systems (CV/DV)	Q-secure IoT, database access, cloud processing
Expected ROI	> 2 years	> 2 years	> 5 years	> 4 years	> 3 years	> 5 years	> 4 years	> 3 years	> 3 years	> 5 years
	MAIN BUSINESS CASE for the quantum engineers (AIT, UPB, DTU, UNIVIE and UIBK) and the other academic partners (ICCS/NTUA, TUE, POLIMI): The main exploitation path for the quantum engineers includes the establishment of close collaboration with the photonic integration and packaging partners in order to develop devices that can facilitate the quantum concepts in a compact, practical and inexpensive way. Moreover, it includes establishment of close collaboration with system partners like MLNX and COSM that can turn these concepts into commercial products and applications over real networks. The participation of the quantum engineers in UNIQORN project thus represents a unique opportunity for establishing all necessary collaborations and bringing quantum research from a theoretical level all the way up to a very tangible level with the commercialization of quantum secure applications like one-time functions, oblivious transfer and secure communication of critical IoT signals. For the academic photonic partners, on the other hand, the participation in UNIQORN is a unique opportunity to bridge the photonic and the quantum worlds, and contribute with their photonic circuit design and their optical system design capabilities to the successful incorporation of the quantum concepts into real optical communication networks									

5 Communication and Dissemination Strategy

The UNIQORN communication and dissemination activities aim to communicate to a very diverse range of recipients the objectives, the technical concepts and results of the project, to describe the expected benefits from the project technology in the years to come and to make the projects scientific results available to those who can use them in the best way.

The UNIQORN consortium as a whole and the individual partners will perform dissemination and communication activities to maximize the visibility of the project and to present the project's advancements and results to their own countries and communities.

In order to maximize the efficiency of the dissemination and communication activities, the overall communication strategy will be based on:

- Clear identification of the different types of target audience and definition of the respective communication strategy for each one of them.
- Definition of the objectives of the communication actions in relation to the target audience each time.
- Definition of specific timelines for the promotion plan of the project and care of the coherence and the continuity of the communication actions.
- Involvement of professionals in the communication activities taking advantage of the in-house capacity of some partners.
- Quantification of the outcome of each communication action or promotion campaign (e.g. in terms of number of citations, visits on website, visits at exhibition booths, views on promotion videos or views on live demos) and provision of feedback to the dissemination and communication planning of the project.
- Use of established communication paths of partners to spread the word for UNIQORN and amplify the message.
- Exploitation of communication tools available by the EC.
- Definition of a simple internal procedure for evaluating the soundness and the confidentiality level of any information before dissemination, and creation of dissemination kits with approved technical/business content.

The promotion plan will be regularly updated in order to improve the efficiency of the communication activities and ensure that the provisions of the consortium agreement regarding confidentiality and publication of information are followed.

The communication and dissemination methods used by the consortium are summarized to:

- Project website and social media;
- Press releases;
- Flyers / brochures;
- Participation in Quantum Flagship meetings and events and cluster activities;
- Scientific publications / posters / presentations;
- Participation in workshops / events / exhibitions;
- Project's deliverables;
- Lectures and thesis.

The communication and dissemination strategy is carried out mainly by the UNIQORN consortium. In addition to the overall project dissemination and communication plans, UNIQORN partners have individual plans which fit best to their countries, their expertise and the type of their organization.

5.1 Target Audience

The project's target audience is expected to contribute to the project's success and can be categorized to internal and external stakeholders. Each group will be reached by the consortium

as a whole or by the partners individually.

The internal stakeholders are directly involved and influence the project's direction and comprises the project's partners, which are coming from 9 EU Member States and Horizon 2020 Associated States (Austria, Germany, Denmark, The Netherlands, Italy, Greece, United Kingdom, Belgium and Israel) and the European Commission (EC).

Internal Stakeholders

- 8 academic organizations (UIBK, UPB, UNIVIE, DTU, TUE, POLIMI, ICCS/NTUA and UNIVBRIS);
- industry-oriented research institutes (AIT, HHI and IMEC);
- SMEs (SMART, MPD and VPI);
- large companies (CORDON, MLNX and COSM);
- European Commission.

External stakeholders are not directly involved in the project and an indicative list comprises of:

External Stakeholders

- Research community – industrial and academic research;
- Industry;
- Other relevant to UNIQORN projects – add the other projects from the pillar and the UK;
- Standardization Bodies;
- Students and Trainees;
- General Public.

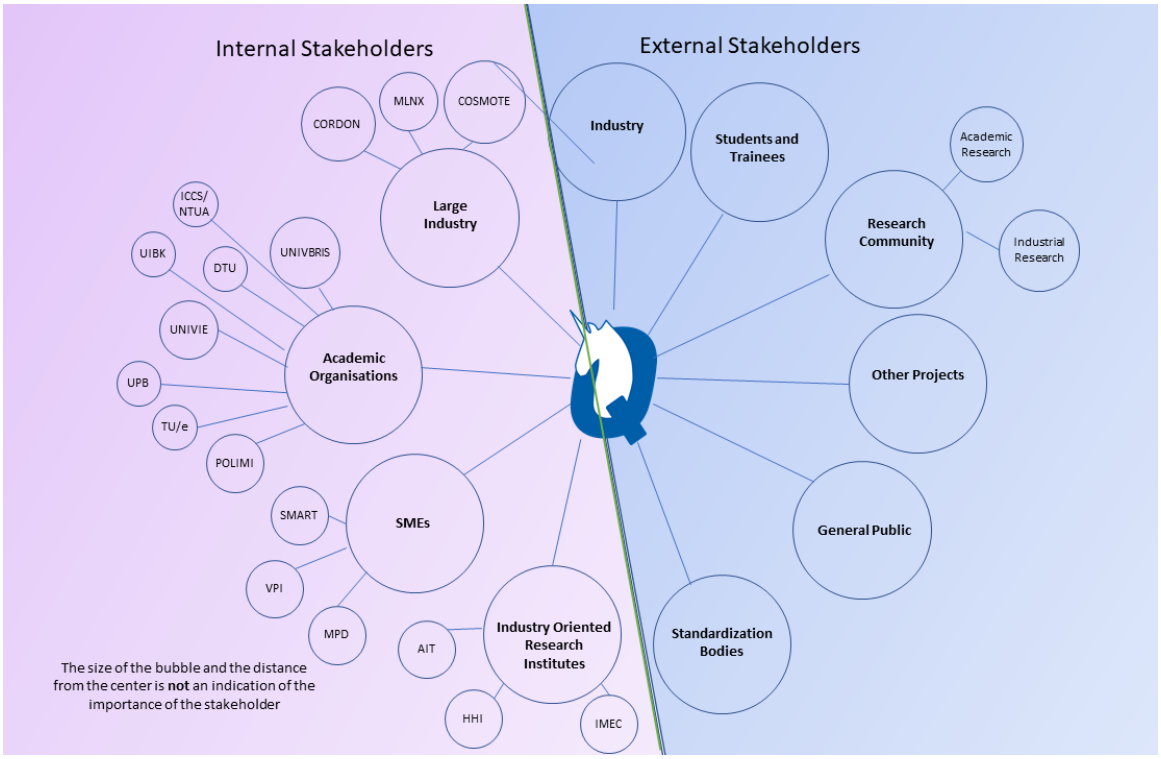

Figure 3: Stakeholder map.

In order to activate the stakeholders' help potential, the consortium designed already in the proposal stage a communication and dissemination strategy and defined the necessary means to achieve the objectives of stakeholders' communication.

5.2 Communication and Dissemination Objectives

The project's communication and dissemination objectives are to share knowledge to, engage with, get feedback from and promote project's activities and results to the relevant stakeholders, which will also ensure the sustainability of the project's results after the end of the project.

The key communication and dissemination objectives of the UNIQORN consortium are to:

- Share the project's activities and results to the relevant stakeholders and to the consortium internally.
- Identify and establish collaborations with other endeavours relevant to the project.
- Prepare and publish scientific papers in high profile conferences and journals in order to distribute the project's results to the scientific community.
- Give the opportunity to young researchers/students to engage and deepen the knowledge on UNIQORN's scientific domain by involve them with thesis and lectures.
- Plan and execute events/workshops with other Quantum Flagship projects to promote research exchange and share knowledge.
- Inform a diverse audience on the quantum communications field and to raise awareness on the benefits and everyday life improvements of UNIQORN's results.
- Establish contacts and collaborations with industry and standardization bodies on national and European level.
- Make the project's results available to the EC and scientific community.

5.3 Means to Achieve objectives in relation to target audience

The suitable means to reach the dissemination and communication objectives depends on the stakeholder and can be impersonal or interpersonal. The following list summarizes the various means/channels used by project partners to maximize the project's impact and to reach all identified stakeholders at national, European and international levels.

Web presence

- UNIQORN website
- Social media – Twitter and LinkedIn
- Partners' websites
- Audio-visual material

Publications

- Scientific Publications
  - Publications in Journals
  - Publications at international congresses
  - Talks at workshops and Symposia
  - Pre-prints (arXiv papers)
- Articles in technical magazines
- Public talks
- Project Deliverables

Media/press

- In the news (periodicals and local newspapers)
- Press releases

Events

- Conferences & Workshops
- Lab visits
- Industry fairs & exhibitions

Joint collaborative tasks & establishment of partnerships

- Activities organised together with other Flagship projects
- Collaboration with project's relevant to UNIQORN in national & international level

Lectures & Theses

- University lectures
- BSc, MSc & PhD thesis

Print Material

- Flyers
- Posters

The following table summarizes the project's identified stakeholders, the communication and dissemination goals for each stakeholder group and the means to achieve these goals.

Table 4: Summary of Stakeholders, communication goals and means to achieve the goals.

Stakeholders	**Communication and Dissemination Goals**	**Communication and Dissemination Means**
Project partners	Share knowledge, engage	Distribution of documents via project collaboration tool, project meetings and internal presentations to other units and departments, research visits, website and social media
Research community	Share knowledge and results, get feedback, engage	Scientific articles in journals and conferences, presentations and posters at conferences and workshops, research visits, website and social media
Industry	Share knowledge and results, get feedback, promote the project, engage	Participation in exhibitions and industry fairs, standardization activities, website and social media
Other relevant to UNIQORN projects	Share knowledge and results, get feedback, engage	Initiate technical cooperation, organise joint workshops and conferences with other projects
Standardization bodies	Influence policy and practices	Participation is standardization bodies meetings
Students and trainees	Attract students to share the existing knowledge (training/education) and generate new insights (foster research in UNIQORN related problems), and to train employees/students	Give lectures, offer research opportunities through thesis and trainings
General public	Raise awareness	Website, social media, videos, events, popularized publications

5.4 Communication and Dissemination Strategy Monitoring

In order to monitor and evaluate the success of the communication and dissemination activities, the consortium introduced KPIs which are presented in the following table.

Table 5: Dissemination and Communication KPIs.

Category	**Quantitative Measures**	**Qualitative Measures**
Scientific publications	• Number of accepted publications • Joint/solo publications • Citations	• Publications in high profile conferences and journals • Topics
Conferences/workshops/ industry events	• number of conferences/workshops attended/organised • Number of industry events attended	• Evaluation of networking and feedback received • Geographical distribution
Website*	• Number of unique visitors • Number of total visitors	• Evaluation of the most visited pages
Social media*	• Twitter impressions • Followers • LinkedIn max views on post • YouTube videos	• Evaluation of topics of interest of the followers: videos, events, publications, interviews
Collaboration with other projects	• Number of interactions	• Results from collaboration, technical collaboration

6 Communication and Dissemination Tools and Activities

The UNIQORN dissemination and communication strategy and roles have been already defined in the proposal stage. The aim of the dissemination and communication activities is to raise awareness and promote the project and inform and engage with the project stakeholders. In order to reach all identified Stakeholder groups, the consortium will carry out activities, taking into consideration their attitudes, habits, and preferences. The communication and dissemination strategy will be reviewed periodically and updated if needed.

During the first 18 months of the project, the UNIQORN consortium actively participated to communicate and disseminate the project's activities and results. The goal in the firsts 18 months of the project is not only to reach out to the stakeholders to inform about the project's activities and to make the project's results available to those who can do best use out of them, but also to demonstrate how EU funding contributes to tackling societal challenges.

6.1 Visual Identity

The general communication is based on the corporate graphical identity of the project, in order to easily identify the project. For this reason, a project logo in three different versions has been created, a visual identity (colour palette) has been defined and set of templates to distribute information internally and externally has been used. The EU emblem is used next to the project's logo as well.

6.2 Web Presence

6.2.1 UNIQORN Website

The UNIQORN website (https://quantum-uniqorn.eu/) is a versatile communication and dissemination tool, which can be accessed any time and has been set up and maintained from the beginning of the project. It contains information material all relevant to the project stakeholders and gives the opportunity to the UNIQORN consortium to promote project's activities and results. In brief, the website serves as a repository for the interested audience, but external to the project. The website is maintained by AIT with contributions from all project partners. In addition, the project partners are distributing information about UNIQORN on their organisations' websites.

In December 2019 UNIQORN introduced the UNIQORN Advent Calendar, where the project's technology, results, other relevant project information, Christmas stories connected to the quantum communication technology and tasty recipes were revealed every single day in December and addressed a diverse audience. This novel for an EU funded research project activity, where all partners contributed with their stories, was very popular, and received good reviews and brought high visibility to the project as can be also seen by the website and twitter statistics.

Figure 4: Advent Calendar stories: (left) putting up the Christmas tree and (right) on-chip Source for Time-bin Entangled Photon Pairs.

The following figure shows the evolvement of the project's visitors in the first 17 months of the project in a monthly basis. It can be observed that there is an increasing tendency. Moreover, it can be seen the impact of the advent calendar in December 2019 in project's visibility. The promotion of partner's activities and the dissemination of project's results through the social media and the participation of partners in various conferences and events resulted in a successful building of a stable visitor base. In addition, the total visitors is always higher than the unique visitors which means that they keep coming back to the website to consult about the project. Moreover, the website is accessed by many countries outside Europe as well.

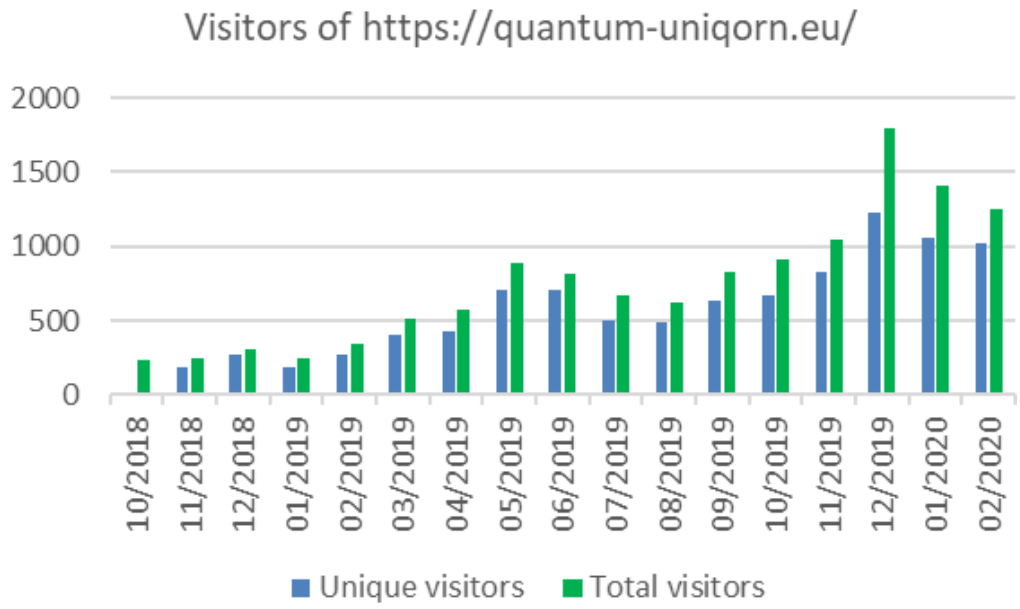

Figure 5: Website statistics

For the website statistics, AIT uses the AWStats platform, which gives the following definition for the unique visitor: "A unique visitor is a person or computer (host) that has made at least 1 hit on 1 page of your web site during the current period shown by the report. If this user makes several visits during this period, it is counted only once. Visitors are tracked by IP address, so if multiple users are accessing your site from the same IP (such as a home or office network), they will be counted as a single unique visitor."

6.2.2 Social media

In order to maximize the project's impact by reaching a wider audience and to allow for bi-directional communication Twitter and LinkedIn accounts have been set up and maintained from the project's start. Twitter (https://twitter.com/UNIQORNFlagship @UNIQORNFlagship) and LinkedIn (https://www.linkedin.com/in/quantumuniqorn/) platforms have been selected since they are more business-oriented social media platforms, which are used by the project's close and extended community. These accounts are maintained by AIT with contributions from all project partners. Form our experience, the Twitter account is a more suitable channel to share information about the project with the interested community. Thus, in the following we present the twitter statistics.

The key indicator we are using to monitor the twitter impact in project communication is the "impressions" which is defined as the number of "times a user is served a Tweet in timeline or search results".

Overall, we gained more than 116k impressions within the first 17 months of the project. The following figure shows the impression per months. As it can be seen, impression picks are connected to events, meetings, or workshops organized or attended by the project partners. As mentioned above, the Advent Calendar results in high project visibility in December, where we also had the highest number of impressions in the first reporting period.

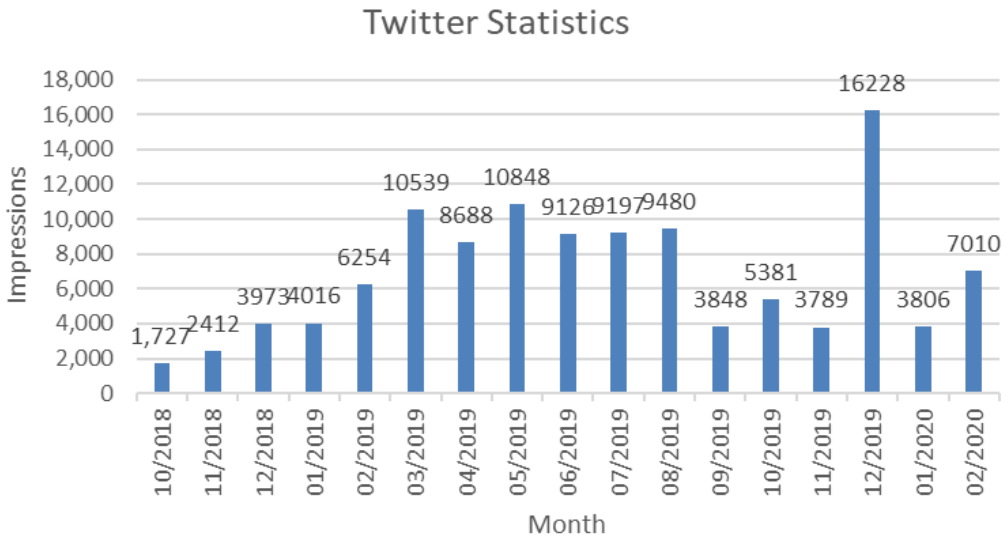

Figure 6: Twitter statistics.

LinkedIn has less connections. However, the quality of contacts and the visibility they give to the project by sharing the project's information makes it a useful tool for the project communication as well.

6.2.3 Videos

The UNIQORN consortium created in M10 of the project the promotional project video (https://youtu.be/PQoVeF2jGEU), explaining the main idea, ambition and goals of the UNIQORN project, as well as the scientific concept of the project and the related benefits of its applications in everyday life. The video has been designed in a way so that it will be understood from a diverse audience. The video was published on the project's YouTube channel and distributed to the public via the project's website and social media accounts. This video has been also produced with Greek subtitles and got more than 500 views so far. Moreover, other lab videos and videos from different events are published in the project's YouTube channel.

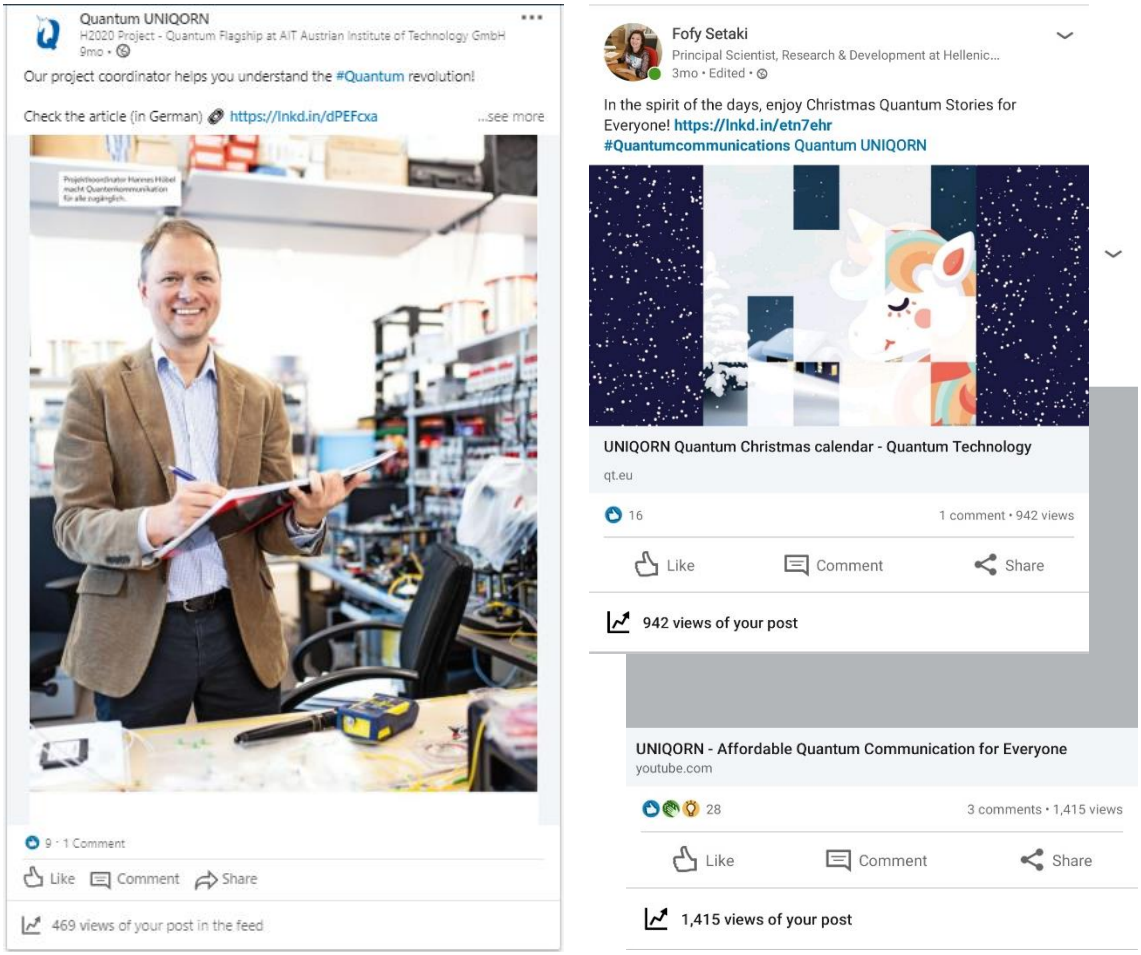

Figure 7: LinkedIn posts.

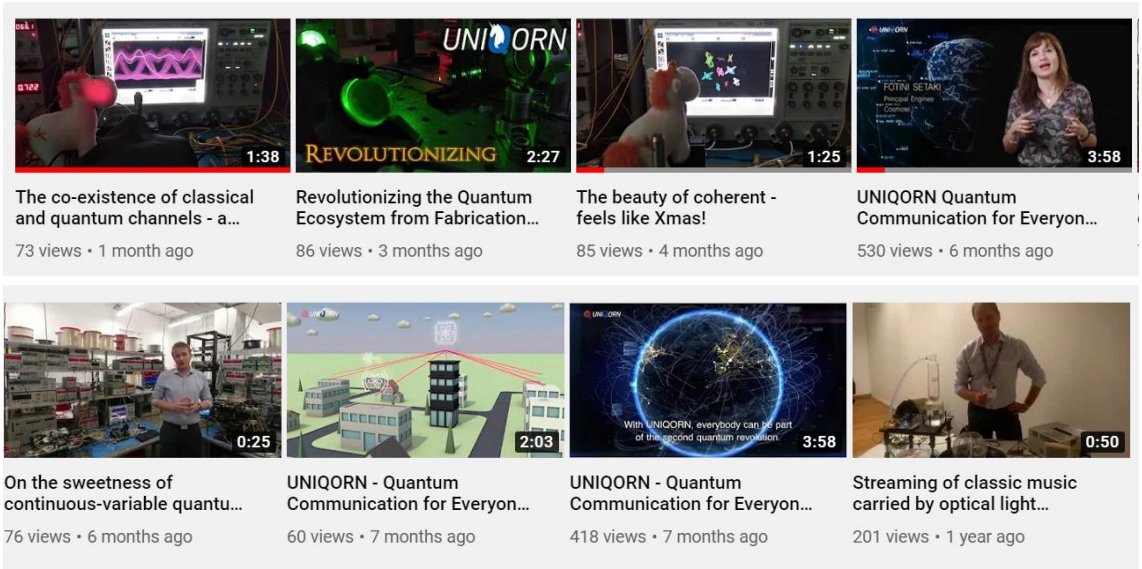

Figure 8: UNIQORN videos produced until M18.

6.3 Scientific Publications

During the first 18 months of the project, the project partners prepared and published peer reviewed scientific publications and articles in technical magazines and journals to promote and

make the project's results available to the scientific community. According to Article 29.2 of the Grant Agreement, the authors deposited a machine-readable electronic copy of the published version or final peer-reviewed manuscript accepted for publication in a repository for scientific publications. Moreover, the project partners gave talks in conferences and workshops. An overview list of the scientific publications published by the project partners can be found in the Appendix and in the project's website as well.

In the first 18 months of the project, we have 22 peer-reviewed conference and journals publications accepted and presented by the partners either as talks or posters in the conferences. Almost all publications have been jointly prepared with the participation of the academic and industry internal to the consortium partners or with external to the consortium collaborations.

In addition to the conferences and journal scientific publications the project partners prepared and submitted technical deliverables to the EC. These deliverables will be available at the project's website after approval by the EC.

6.4 Press Releases, periodicals and local newspapers

The consortium will inform the stakeholders on interesting project results through press releases in different languages. An official press release have been prepared and published at the beginning of the project. In addition, the project partners prepared and published press releases in other languages such as German, Greek, and Dutch. Moreover, articles in local newspapers such as in Heise Magazine, "Wien Wissen", and "Wiener Zeitung".

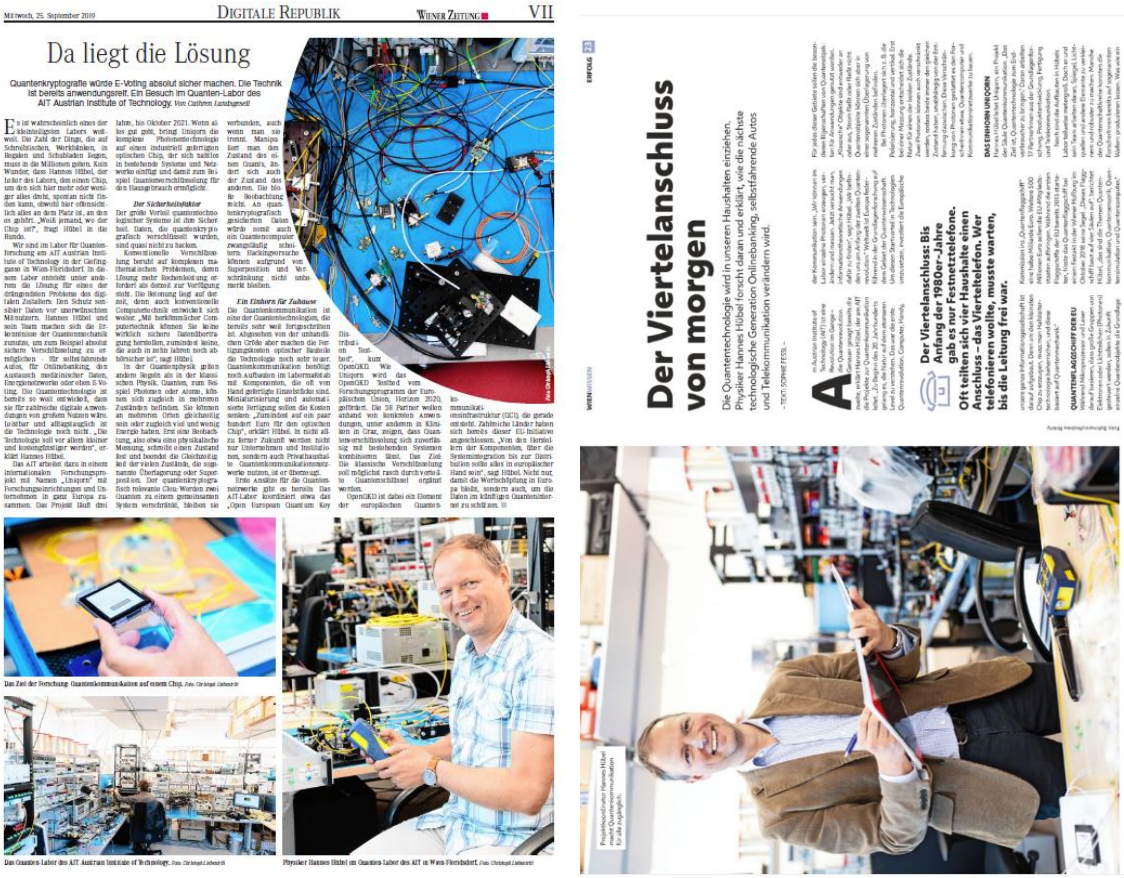

Figure 9: Screenshots from local newspapers.

6.5 Major Events/ Workshops/ Exhibitions

The objective of the project is to be present, through the submission of publications, posters and talks, in high profile conferences and events or to showcase its results by having a booth or participating in panel discussions in exhibitions. The idea of participating in different events is to share knowledge, interact with the identified stakeholders and the community and to showcase the available UNIQORN technologies and to contact public experiments. Moreover, the UNIQORN partners participate in events to establish synergies with other initiatives close to the scope of UNIQORN to share results and save effort and resources.

During the first reporting period, the project partners participated in various high-profile conferences and events in the field of quantum and photonics. The full list of events attended by the project partners so far can be found in the Appendix in the "Dissemination and Communication Activities" table. In addition, impressions on the events can be found in UNIQORN's website.

In the following we list some of the highlights.

- OFC 2020 & OFC 2019- The Optical Networking and Communication Conference & Exhibition, San Diego, California, USA.
- SPIE. Photonics West 2020 & 2019, San Francisco, California, USA.
- INFOCOM World 2019, 26 November 2019, Athens, Greece
- ECOC 2019 – The 45th European Conference on Optical Communication, 22 - 26 September 2019, Dublin, Ireland.
- QCRYPT 2019 - 9th International Conference on Quantum Cryptography, 26 – 30 August 2019, Montreal, Canada.
- ICTON 2019 – 21st International Conference on Transparent Optical Networks, 9 – 13 July 2019, Angers, France.
- OPIC 2019 Optics and Photonics International Conference 20 - 24 April 2020, Pacifico Yokohama, Japan.
- OFC 2019 - The Optical Networking and Communication Conference & Exhibition, 7 March 2019, San Diego, California, USA.
- ICT 2018: Imagine Digital - Connect Europe – Networking Session "Beyond 5G", 6 December 2018, Vienna, Austria.

In addition, the project partners participated in events organised by the Quantum Flagship as well as the workshops of the Quantum Flagship Science and Engineering Board.

- Quantum Flagship kick-off event, 29-30 October 2018, Vienna, Austria.
- EQTC 2019 - European Quantum Technology Conference, 18-22 February 2019, Grenoble, France.
- WMC 2019 - World Mobile Congress, 24 – 28 February 2019, Barcelona, Spain

The consortium as a whole and the project partners individually will continue to actively promote the project and its results through future organisation and participation in national, European and international events and events organised by the Quantum Flagship.

Figure 10: Snapshots from events with UNIQORN participation.

6.6 Joint Collaborative Tasks and Establishment of Partnerships

The UNIQORN partners started interactions with other European and national initiatives in the field of Quantum Technologies, in particular the field of quantum communication systems. Efforts for clustering and coordination of activities will specifically address the other projects of the FET Flagship on quantum technologies, the Coordination and Support Action on Quantum Technologies that has be launched by the Quantum Flagship.

At the moment of compiling this document, the Science and Engineering Board of the Quantum Flagship is organising different focus groups were the UNIQORN partners will have the chance to participate and establish better collaboration.

The UNIQORN partners had the chance to participate in all events/activities organised by the Quantum Flagship and meet with other projects' representatives and exchange ideas for collaborations. At the moment the UNIQORN partners are setting the ground for collaborations

with other Flagship projects from the same pillar, and the results will be presented in the second half of the project.

Moreover, with the participation of three UNIQORN partners is the QCI project OPENQKD, the partners will seek to benchmark our technology in the testbeds.

When it comes to the scientific publications, there is already a joint publication between UNIQORN and CiViQ titled “Analysis of the trusted-device scenario in continuous-variable quantum key distribution”, and more are expected in the future.

HHI is part of the German QuNET project on Quantum Communications initiated by the federal ministry of research and education and UIBK is involved with the FWF-funded SFB BeyondC. In addition, HHI and UIBK have granted a project from the national QFTE call (FWF) on Quantum Range-finding. It is, in part, an outcome of UniQorn, because it involves a collaboration with HHI based on collaboration within UniQorn.

6.7 Lectures and Theses

University students will have the chance to contribute to the project’s research activities and choosing their thesis or parts of their thesis on the research topic of the project. Moreover, the UNIQORN consortium will present the project’s research activities and results in several courses in universities in order to raise awareness. These activities are also considered as “academic exploitation”. An overview table with the thesis written in the scope of UNIQORN can be found in the Appendix.

6.8 Print Media

UNIQORN posters and flyers has been designed and updated in order to be perfect fit for the conferences and events. The print material includes information about the project such as project’s objectives, partner information and technologies. This material can be found in project’s website under the “Communication kit” page.

6.9 Sustainability of project’s results

In order to ensure sustainability of UNIQORN results the consortium partners will continue to perform communication and dissemination activities. In particular, the project’s website and social media accounts will be online for three years after the end of the project and will be updated with various project information, the technical public deliverables will be uploaded to the project’s website after review and approval by the EC, the project partners will try to develop ideas for collaboration and integration, use and adoption of the project’s results to upcoming projects, and the coordinator will cooperate with the EC to contribute to leaflets relevant to the project’s topic.

7 Conclusion

UNIQORN is a research-intensive project introducing significant innovations across the board, from component to system and network level. The project presents manifold exploitation opportunities to the members of the consortium and is already generating substantial material for communicating the project results to a broad audience and disseminate to the research community. The present document outlined the exploitation strategy methodology and identified the main exploitable outcomes of the project.

In the next phases of the project, partners will select the exploitable outcomes with the most promising value proposition and will further analyse them to identify the key parameters to build the relevant business case.

The report continued to describe the communication and dissemination strategy and the mechanisms that were put in place by the consortium and listed all activities performed so far. In the next period the partners will continue to execute the communication and exploitation plan and increased outputs are expected as the technology matures.

8 References

[1] Osterwalder, A. (2014). Value proposition design: how to create products and services customers want. John Wiley and Sons.
[2] Osterwalder, A., & Pigneur, Y. (2013). Designing business models and similar strategic objects: the contribution of IS. Journal of the Association for Information Systems, 14(5), 237-244.
[3] Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers and challengers. John Wiley & Sons.

Appendix

Scientific Publication M01 – M18

1. N. Vokić, D. Milovančev, B. Schrenk, M. Hentschel, and H. Hübel, "Differential Phase-Shift QKD in a 2:16-Split Lit PON with 19 Carrier-Grade Channels," IEEE J. Sel. Topics in Quantum Electron., to be published
2. N. Vokic, D. Milovancev, W. Boxleitner, H. Hübel, and B. Schrenk, "Compact Differential Phase-Shift Quantum Receiver Assisted by a SOI / BiCMOS Micro-Ring Resonator," in Proc. OFC'20, San Diego, United States, Mar. 2020, M4A.4
3. F. Laudenbach, B. Schrenk, M. Achleitner, N. Vokic, D. Milovancev, and H. Hübel, "Flexible Entanglement Distribution Overlay for Cloud/Edge DC Interconnect as Seed for IT-Secure Primitives," in Proc. OFC'20, San Diego, United States, Mar. 2020, M2K.5
4. N. Vokic, D. Milovancev, B. Schrenk, M. Hentschel, and H. Hübel, "Deployment Opportunities for DPS-QKD in the Co-Existence Regime of Lit GPON / NG-PON2 Access Networks," in Proc. OFC'20, San Diego, United States, Mar. 2020, W2A.56
5. D. Zavitsanos (NTUA), G. Giannoulis (NTUA), A. Raptakis (NTUA), Ch. Kouloumentas (NTUA), and H. Avramopoulos (NTUA). On the Filter Issues in Multiplexing Classical and QKD Links through WSS-based Nodes. Asia Communications and Photonics Conference (ACP) 2019. Chengdu, China, Nov. 2-5, 2019.
6. Fabian Laudenbach, Bernhard Schrenk, Martin Achleitner, Nemanja Vokic, Dinka Milovancev, Hannes Hübel. Flexible User/Cloud-Centric Entanglement Distribution with Synthesizable Network Node. arXiv.org. Submitted on 5 August 2019.
7. Sören Kreinberg, Igor Koltchanov, André Richter. Adding artificial noise for code rate matching in continuous-variable quantum key distribution. arXiv.org. Submitted on 13 May 2019.
8. Fabian Laudenbach, Christoph Pacher. Analysis of the trusted-device scenario in continuous-variable quantum key distribution. arXiv.org. Submitted on 03 April 2019.
9. F. Laudenbach. Photon-Pair Sources and Quantum Cryptography using Continuous Variables. PhD Thesis, Vienna, Austria, 2019.
10. D. Zavitsanos, G. Giannoulis, A. Raptakis, C. Papananos, F. Setaki, E. Theodoropoulou, G. Lyberopoulos, Ch. Kouloumentas, and H. Avramopoulos. Coexistence of discrete-variable QKD with WDM classical signals in the C-band for fiber access environments. ICTON 2019, Angers, France, July 9-13, 2019.
11. Sören Kreinberg, Igor Koltchanov, Piotr Novik, Saleem Alreesh, Fabian Laudenbach, Christoph Pacher, Hannes Hübel, André Richter. Modelling Weak-Coherent CV-QKD Systems Using a Classical Simulation Framework. ICTON 2019. Angers, France, July 9-13, 2019.
12. Hannes Hübel, Bernhard Schrenk, Sophie Zeiger, Fabian Laudenbach and Michael Hentschel. Flexible entanglement distribution based on WDM and active switching technology. ICTON 2019. Angers, France, July 9-13, 2019.
13. M. Kleinert, H.Conradi, B. Schrenk and H. Hübel. UNIQORN – Making quantum photonics affordable. LaserFocusWorld, vol 55, no. 4, April 2019.
14. Fabian Laudenbach and Christoph Pacher. Noisy Detector? Good! Analysis of Trusted-Receiver Scenario in Continuous-Variable Quantum Key Distribution. QIM V 2019. Rome, ITA, April 4 – 6, 2019.
15. Bernhard Schrenk, Michael Hentschel, and Hannes Hübel. O-Band Differential Phase-Shift Quantum Key Distribution in 52-Channel C/L-Band Loaded Passive Optical Network. OFC 2019. San Diego, California, USA, March 4 – 8, 2019.

16. R. Nejabati, R. Wang, A. Bravalheri, A. Muqaddas, N. Uniyal, T. Diallo, R. S. Tessinari, R. S. Guimaraes, S. Moazzeni, E. Hugues-Salas, G. T. Kanellos and D. Simeonidou. First Demonstration of Quantum-Secured, Inter-Domain 5G Service Orchestration and On-Demand NFV Chaining over Flexi-WDM Optical Networks. OFC 2019. San Diego, California, USA, March 4 – 8, 2019.
17. Marie-Christine Roehsner, Joshua A. Kettlewell, Tiago B. Batalhão, Joseph F. Fitzsimons & Philip Walther. Quantum advantage for probabilistic one-time programs. Nature Communications (Journal)
18. E. Hugues-Salas, R. Wang, G. Kanellos, R. Nejabati, D. Simeonidou. Co-existence of 9.6 Tb/s Classical Channels and a Quantum Key Distribution (QKD) Channel over a 7-core Multicore Optical Fibre. 2018 IEEE British and Irish Conference on Optics and Photonics. London, United Kingdom, Dec. 12-14 , 2018
19. Poster: S. Zeiger, F. Laudenbach, B. Schrenk, M. Hentschel, and H. Hübel. A ps-pulse laser for ultrafast entanglement generation at 42.66 GHz repetition rate. CLEO/EUROPE-EQEC 2019. June 23 – 27, Munich, Germany.
20. Poster: Fabian Laudenbach, Michael Hentschel, Moritz Kleinert, Hauke Conradi, Hannes Hübel. Intrinsic Entanglement Generation on Polymer-based Integrated Circuit. CEWQO 2019. June 3–7, 2019, Paderborn University, Germany
21. Poster: Fabian Laudenbach and Christoph Pacher. Noisy Detector? Good!Analysis of Trusted-Receiver Scenario in Continuous-Variable Quantum Key Distribution. QIM V 2019. Rome, ITA, April 4 – 6, 2019
22. Tutorial: Hannes Hübel, Fabian Laudenbach. Quantum Computer. Why is it a cyber security threat? … and how to prepare for it. (Quantum Computing & QKD) Vienna Cyber Security Week 2019. March 11 – 15, 2019, Vienna, Austria.
23. Poster: H. Thiel, B. Pressl, A. Schlager, K. Laiho, H. Suchomel, M. Kamp, S. Höfling, M. Kleinert, H. Conradi, N. Keil, C. Schneider and G. Weihs. Bragg-Reflection Waveguides as Photon Pair Sources for Polymer Photonic Circuits. European Quantum Technology Conference (EQTC19), February 18 -22, 2019, Grenoble, France.
24. Poster: E. Hugues-Salas, R. Wang, G.T. Kanellos, R. Nejabati and D. Simeonidou. Co-existence of 9.6 Tb/s Classical and Quantum Key Distribution (QKD) Channels over a 7-Core Multicore Fibre. European Quantum Technology Conference (EQTC19), February 18 -22, 2019, Grenoble, France.
25. Poster: Moritz Kleinert, Hauke Conradi, Madeleine Nuck, David de Felipe, Martin Kresse, Crispin Zawadzki, Norbert Keil, Martin Schell. Versatile micro-optical bench for photonic integration in quantum technology. European Quantum Technology Conference (EQTC19), February 18 -22, 2019, Grenoble, France.
26. Poster: Marie-Christine Roehsner, Joshua A. Kettlewell, Tiago B. Batalhão, Joseph F. Fitzsimons and Philip Walther. Quantum advantage for probabilistic one-time programs. European Quantum Technology Conference (EQTC19), February 18 -22, 2019, Grenoble, France.

Communication and Dissemination Activities M01-M18

The following list contains a non-exhaustive overview of communication and dissemination activities of CREDENTIAL partners in the project's 3rd year.

Main Leader	Title	Date	Place	Type of audience
SMART	https://compoundsemiconductor.net/article/105811/UNIQORN_To_Develop_Quantum_Tech_For_The_Mass_Market	20/11/2018	web	scientific community, industry, customers, investors, media, policy makers, civil society
SMART	https://www.techzine.nl/nieuws/413403/europese-commissie-investeert-fors-om-wereldleider-kwantumtechnologie-te-worden.html	31/10/2018	web	scientific community, industry, customers, investors, media, policy makers, civil society
SMART	https://smartphotonics.nl/smart-photonics-joins-eu-quantum-flagship-project-uniqorn/	29/10/2018	web	scientific community, industry, customers, investors, media, policy makers, civil society
AIT	http://science.apa.at/dossier/Sicher_kommunizieren_mit_Quanten/SCI_20181129_SCI81115451045599356		web	scientific community, industry, customers, investors, media, policy makers, civil society
AIT	https://science.apa.at/dossier/EU_Quanten-Flagship_Projekt_UNIQORN_fuehrt_die_Quantenkommunikation_in_die_naechste_Generation/SCI_20181129_SCI81155451445604084	29/11/2018	web	scientific community, industry, customers, investors, media, policy makers, civil society
AIT	https://opticalconnectionsnews.com/2018/11/eu-gets-uniqorn-quantum-project-off-the-ground/?utm_source=OpCons&utm_campaign=Aug&utm_medium=Email&utm_term=ApplicationsResearch&utm_content=Main	06/11/2018	web	scientific community, industry, customers, investors, media, policy makers, civil society
AIT	Quantum Flagship kick-off event	29-30/10/2018	Vienna, Austria	scientific community, industry, customers, investors, media, policy makers, civil society
AIT	ICT 2018 - Networking Session "Beyond 5G"	05/12/2018	Vienna, Austria	scientific community, industry, customers, investors, media, policy makers, civil society

Main Leader	Title	Date	Place	Type of audience
AIT	Twitter	29/10/2018	web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
AIT	LinkedIn	29/10/2018	web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
AIT	Quantum UNIQORN	25/10/2018	web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
HHI	https://www.hhi.fraunhofer.de/en/departments/pc/projects/uniqorn.html	Oct. 2018	web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
HHI	https://www.hhi.fraunhofer.de/en/press-media/news/2018/fraunhofer-hhi-is-developing-next-generation-quantum-communications-technology-in-the-uniqorn-project.html	16/08/2018	web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
HHI	https://www.hhi.fraunhofer.de/en/press-media/news/2018/quantum-technologies-forster-a-new-initiative-in-europe.html	29/10/2018	web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
HHI	https://www.hhi.fraunhofer.de/en/press-media/news/2018/eu-quantum-flagship-project-uniqorn-advances-the-next-generation-of-quantum-communication-systems.html	29/10/2018	web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
UNIVIE	https://medienportal.univie.ac.at/uniview/forschung/detailansicht/artikel/universitaet-wien-beteiligt-am-eu-quanten-flagship-zur-quantenkommunikation/	29/10/2018	web	media/general public
UNIVIE	https://walther.univie.ac.at/detailview-news/news/quantenphysik-ermoeglicht-selbst-zerstoerende-software-3/?tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Baction%5D=detail&cHash=62ba824c78956d32daafc2c422aef7ed	07/12/2018	web	media/general public
VPI	http://vpiphotonics.com/Services/Downloads/DownloadArea/Files/Press_	30/10/2018	web	scientific community, industry, customers,

Main Leader	Title	Date	Place	Type of audience
	Release_VPIphotonics_UNIQORN_20181030.pdf			general public, investors, media, policy makers, civil society
COSMOTE	Η COSMOTE συμμετέχει στο ευρωπαϊκό ερευνητικό έργο UNIQORN για κβαντικά συστήματα επικοινωνίας	11/07/1905	web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
VPI	http://www.VPIphotonics.com/Community/Projects/ http://www.vpiphotonics.com/News/2018/index.php#UNIQORN_Project		web	scientific community, industry, customers, general public, investors, media, policy makers, civil society
AIT	Flyer	25/10/2018		scientific community, industry, customers
AIT	Poster	25/10/2018		scientific community, industry, customers
AIT	Factsheet	25/10/2018		scientific community, industry, customers
UIBK	https://www.uibk.ac.at/newsroom/eu-millionen-fuer-die-entwicklung-von-quantentechnologien.html.de	29/01/2018	web	media/general public
UIBK	Quantum Flagship kick-off event	29-30/10/2018	Vienna, Austria	scientific community, industry, customers, investors, media, policy makers, civil society
UNIVIE	https://www.heise.de/select/ct/2019/2/1546939157779909	01/02/2019	web & print media	media/general public
UNIVIE	https://science.apa.at/site/natur_und_technik/detail.html?key=SCI_20181207_SCI39391351445846308 https://orf.at/stories/3103521/ http://unternehmen-heute.de/news.php?newsid=541079 https://www.derstandard.de/story/2000093406601/wiener-physiker-nutzen-quanteneffekte-fuer-selbstzerstoerende-software https://futurezone.at/science/wiener-physiker-nutzen-quanteneffekte-fuer-einweg-software/400347583 https://www.krone.at/1822459 https://www.extremnews.com/berichte/computer/eeb71702959d485 https://www.deutschlandfunknova.de/nachrichten/computerprogramm-	Dec 2018	web & print media	media/general public

Main Leader	Title	Date	Place	Type of audience
	einmal-benutzt-direkt-kaputt-mit-absicht http://www.pro-physik.de/details/news/11118429/Quantenphysik_ermoeglicht_selbstzerstoerende_Software.html http://www.schattenblick.de/infopool/natur/physik/npfo1559.html			
AIT	https://www.youtube.com/watch?v=Tzr-5p2hnNs	01/12/2018	web	scientific community, industry, customers, investors, media, policy makers, civil society, general public
UNIQORN partners	European Quantum Technology Conference https://eqtc19.sciencesconf.org	18-22/2/2019	Grenoble, France	scientific community, industry, customers, investors, media, policy makers, civil society
represented by our colleagues of Quantum Flagship	Mobile World Congress https://www.mwcbarcelona.com/	25-28/02/2019	Barcelona, Spain	scientific community, industry, customers, investors, media, policy makers, civil society
AIT, UNIVBRIS	OFC - The Optical Networking and Communication Conference & Exhibition https://www.ofcconference.org/en-us/home/	04-08/03/2019	San Diego, California	scientific community, industry, customers, investors, media, policy makers, civil society
AIT	Vienna Cyber Security Week 2019	11-15/03/2019	Vienna, Austria	scientific community, industry, customers, investors, media, policy makers, civil society
UIBK	International Day of Light	16/05/2019	Innsbruck, Austria	scientific community, industry, customers, investors, media, policy makers, civil society
AIT	CEN&CENELEC workshop	28-29/03/2019	Brussels, Belgium	scientific community, industry, customers, media, policy makers
UIBK	EQTC 19	18/02/2019	Grenoble,	Scientific Community

Main Leader	Title	Date	Place	Type of audience
			France	
DTU	EQTC 19	18/02/2019	Grenoble, France	Scientific Community
AIT	Quantum Information and Measurement Qim V: Quantum Technologies	04-06/04/2019	Rome, Italy	Scientific Community
VPI	OFC 2019 https://www.ofcconference.org/en-us/home/news-and-press/ofc-nfoec-press-releases/ofc-2019-closes-strong-with-focus-on-800g,-400zr,/	03-07/03/2019	San Diego, USA	scientific community, industry, customers, investors
VPI, AIT, COSM, NTUA	ICTON 2019 http://www.icton2019.com/	09-13/07/2019	Angers, France	scientific community
AIT	Quantum Optics https://www.ugent.be/nb-photonics/en/news-events/events/quantumoptics	03/05/2019	Gent, Brussels	scientific community
VPI	Open Training Courses on the usage of VPIphotonics software: Apr 8-10 - Design of Optical Devices and Photonic Integrated Circuits Apr 15-17 - Design of High Speed Transmission Systems	08-17/04/2019	Berlin, Germany	scientific community, industry, customers
AIT	ITU Workshop on Quantum Information Technology for Networks	05-07/06/2019	Shanghai, China	scientific community
AIT	Nationale Ausschreibung 2019 „Quantenforschung und -technologie (QFTE)“	28/06/2019	Vienna, Austria	scientific community, industry
HHI	World Industrial Quantum Photonics Technology Summit	05-06/06/2019	Barcelona, Spain	scientific community, industry, customers, investors
AIT	Nationale Ausschreibung 2019 „Quantenforschung und -technologie (QFTE)	28/06/2019	Vienna, Austria	scientific community
AIT	Workshop on Hybrid PICs - Talk: Quantum Labs on the Chip	22/09/2019	Dublin, Ireland	scientific community
AIT	WWTF - Projektkoordinator Hannes Hübel macht Quantenkommunikation für alle zugänglich. Der Viertelanschluss von morgen. https://club.wien.at/static/ePaper/WIEN-WISSEN-2019-02/index.html#/2	01/06/2019	Vienna, Austria	scientific community, industry, media, general public
HHI	Poster at 26th Central European Workshop on Quantum Optics	03-07/06/2019	Paderborn,	scientific community

Main Leader	Title	Date	Place	Type of audience
			Germany	
UIBK	Invited talk at CLEO-Europe/EQEC,	23/06/2019	Munich, Germany	scientific community
VPI	Talk at "EPIC World Industrial Quantum Photonics Technology Summit at ICFO"	06/06/2019	Barcelona, Spain	scientific community, industry, customers, investors
IMEC	ITF/FutureSummits: high-performance TIA & driver demo booth	14-15/06/2019	Antwerp, Belgium	scientific community
AIT	CLEO Europe - -EQEC 2019			scientific community
UIBK	QKD Summer School at the University of Waterloo	19. - 23/08/19	Waterloo, Canada	Students
UIBK	QCrypt	26. - 30/08/19	Montreal, Canada	Scientific community, Industry
CORDON	EPIC meeting at ESA on New Space	12-13/09/2019	Noordwijk, The Netherlands	scientific community
VPI	Talk at "21st International Conference on Transparent Optical Networks"	10/07/2019	Angers, France	Scientific community, Industry
DTU	QCrypt	26. - 30/08/19	Montreal, Canada	Scientific community, Industry
VPI	VPIphotonics - Design of CV QKD Systems https://www.youtube.com/watch?v=QpktICvcX0E	05/08/2019	web	Scientific community, Industry
ICCS/NTUA	Training school for “Emerging Technologies for 5G Networks”, co-organized from EUIMWP Cost action and 5G-PPP Phase 2 5G-PHOS project.	09/12/2019	Thessaloniki, Greece	PhD Students
ICCS/NTUA	ICCS/NTUA presented communication material from UNIQORN project through the participation of Photonics Communication Research Laboratory (PCRL) in 2019 Researchers’ Night, organized from National Technical University of Athens	27/9/2019	Athens, Greece	General Public
AIT	EU-Ausschuss für Industrie, Forschung und Energie besuchte AIT	30/10/2019	Vienna, Austria	scientific community, industry
AIT	The Quantum Flagship has recently hired the PR agency MatterPR to work	10/12/2019	Telco	scientific community, industry

Main Leader	Title	Date	Place	Type of audience
	on and promote in-depth pieces about the quantum technologies that are being developed within the initiative.			
all partners	https://qt.eu/newsroom/uniqorn-quantum-christmas-calendar/	09/12/2019	web	scientific community, industry, customers, investors, media, policy makers, civil society, general public
COSMOTE	Affordable Quantum Communication for Everyone: Revolutionizing the Quantum Ecosystem from Fabrication to Application	26/11/2019	Athens, Greece	scientific community, industry, customers, investors, media, policy makers, civil society, general public
TUE	IEEE Photonics Benelux Symposium	21-22/11/2019	Amsterdam, Netherlands	Scientific community, Industry
AIT	OFC 2020 - The Optical Networking and Communication Conference & Exhibition	8-12/03/2020	San Diego, California, USA	Scientific community, Industry
POLIMI	"BCD SPAD arrays for quantum optics application"	18-20/09/2019	Trento (Italy)	Scientific community, Industry
POLIMI	"BCD SPAD arrays for quantum optics application"	21-25/10/2019	Milano (Italy)	Scientific community, Industry
ICCS/NTUA	Photonics Communication Research Laboratory (PCRL) from ICCS/NTUA presented communication material from UNIQORN project to high school students, during a University visit	05/02/2020	Athens, Greece	Students
VPI	CLEO 2020	10-15/03/2020	San Jose, CA, USA	Scientific community, Industry
VPI	OFC 2020 (Exhibition)	8-12/03/2020	San Diego, California, USA	Scientific community, Industry
TUE	ECIO 2020	23-25/06/2020	Paris, France	Scientific community, Industry
UIBK	Quantum Optics 2020 https://www.uibk.ac.at/th-physik/obergurgl2020/application.htm	23/02/2020	Obergurgl, Austria	Scientific community
UIBK	Quantum Optics 2020 https://www.uibk.ac.at/th-physik/obergurgl2020/application.htm	24/02/2020	Obergurgl, Austria	Scientific community
UIBK	Quantum Frontiers & Fundamentals http://www.rri.res.in/~qff2020/	13/01/2020	Bengaluru, India	Scientific community
UIBK	W3+ Fair	19/09/2019	Dornbirn,	Industry

Main Leader	Title	Date	Place	Type of audience
	https://w3-messe.de/de/Rheintal/Die_W3_im_Rheintal.html		Austria	
HHI	Optics and Photonics International Exhibition	24-26/04/2020	Yokohama, Japan	Scientific community, Industry
HHI	EQTC 19	18/02/2019	Grenoble, France	Scientific Community
HHI	ECOC 2019	22-26/09/2019	Dublin, Ireland	Scientific community, Industry
HHI	ICSJ 2019	18-20/11/2019	Kyoto, Japan	Scientific Community
HHI	OFC 2019	03-07/03/2019	San Diego, USA	scientific community, industry, customers, investors
HHI	OpTecNet Jahrestagung 2019	14/05/2019	Jena, Germany	scientific community, industry, customers
HHI	Photonics West 2019	02-07/02/2019	San Francisco, USA	scientific community, industry, customers
HHI	PolyPhotonics Workshop	24/10/2019	Berlin, Germany	Scientific community, Industry
HHI	OFC 2020	08 - 12/03/2020	San Diego, USA	scientific community, industry, customers, investors
HHI	Photonics West 2020	01 - 06/02/2020	San Francisco, USA	scientific community, industry, customers
HHI	InnoQT - Innovationsforum Photonische Quantentechnologien	02 - 03/03/2020	Berlin, Germany	scientific community, industry, customers
UNIVBRIS	University Website http://www.bris.ac.uk/engineering/research/hpn/projects/uniqorn/ https://www.bristol.ac.uk/news/2018/november/uniqorn-project.html https://www.bristol.ac.uk/engineering/news/2018/eu-quantum-flagship-project-uniqorn.html		web & print media	general Public
UNIVBRIS	BICOP 2019 (2nd IEEE British and Irish Conference on Optics and Photonics (2019) Invited talk	13-14/12/2019	London	Scientific community, Industry
UNIVBRIS	OSA-POEM 2018 Invited talk	Nov-18	Wuhan	Scientific community, Industry
UNIVBRIS	ECOC 2019 Postdeadline Paper	Sep. 2019	Dublin, Ireland	Scientific community, Industry

Main Leader	Title	Date	Place	Type of audience
UNIVBRIS	OFC 2019 Postdeadline Paper	Mar-19	California USA	Scientific community, Industry
UNIVBRIS	participation in the National Quantum Technology Showcase 2018	Nov. 2018	London	scientific community, industry, customers, general public, investors, media, policy makers, civil society
UNIVBRIS	participation in the National Quantum Technology Showcase 2019	Nov. 2019	London	scientific community, industry, customers, general public, investors, media, policy makers, civil society
UNIVBRIS	ONDM 2019 (ONDM 2019 23rd Conference On Optical Network Design And Modelling May 13-16, 2019, Athens, Greece	May-19	Athens, Greece	Scientific community, Industry
UNIVBRIS	ECOC 2019	Sep. 2019	Dublin, Ireland	Scientific community, Industry
UNIVBRIS	European Quantum Technology Conference https://eqtc19.sciencesconf.org	18-22/2/2019	Grenoble, France	scientific community, industry, customers, investors, media, policy makers, civil society

Theses in the scope of UNIQORN

No.	Name	Type	Title	Organisation	Status
1	Sophie Zeiger	MSc	Photon-Pair Generation at GHz Rates	AIT	completed
2	Hannah Thiel	MSc	Testing Optically and Electrically Pumped Bragg-Reflection Waveguides	UIBK	ongoing
3	Fabian Laudenbach	PhD	Photon-Pair Sources and Quantum Cryptography using Continuous Variables	AIT	completed
4	Florian Prawits	MSc	Phase reference QKD for robust and scalable systems	AIT	ongoing
5	Fabio Severini	PhD	Single Photon Avalanche Diode arrays for quantum applications	POLIMI	ongoing
6	Alfonso Incoronato	PhD	SPADs and SiPM arrays for 3D ranging and quantum communication	POLIMI	ongoing
7	Francesca Madonini	PhD	Single Photon Avalanche Diode arrays for quantum-enhanced microscopy	POLIMI	ongoing
8	Christos Papapanos	MSc	Security proof of BB84 Quantum Key Distribution (QKD) Protocol and Study of Imperfections over the Implementation of the Weak+Vacuum Decoy-state QKD Protocol	ICCS/NTUA	ongoing
9	Ozan Cirkinoglu	PhD	Quantum grade InP integrated photonic circuits for QKD systems	TU/e	ongoing
10	Christian Kießler	PhD	Hybrid quantum devices with X(2) nonlinearity	UPB	ongoing
11	Maximilian Götsch	MSc	Optical and Electrical Characterization of active Bragg-Reflection Waveguides	UIBK	ongoing
12	Moritz Kruska	MSc	Photon pair source with integrated modelocked laser	UIBK	ongoing
13	Bernhard Unterlechner	MSc	Design of functional structures in Bragg-reflection waveguides	UIBK	ongoing
14	Alexander Schlager	PhD	Entanglement from Bragg-reflection waveguides	UIBK	ongoing
15	Hannah Thiel	PhD	Hybrid integrated photon pair sources for QKD	UIBK	ongoing

16	Martin Achleitner	MSc	Optical Quantum Random Number Generation using an integrated Polymer Waveguide Chip	AIT	ongoing
17	Matteo Santandrea	PhD	Design of nonlinear integrated devices for quantum optics applications	UPB	completed
18	Marcello Massaro	PhD	Integrated single photon sources with electro-optic control	UPB	ongoing
19	Lennart Jehle	MSc	Design and Characterization of Photonic Integrated Circuits for Quantum Communications	HHI	ongoing